Project

Project Acronym	HILT III	Project ID	
Project Title	High-level Thesaurus Phase III		
Start Date	01/11/05	End Date	31/01/07
Lead Institution	CDLR, University of Strathclyde		
Project Director	Dennis Nicholson		
Project Manager & contact details	Shared role between Emma McCulloch and George Macgregor, both contactable at: CDLR (Centre for Digital Library Research) Department of Computer and Information Sciences University of Strathclyde 12.12 Livingstone Tower 26 Richmond Street Glasgow G1 1XH Phone: +44 (0)141 548 4752 Fax: +44 (0)141 548 4523		
Partner Institutions	EDINA, University of Edinburgh		
Project Web URL	http://hilt.cdlr.strath.ac.uk/		
Programme Name (and number)	Integrated Information Environment committee (JIIE)		
Programme Manager	Phil Vaughan		

Document

Document Title	*Completion Report*		
Reporting Period	*1/12/05-31/1/07*		
Author(s) & project role	Dennis Nicholson (Project Director), Emma McCulloch (Joint Project Manager) and George Macgregor (Joint Project Manager).		
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Document History

Version	Date	Comments
1.0	23/01/07	First draft (EM)
2.0	06/02/07	Second draft following consultation with Dennis Nicholson and George Macgregor.
3.0	08/02/07	Third draft (DN)
4.0	13/02/07	Financial information added (EM)

Project Sign-off

1. Project Outputs

[*Have all **project deliverables** been submitted to JISC and accepted? Please list any outstanding issues and how they will be addressed.*]

The project deliverables are detailed below. Both have been achieved, except in one small detail:

- A working SRW/SKOS Core based M2M pilot demonstrating M2M terminology services for the JISC IE based on the HILT Phase II pilot, illustrative extensions to cover the five use cases determined in the M2M Feasibility Study, clients to service the needs of two different service environments, and advice to intute on issues that will affect their own needs as regards a client for accessing HILT.
- A final report on the project, together with details of future research and development requirements leading towards a future operational service.

In retrospect, the appropriate time to provide intute with advice on this front is in Phase IV, should it be funded. The current position is that the project is able to give a level of advice, should it be requested, but that no advice has yet been given. The project does have a working link with intute, however, and the provision of advice will form a key part of Phase IV as regards interacting with intute.

[*Have all **core project documents** been submitted to JISC and accepted? List any outstanding issues and how they will be addressed.*]

Core project documents including a project plan, biannual report, final report and this completion report have been submitted to JISC. Acceptance of the latter two documents is awaited.

2. Intellectual Property Rights

[*Confirm that there are no IPR issues that will prevent project outputs from being made available to the teaching, learning, and research communities when the project ends.*

Confirm that all necessary permissions for third-party IPR have been granted and attach any applicable permissions or licenses.

Explain any outstanding IPR issues and how these will be resolved.]

HILT Phase III has adhered to the IPR guidance stated in the funding award letter dated 17th June 2005. As such, JISC does not retain any formal intellectual property rights in the end products/services funded. JISC is able to archive, preserve and disseminate the resources for non-commercial use within the UK Further and Higher Education sectors in perpetuity.

As on previous occasions the project established a research agreement with OCLC permitting the use of their DDC files and mappings. Other schemes used were either freely available at the point of use, or an agreement was made with scheme owners.

(NB. Emailed Libbie to ask for copy of research license – append once received.)

3. Project Staff

List all project staff at the end of the project (noting FTEs), and summarise career development opportunities offered.

Dennis Nicholson: 0.05 FTE
Further development of HILT portfolio; several international conference presentations and invited talks.

Emma McCulloch: 0.5 FTE
Academic journal article accepted to Journal of Information Science. Further research experience in the area of terminology mapping.

George Macgregor: 0.5 FTE
Gained the opportunity to present at an international conference (International Conference on Semantic Web and Digital Libraries; Academic journal article accepted to Journal of Information Science; Acquired in-depth knowledge of SKOS Core markup and its application. Further research experience in the area of terminology mapping.

Anu Joseph: 0.5 FTE
Gained knowledge of XML based SOAP communication protocol by developing client and server. Also gained knowledge of SKOS Core markup and extended the SOAP server to send data in SKOS format. Further understanding of SRW (Search Retrieve Webservice) while developing client and server that communicate with the SOAP server was also attained.

Christine Rees: 0.025 FTE

Tim Stickland; Ben Soares; Eddie Boyle: 0.25 FTE (for final 5 project months).
0.425 FTE (for initial 10 project months).
Gained experience developing applications that use SOAP and SRW.

EDINA administrator: 0.01 FTE

4. Dissemination Plan

[*List the dissemination that has been done (or is being done) about project findings and outcomes, e.g. journal articles, conference presentations. For each, note the URL on the project or other web site.*]

Conference Papers:

"Interoperable subject retrieval in a distributed multi-scheme environment: new developments in the HILT project." D. Nicholson and E. McCulloch. *Ibersid, 2-4 November 2005, Zaragoza, Spain*. 2005. Available at: http://cdlr.strath.ac.uk/pubs/nicholsond/ZaragosaPaperFinal.pdf

"HILT Phase III: Design requirements of an SRW-compliant terminologies mapping pilot." D. Nicholson and E. McCulloch. *5th European Networked Knowledge Organization Systems (NKOS) Workshop, 10th ECDL Conference, 21 September 2006, Alicante, Spain, 2006*.

"Investigating the feasibility of a distributed, mapping-based, approach to solving subject interoperability problems in a multi-scheme, cross-service, retrieval environment." D. Nicholson and E. McCulloch. *International Conference on Digital Libraries, December, 5-8 December 2006, India Habitat Center, New Delhi, India, 2006*.

A further conference paper has been accepted by the International Conference on Semantic Web and Digital Libraries to be held in Bangalore, India in February 2007. In addition, the project has been invited to give a presentation at the *Europe's cultural and scientific heritage in a digital world* international conference in Berlin, February 2007.

Journal Articles:

"HILT: a terminology mapping service with a DDC spine." Nicholson D., Dawson A. & Shiri, A. *Cataloging & Classification Quarterly* 2006 42(3/4) pp.187-200.

"Analysis of equivalence mapping for terminology services." McCulloch, E. and Macgregor, G. Journal of Information Science. In Press.

[*List any publicity the project has received, e.g. press coverage, awards.*]

Dennis Nicholson has been awarded Honorary Membership of CILIP in Scotland. HILT was one project specifically mentioned as a contributory factor.

5. Exit Plan

[*Explain what arrangements have been made to archive/preserve project outputs and/or make them available to the community when the project ends. List any outstanding issues and how they will be addressed.*

Confirm that the lead institution will continue to host your project web site for 3 years after the project ends and assist JISC in archiving it subsequently.]

The HILT pilot terminologies server will be maintained by CDLR for the foreseeable future. The nature of this output is likely to change in the event of a Phase IV bid being successful. If a new phase is funded the current pilot will be developed with a view to moving it towards a service.

The HILT project website (http://hilt.cdlr.strath.ac.uk/) will be maintained until at least January 2010 and assistance will be given to JISC when subsequently archiving it. However, the CDLR is likely to maintain it in some form for as long as it is a current area of our research, or is linked to a current area of our research.

6. Sustainability Plan

[*Explain if any project outputs will be further developed after the project ends, who will take them forward, and how. If so, have you written a business plan?*]

A bid for a further phase of the project (Phase IV) was submitted in early February 2007 and proposes a move to a 'transition to service' stage of the project. The outcome of this funding proposal will determine the requirements and proposed solution to the sustainability issue. The current assumption is that CDLR and EDINA will continue to take development forward in the foreseeable future, assuming continued JISC support for this. Please see Appendix B for a copy of the Phase IV bid.

7. Budget

[*Use the budget template and attach the final budget statement as Appendix A. Briefly explain if overall project expenditure, or expenditure in any area, exceeded or fell short of the funding awarded.*]

The project director and both project managers at CDLR gave more time than the 0.5FTE allocated within the project budget. The dissemination budget was exceeded due to the acceptance of HILT papers at a range of conferences throughout the project lifetime.

[*Did the project seek/receive funds from other sources, and how these funds were used?*]

The project did not seek or receive funds from sources other than JISC, but did seek and receive resources and support in kind from OCLC.

Lessons Learned

8. Aims and Objectives

[*At the end of the project, do you feel you achieved the aims and objectives set at the start? Note any objectives that changed during the project and why. Do you feel the project fulfilled the need originally envisaged, or perhaps a new need?*]

Yes, the project envisaged creating an M2M pilot demonstrator in line with the architecture shown in Diagram 1 below. The project has achieved this and incorporated a range of functionality in line with the various use cases proposed. In addition, the project identified new areas of service that could be offered within the original specification – in particular, the ability to provide services with data on individual subject schemes stored in addition to inter-scheme mappings.
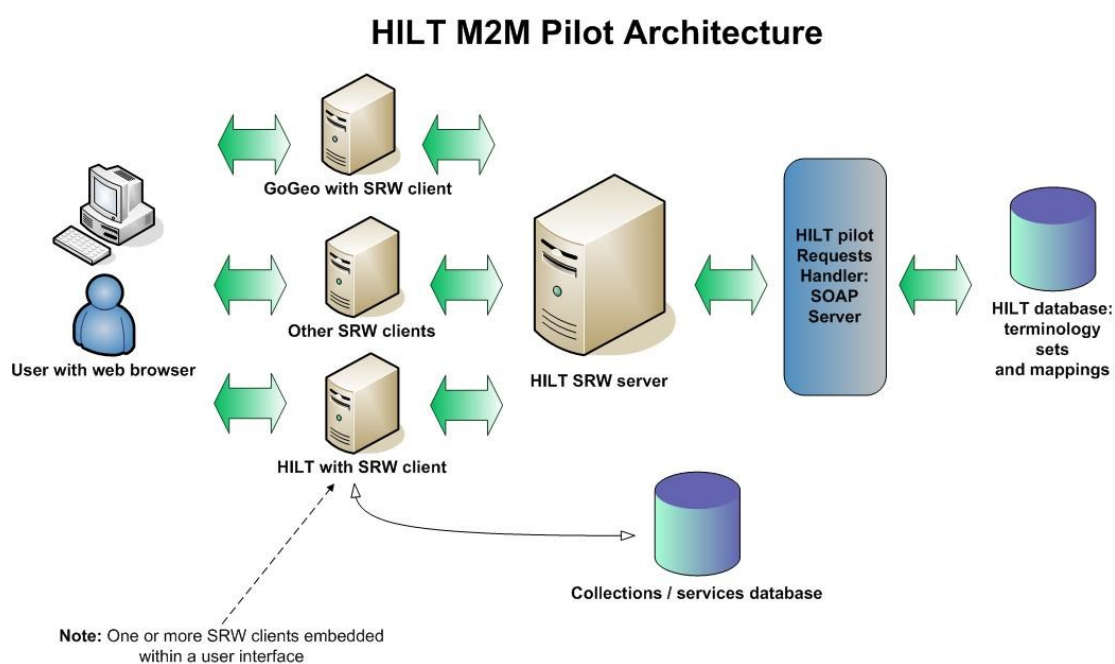

Diagram 1: HILT M2M Pilot Architecture

9. Overall Approach

[*If you could start again, what would you have done differently? What lessons would you pass on to other JISC development projects?*]

This was the third main phase (and fourth stage) of the HILT project. There was a clear vision of what should be achieved and the means by which this should be done. In retrospect we would not have done anything differently. The collaboration with Edina worked well, the work stayed on schedule, the deliverables were met, and the outcomes, if anything, surpassed expectations.

10. Project Outcomes

[*Summarise key project outcomes and impacts on the teaching, learning, or research communities briefly (as bullet points).*]

Impact on the teaching learning and research communities are potential rather than actual at this stage since this phase of the project has involved the development of a pilot demonstrator. However, long term impact should be to ensure subject interoperability across retrieval services useful to these communities.

It is hoped that dissemination activities (as reported under section 4) have impacted upon members of the teaching, learning and research communities reached by the various publications and presentations undertaken during this phase of the project.

Input was made to the SKOS Core community in light of findings throughout the project relating to SKOS Core markup and the SKOS Core Mapping Vocabulary Specification (MVS).

[*Summarise the main lessons learned that you would pass on to the community briefly (as bullet points).*]

The SKOS MVS was found to be inadequate for the purposes of characterising equivalence relationships between a sub-sample of mappings implemented from AAT, LCSH, MeSH, UNESCO to DDC.

[*Have there been any unexpected outcomes or opportunities?*]

The project has been able to propose a move to a transition to service stage in Phase IV.

The level in which one member of the project team has become involved in SKOS Core has provided excellent opportunities. Initial involvement in the SKOS Core mailing list has led to personal correspondence with Alistair Miles and a planned meeting with him. In addition, a research paper focusing on SKOS Core has been submitted and accepted to ICSD 2007 (International Conference on the Semantic Web and Digital Libraries), to be held in Bangalore, India.

In addition, the wider issues of the project will be the subject of an invited presentation at the *Europe's cultural and scientific heritage in a digital world* international conference in Berlin, February 2007. A paper was also accepted and given to the ECDL Terminologies Workshop.

11. Stakeholders

[*Who are the likely beneficiaries of project outcomes in the community, and how will they benefit?*]

Although there has been no direct value to JISC users and services as yet, the project has helped inform an understanding of the architecture and functionality required to support JISC and other information services aiming to facilitate interoperable subject retrieval across distributed information services in a fashion that, being M2M based, can be transparent to their users. If the proposed 'transition to service' phase is successful, outcomes will aid users in all JISC communities – HE, FE, e-learning, research, and so on. The project has also helped inform on subject retrieval and terminology service requirements generally and may ultimately help inform the semantic web community, which will also face inter-scheme mapping issues at some point. HILT has also helped inform future requirements in respect of the SKOS mark-up language, has identified a possible need to extend SKOS mapping types, and has been able to submit a detailed subject interoperability based use case to the W3C Semantic Web Deployment Working Group (see HILT Final Report, Appendix H).

12. Project Partners

[*What lessons about working with project partners and subcontractors would you pass on to other JISC development projects?*]

The main project partner was Edina. The collaboration between CDLR and Edina worked well, encountering no significant difficulties. Communication was a key factor in this.

[*What other institutions, organisations, or projects did you collaborate with, and was this productive?*]

British Library, EDINA, intute, National Library of Scotland, National Library of Wales, OCLC, SKOS team.

It was deemed productive to work with the organisations listed above since extensive input from a variety of perspectives was harnessed by doing so. Physical meetings were held with all except for a SKOS Core representative (with whom extensive email communication was undertaken, together with an ad hoc meeting with Alistair Miles at a conference) and OCLC. Even given OCLC's considerable distance from us, our dealings with them were extremely productive, with DDC 22 forming the main spine of the terminologies pilot server developed.

13. Project Management

[*What lessons about project planning or project management would you pass on to other JISC development projects?*]

Only the obvious – create a detailed plan of tasks in advance, schedule carefully, organise management and steering group meetings early on in the project so that participants have an idea of the level of commitment required of them, maintain internal to do lists for the project as a whole (in addition to those for individuals), and, above all, make good communication and a shared understanding of project goals and terminology a key aim. On the latter point, it is worth noting that this is always an ongoing process. Even late in the project, we were discovering some cross-partner terminological issues that caused a level of confusion.

14. Programme Support

[*What influence did other projects, the programme, or the programme manager have on the project, either positive or negative?*]

Although new to the HILT project (previous programme managers have included Leona Carpenter and Helen Hockx), Phil Vaughan was engaged with the team and made useful input at the Steering Group meeting he attended in October. He was also extremely helpful in advising the HILT team during the preparation of a funding proposal for a follow-up HILT Phase IV.

[*Are there areas where you would like to have had more support from the programme manager or the programme generally?*

We are not 'laying blame' or making a criticism here, merely suggesting an area where improvements could be made. However, JISC (in general, not a specific individual) could have been more helpful in clarifying its position regarding the recently introduced Full Economic Costing (FEC) model, now implemented within UK Universities. During the preparation of a funding proposal for HILT Phase IV, there seemed to be uncertainty about JISC's stance on paying FEC and, in particular, in what capacity. This resulted in delayed feedback on questions relating to the proportion of FEC we would be able to charge JISC and it emerged that JISC do not seem to be following the same model as other types of funder(s) (e.g. research council and so on) we have dealt with and for which the University has established costing templates.

15. Future Work

[*Have any issues emerged from the project which merit further investigation or future development work by JISC or other organisations?*]

Yes, a funding proposal for HILT Phase IV has been submitted (see Appendix B). This covers further investigation and development work and echoes issues detailed in the HILT Final Report (see, in particular, the **Conclusions** section).

Appendix A. Final Budget

Indicate Reporting Period	YR1 Budget	YR 1 Spend	*Indicate Reporting Period*	YR2 Budget	YR2 Spend	Total Budget	Total Spend
(Nov 05 – Jul 06) (9 mths)	(Nov 05–Jul 06) (9 mths)		(Aug 06–Jan 07) (6 mths)	(Aug 06–Jan 07) (6 mths)	(Aug 06–Jan 07) (6 mths)		
Staff *(list all staff with FTEs and salary scale range)***			**Staff** *(list all staff with FTEs and salary scale range)***				
Project Director (CDLR) 0.05 FTE	£xxx	£xxx	Project Director (CDLR) 0.05 FTE	£xxx	£xxx	£xxx	£xxx
Project manager (CDLR) 0.5 FTE			Project manager (CDLR) 0.5 FTE				
Project manager (CDLR) 0.5 FTE			Project manager (CDLR) 0.5 FTE				
Temporary Programmer (CDLR) 1.0 FTE (1/11/05-30/4/06)			Programmer (CDLR) 0.5 FTE (1/5/06-31/1/07) (following maternity leave)				
Liaison (EDINA) 0.025 FTE	£xxx	£xxx	Liaison (EDINA) 0.025 FTE	£xxx	£xxx	£xxx	£xxx
Programmer (EDINA)			Programmer (EDINA)				
Programmer (EDINA)			Programmer (EDINA)				
Programmer (EDINA)			Programmer (EDINA)				
Admin (EDINA) 0.01 FTE			Admin (EDINA) 0.01 FTE				
Travel & Subsistence	£xxx	£xxx	**Travel & Subsistence**	£xxx	£xxx	£xxx	£xxx
Equipment *(items over £10k)*			**Equipment** *(items over £10k)*				
Dissemination activities		£xxx	**Dissemination** activities		£xxx		£xxx
Evaluation activities			**Evaluation** activities				
Other			**Other**				
List headings as in project			*List headings as in project*				
budget			*budget*				
Consultancy	£xxx	£xxx	**Consultancy**	£xxx	£xxx	£xxx	£xxx
Total from JISC	£xxx	£xxx	**Total from JISC**	£xxx	£xxx	£xxx	£xxx

*although no specific budget was allocated to dissemination activity, much dissemination was undertaken throughout the project. The salary budget was underspent by £xxx, which absorbed some of the dissemination costs. In addition to the £xxx spent on dissemination recorded above, a further £xxx was absorbed by CDLR for dissemination activity, specifically to present a paper at the International Conference on Semantic Web and Digital Libraries in Bangalore, India and to deliver an invited presentation at *Europe's cultural and scientific heritage in a digital world* international conference in Berlin, both to be held in February 2007.

**Information on salary scale range is not yet available following the recent pay modernisation exercise.

Appendix B. HILT IV Bid

HILT Phase IV: Transition to Service Testbed and Future Requirements Study

1. Summary

This proposal is a 21 month follow-up to HILT Phase III, a project charged with building an M2M version of the pilot demonstrator service built in HILT Phase II based on an outline specification determined in the subsequent Machine to Machine (M2M) Feasibility Study[1]. Phase III built an M2M pilot interoperability service that:

1. Offers web-services access via the (SOAP-based[2]) SRW protocol[3], but is designed so that a possible extension offering other protocols (Z39.50[4], or SRU[5], for example) at a later date could be an option.
2. Uses SKOS Core[6] as the 'mark-up' for sending out and structuring terminology sets and classification data responses, but is designed so that adding other formats such as MARC[7] and Zthes[8] would be an option at a later date.
3. Provides the pilot datasets, mappings, and functionality capable of servicing the 5 use cases agreed in the HILT M2M Feasibility Study.
4. Bases the pilot on a centralised approach to the provision of mapping services as piloted in HILT Phase II, but is designed so that the possibility of a future move towards a more distributed model is kept open.

Based on Phase III findings and outcomes[9], it is now proposed to move HILT to a transition to service phase which would:

1. Utilise SRW, SOAP, and SKOS to build a baseline or entry-level[10] terminologies and subject interoperability shared service offering M2M functionality to JISC information services; a useful initial service, open to future extension, but based in the first instance on top level mappings between schemes and offering collection or service level retrieval via the generation of an appropriate scheme hierarchy from a point relevant to a user query.
2. Evaluate[11] it for retrieval effectiveness and user interface effectiveness, helpfulness, and ergonomics and for performance levels, then refine its features – or make recommendations for future improvements - in line with the results.
3. Design and implement an integrated programme of project dissemination and survey activity starting early in the project to ensure ongoing interaction and feedback between the project and the services community and culminating late in the project with (1) a dissemination programme spelling out the advantageous features and limitations of the entry-level service, and its future possibilities (2) a subsequent survey to determine the level of demand for an operational service.
4. Compile a report on research into various selected issues of relevance to the provision of an effective future entry-level service or its further refinement – e.g. any possible alternative approaches to spine provision and their implications; the identification of

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[1] HILT Machine to Machine (M2M) Feasibility Study: http://hilt.cdlr.strath.ac.uk/hiltm2mfs/
[2] SOAP: http://www.w3.org/TR/soap/
[3] Search/Retrieve Web Service (SRW): http://www.loc.gov/standards/sru/
[4] Z39.50: http://www.loc.gov/z3950/agency/
[5] Search/Retrieve via URL (SRU): http://www.loc.gov/standards/sru/
[6] Simple Knowledge Organization System (SKOS) Core: http://www.w3.org/2004/02/skos/
[7] MARC Concise Format for Authority Data: http://www.loc.gov/marc/authority/
[8] Zthes: http://zthes.z3950.org/
[9] For further information on the architecture, design, implementation, functionality, and testing of the Phase III pilot, together with associated research findings, conclusions on the best way forward in this area and the reasoning behind them, see the Final report on HILT Phase III and its various appendices.
[10] An 'entry-level service is defined here as a useful service that has facilities of value to JISC services and their users, but is limited in comparison with the range of facilities that might subsequently be offered and is extendible to permit the addition of these later facilities at a later date.
[11] The evaluation phase will identify the most appropriate criteria for performance measurement, matching the objective of the project in providing improved single-search access to collections with disparate classification and indexing systems. It is noted that it will be important to distinguish between the criteria that relate to 'findability' (the prime objective of HILT IV) and those that relate to the more general and subjective aspects of user experience. While every effort will be made to ensure that the front-end is attractive and easy to use, it should be remembered that webpage design is not a principal requirement of the project.

preferred spines for specific query types where options exist; many to many mappings; guidelines for others wishing to produce HILT-compatible mappings themselves[12]; searching with compound terms; mapping types required for effective user services at different service levels; mapping grading and coding; a list of terminology or related service types likely to enrich user experience if encompassed within the HILT architecture; the possible value of providing a HILT portlet (based on the JSR168 or WSRP standards) as a way of providing services with a relatively easy way of incorporating useful core user interface features into local services.

5. Develop and present a future business case, including an estimate of the costs of setting up and maintaining an operational service and funding ongoing research and development needs beyond an entry-level service based on information arising out of 1-4 above, together with discussions with JISC and the project Steering Group.

Some of these activities would overlap with each other as shown in the schedule in Appendix B.

As with HILT Phase III, the project will require the expertise of participants at CDLR[13] and EDINA[14], and of the HILT terminology advisors, together with some ongoing liaison with UKOLN[15], who are the project's advisors on the MIMAS[16] IESR[17] project and on intute[18].

The total (full economic) cost of the project is £238,723 over 21 months. The cost to JISC would be £189,020, spread over three financial years, £ 29,390 in year 06/07, £ 78,825 in year 07/08, and £ 31,102 in year 08/09. .The funds available to the project from the £189,020would be approximately £139,317. The proposed start date would be March 19th 2007, soon after the end of HILT Phase III and would run for 21 months until 19th December 2008.

OCLC[19] have again agreed to provide free access to the electronic files of DDC[20] and of LCSH mappings to DDC[21]. They will also work with the project in areas such as the possible experimental integration of terminology or interoperability related OCLC web services into the architecture.

HILT will work with the IE Testbed Project to optimise the benefits of both HILT Phase IV and the IE Testbed Project to the JISC community. Since HILT Phase IV will study how services can best integrate with the HILT shared service and vice versa, the projects should be complementary. HILT will also work with the proposed Terminologies Registry Study.

2. The Problem Addressed

Background: HILT I, HILT II, the M2M Feasibility Study, and HILT III

Ensuring that FE and HE users of the JISC IE can find appropriate learning, research and information resources by *subject search and browse* in an environment where most service providers use different subject schemes to describe their resources is a major challenge facing the JISC domain (and, indeed, other domains beyond JISC). To date, HILT has:

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[12] The problems of mapping between vocabularies faced by organisations internally, and those wishing to promote interoperability with others, is receiving a great deal of attention. It is generally agreed that this is a non-trivial problem, and the HILT Team will continue to address the issue by noting whatever research and implementation is ongoing. Though this is fundamentally a linguistic problem, the HILT Team will seek to establish pragmatic ground rules for mapping at a level that may be seen to be necessary and sufficient., and to produce effective documentation for doing so.
[13] Centre for Digital Library Research (CDLR): http://cdlr.strath.ac.uk/
[14] EDINA: http://edina.ac.uk/
[15] UKOLN: http://www.ukoln.ac.uk/
[16] Manchester Information & Associated Services (MIMAS): http://www.mimas.ac.uk/
[17] Information Environment Services Registry (IESR): http://iesr.ac.uk/
[18] intute: http://www.intute.ac.uk/
[19] OCLC Online Computer Library Center: http://www.oclc.org/
[20] Dewey Decimal Classification (DDC): http://www.oclc.org/dewey/
[21] LCSH to DDC mappings: http://www.oclc.org/asiapacific/zhcn/dewey/updates/numbers/default.htm

1. Established that the preferred approach of the various services in the domain to resolving the issue is one based on mapping the various subject schemes together through a central shared service that provides users with the correct alternative terms to use in the various different schemes (HILT Phase I[22]).
2. Built an illustrative terminologies service pilot capable of taking a user-input subject term, identifying JISC collections relevant to the subject of the query and providing the user with the correct subject term to use for the subject scheme employed by any given identified collection (HILT Phase II).
3. Conducted a study that looked at the feasibility of turning this pilot into an M2M pilot service able to supply terminologies and mapping data for other services to use and scoped out an outline design for the pilot (HILT M2M Feasibility Study).
4. Built the M2M pilot and scoped out a design for the initial entry-level service described in Section 1 above (HILT Phase III).

A transition to service phase as proposed for HILT Phase IV would allow this initial entry-level service to be built, tested for user requirements and retrieval effectiveness, refined in line with the findings, and extended to permit the use of a range of distributed terminology services for interoperability. It would also allow an examination of the level of need and interest amongst JISC services in respect of an operational service and, if appropriate, a scoping of the costs and requirements of a future operational phase of the service. The proposal to conduct a parallel programme of research into selected topics will help inform both the costs and requirements of an initial entry-level operational service and any future extension of this.

HILT Phase III Outcomes and Proposals

Diagram 1 below shows the architecture that forms the basis of the M2M SRW version of the service built in Phase III. The blue boxes show roughly the basis of the Phase II user-accessible service. Users with web browsers access a PHP-based HILT requests handler directly and this interacts with the terminologies and collections and services databases, and uses the data returned to produce results.

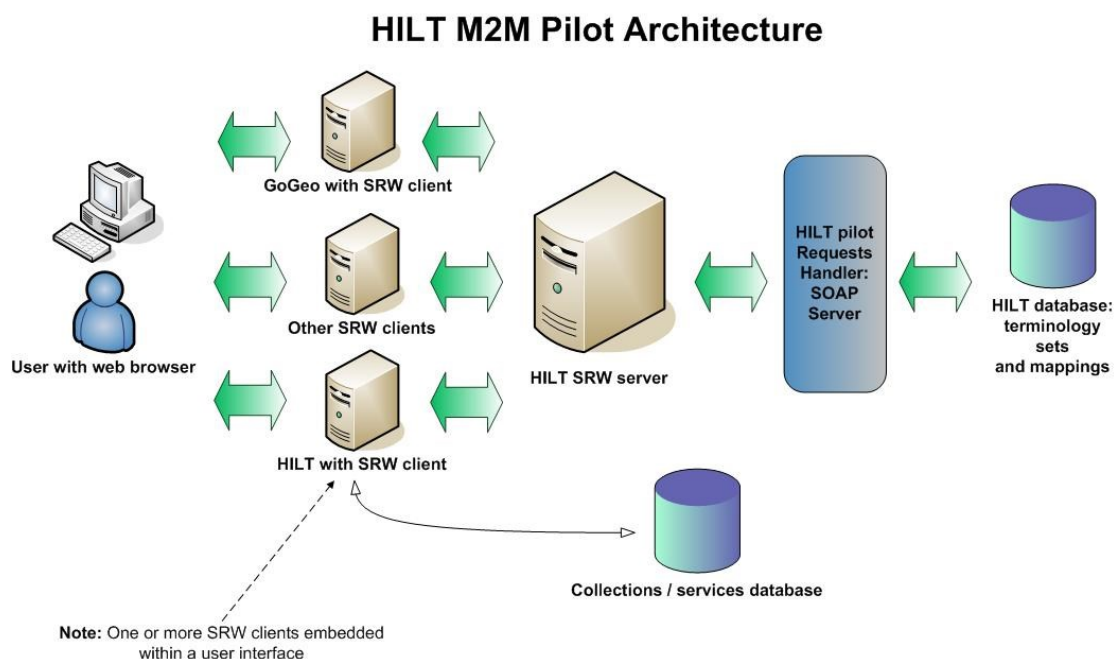

Diagram 1: HILT M2M Pilot Architecture

The grey or light brown boxes show the additional SRW elements in the M2M version. Here, the assumption is that users with web browsers access information services and these services interrogate HILT as and when needed to provide enhancements to local services

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[22] HILT Phase I Final Report: http://hilt.cdlr.strath.ac.uk/Reports/FinalReport.html

using embedded SRW clients invisible to their users. The project has embedded two SRW clients into two services; a HILT service that emulates the Phase II pilot, but also offers additional facilities, and GoGeo! that offers functionality specific to the GoGeo! requirements.

In the SRW version, the clients access the collections and services database directly, rather than via the requests handler as in the Phase II version. The requests handler is a SOAP server that takes requests from the SRW server, queries the database and sends back the results to the SRW server wrapped in SKOS Core.

It is possible to see the pilot service working at http://nevis.ed.ac.uk:9200/gogeo_hilt2.html and http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/hiltsoapclient.php

The Phase III pilot translates the functionality of the Phase II pilot to the above SRW client-server based architecture. It offers mapping based subject interoperability via a DDC spine and works as follows:

1. The user enters a subject term, which is used to search the database for DDC captions that might possibly match the user's query.
2. The retrieved captions and their associated DDC numbers are returned and the user is asked to choose the best match for his or her topic of interest from the list of captions presented.
3. The DDC number associated with the DDC caption chosen is used to find information services covering the user's subject and the subject schemes they use (the number is successively truncated and a database - which simulates IESR - is searched to find services appropriate to the user's topic and associated information on the schemes in use by these services).
4. The full DDC number (non-truncated) is used to find the best term for the user's topic in any given scheme by searching the HILT mappings database for a mapping to the DDC number in question from the scheme.
5. Finally, sample retrieval from the service in question is provided by sending a search to the service.

The Phase III pilot offers the same functionality but also offers the following extended features:

1. A basic SRW client, together with associated user interface routines that include the DDC collections-finding code.
2. More subject schemes than before: DDC, LCSH[23], IPSV[24], AAT[25], GCMD[26], HASSET[27], MeSH[28], NMR[29], JACS[30], UNESCO[31].
3. Additional – but still illustrative – mappings.
4. Detailed data on terms in schemes: broader terms, narrower terms, related terms, and so on.

This last feature enables the enrichment of user search queries via interactive query expansion techniques thus providing users with new narrower, broader, related or non-preferred terms with which to aid retrieval or query reformulation (as demonstrated in the HILT Phase III GoGeo! demonstrator client), and also facilitates the creation of browsable scheme-specific hierarchies. This is not only useful in its own right, it is also key to the provision of the entry-level service now being proposed. If SRW clients in services can generate scheme-specific hierarchies from HILT data, an initial – but extendable - service based only top level mappings between schemes in the first instance (using the top 1000 DDC sections, for instance) then hierarchy based collection level subject retrieval becomes

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[23] Library of Congress Subject Headings (LCSH): http://authorities.loc.gov/
[24] Integrated Public Sector Vocabulary (IPSV): http://www.esd.org.uk/standards/ipsv/
[25] Art & Architecture Thesaurus (AAT): http://www.getty.edu/research/conducting_research/vocabularies/aat/
[26] Global Change Master Directory (GCMD): http://gcmd.nasa.gov/Resources/valids/keyword_list.html
[27] Humanities and Social Science Electronic Thesaurus (HASSET): http://www.data-archive.ac.uk/search/hassetSearch.asp
[28] Medical Subject Headings (MeSH): http://www.nlm.nih.gov/mesh/
[29] National Monuments Record Thesauri (NMR): http://thesaurus.english-heritage.org.uk/
[30] Joint Academic Coding System (JACS): http://www.ucas.ac.uk/figures/ucasdata/subject/
[31] UNESCO Thesaurus: http://www2.ulcc.ac.uk/unesco/

feasible. Deeper levels of mapping could be added as and when possible, and a distributed approach could allow faster progress on both scheme expansion and deeper mapping via national and international collaboration. It would also allow the model to encompass a wide range of external interoperability and terminology services, rather than focusing only on local intellectually composed mappings. This would imply a wider role for the collections and services database in the model.

3. Project Aims and Objectives, Participants, Roles, Deliverables
Aims and Objectives

It is proposed that Phase IV be a transition to service phase with the following aims and associated objectives:

1. The creation of an initial entry-level terminologies and subject interoperability service comprising
   (a) A freely available package consisting of an SRW client from the internet, instructions for making it interact with HILT, and illustrative user interface routines (which could be customised by local JISC information services) for using the client to exploit HILT facilities, terminologies, and terminology mappings. The illustrative user interface routines will be tailored for[32] a minimum of two representative stand-alone JISC information services and/or aggregator facilities[33], but offer illustrative facilities able to be utilised via local customisation by other JISC services. The specific services would be agreed with JISC before submission of the Project plan in Phase IV. For testing and illustrative purposes the client would be embedded in user interfaces appropriate to the services chosen.
   (b) A database comprising a range of subject schemes in use in the JISC IE, high-level mappings between these and (roughly) the top 1000 DDC sections[34], and a limited set of in-depth mappings in a subject area of interest to users of the two chosen services.
   (c) A SOAP-based HILT requests and responses handler based around the eight search and retrieve functions identified in Phase III as meeting the needs of clients.
   (d) An SRW server to provide a standard interface to the SOAP requests and responses handler.
   (e) Client use of IESR and the HILT database of terminologies and mappings to identify collections appropriate to a user's subject request, determine the subject schemes they use, and provide subject interoperability by offering subject access via scheme hierarchies entered at a point appropriate to the user's subject interest.
   (f) Extend client functionality to allow (via IESR) the identification of terminology and interoperability services other than HILT[35] and their use to provide enhanced user services.
2. An examination of client user interface needs and retrieval effectiveness in respect of both the high level and in-depth mappings conducted using users, retrieval problems, and associated 'use cases' from the two services and the initial entry-level service described above.
3. Design and implement an integrated programme of project dissemination and survey activity starting early in the project to ensure ongoing interaction and feedback between the project and the services community and culminating late in the project with (1) a dissemination programme spelling out the advantageous features and limitations of the entry-level service, and its future possibilities (2) a subsequent survey to determine the level of demand for an *operational* JISC interoperability and terminologies service. Significant project effort will go into the creation and implementation of this programme. It

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[32] The client would be embedded in service interfaces to offer HILT- based terminology and interoperability services transparent to local service users
[33] e.g. a Z39.50 clump like CAIRNS or M25 or a repositories service like IRI-Scotland or a union catalogue like Suncat
[34] Or the 1000 (or thereabouts) considered most useful by in-project experts.
[35] We have had discussions with OCLC and would expect, at minimum, to be able to incorporate pilot web service based terminology services developed by them as examples here, although we will also look more widely and will include any compatible terminology services funded under the last JISC capital programme if possible.

will include an appropriate mix of workshops, presentations at JISC and other relevant meetings, publications, and electronic dissemination (via email, web-site, a wiki for stakeholders, and so on). The exact mix will be determined early in the project when a dissemination and survey programme plan will be mapped out in conjunction with JISC.

4. A report on research into various selected issues of relevance to the provision of an effective future entry-level service or its further refinement – e.g. any possible alternative approaches to spine provision and their implications; the identification of preferred spines for specific query types where options exist; many to many mappings; guidelines for others wishing to produce HILT-compatible mappings themselves; searching with compound terms; mapping types required for effective user services at different service levels; mapping grading and coding; a list of terminology or related service types likely to enrich user experience if encompassed within the HILT architecture; the possible value of providing a HILT portlet (based on the JSR168 or WSRP standards) as a way of providing services with a relatively easy way of incorporating useful core user interface features into local services.

5. Develop and present future development proposals, including an estimate of the costs of setting up and maintaining an operational service and funding ongoing research and development needs beyond an entry-level service based on information arising out of 1-4 above, together with discussions with JISC and the project Steering Group.

Participants and Roles

The proposed study requires collaboration between the following participants:

Participant	Role(s)
CDLR	Project management; Final and other reports; Dissemination; Website; programming HILT requests handler and user interface routines; Overall service design; HILT database issues; Mark-up issues; Terminology mappings; Mapping types; Collections database issues; Evaluation work; survey work, research into various selected associated issues.
EDINA	SRW server issues and support; Hosting SRW server; Advice and programming support for SRW client programming and design work generally; testing GoGeo! client against deeper mappings; Advice on Perl programming and related Unix issues; advice on performance issues.
Terminology experts	Advice and views on terminology issues, classification issues, mapping issues, the terminology services scene and standards.

The project will continue to involve UKOLN and other advisors and stakeholders (such as the BL[36], the NLS[37] and NLW[38]) via the project Steering Group.

Deliverables

The HILT Phase IV deliverables will be:

- An entry-level service capable of meeting the high-level mapping needs of two JISC stand-alone information services or aggregator facilities.
- A freely available package consisting of an SRW client from the internet, instructions for making it interact with HILT and illustrative user interface routines (which could be customized by local JISC information services) for using the client to exploit HILT facilities, terminologies, and terminology mappings.
- A dissemination programme as described under 3(3) above to inform JISC service providers of the potential value of an operational service to their services and their users.

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[36] British Library (BL): http://www.bl.uk/
[37] National Library of Scotland (NLS): http://www.nls.uk/
[38] National Library of Wales (NLW): http://www.llgc.org.uk/

- The results of a survey of JISC services aimed at gauging the level of interest and need for an operational JISC interoperability and terminologies delivery service.
- If appropriate, an estimate of the costs of setting up and maintaining an operational service and funding ongoing research and development needs beyond an entry-level service.
- Project documentation, including a Final Report.

4. Description of Work Proposed

The following is an outline of the work plan required to meet the aims and objectives detailed in Section 3 above:

- An in-depth examination of the user interfaces, subject schemes, and subject interoperability needs of the two JISC services chosen to be part of the project.
- The subsequent compilation of a requirements document describing user interface functionality development needs, initial screen design needs and programming language issues, terminologies preparation and loading issues and associated database design questions, HILT requests and responses functional requirements (note that all three would be built on an extension of the facilities created in Phase III; they would not be redesigned from scratch).
- The programming and implementation of the SRW client, user interface routines, database, and requests handler elements of the *initial* version of the entry-level service for the two JISC services.
- The creation of high-level mappings between the schemes used by the chosen JISC services and (roughly) the top 1000 DDC sections.
- The creation of in-depth mappings in a chosen subject area of each of the two JISC services.
- The design of an evaluation programme to test the functionality of the initial entry-level service.
- The implementation of the functionality evaluation programme and tabulation of the results.
- The design of an evaluation programme to the test retrieval effectiveness of the initial entry-level service, comparing the high-level hierarchy-driven approach with the more in-depth mapping based approach in each of the two JISC services.
- The implementation of the retrieval evaluation programme and tabulation of the results.
- The design of an evaluation programme to test the effectiveness, helpfulness, and ergonomics of the user interface in each of the two clients and their associated service environments.
- The implementation of the user interface evaluation programme and tabulation of the results.
- The use of the results from the three evaluations to write an improved requirements specification for the entry-level service and its elements.
- The programming and implementation of the client, user interface, database, and requests handler elements of an improved *post-evaluation* version of the entry-level service for the two JISC services.
- An evaluation of the implications of allowing for the extension of the clients or the server to use other terminology and interoperability services[39] that might be discovered via IESR or similar services, either now or in future (OCLC may be a source of pilot services of this kind).
- A determination of the likely impact of the need to deal with such terminology and interoperability services on collection and/or service level description requirements.
- The programming and implementation of a pilot version of the two service interface illustrations able to handle intercourse with additional terminology services of this kind in order to demonstrate 'proof of concept'.
- The design and creation of an entry-level service dissemination programme (see 3(3) above) to inform JISC service providers likely to benefit from an operational HILT service of the possibilities of the proposed service for their services and users.

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[39] The services concerned are most likely to be pilot services available via our collaboration with OCLC

- The design and implementation of a survey to determine the impact of the dissemination programme on service providers and measure the likely demand for the proposed service.
- An estimate of the costs of setting up and maintaining an operational service and funding ongoing research and development needs beyond an entry-level service.
- An associated proposal to JISC requesting funding to set up an operational service.

5. Associated Staffing Requirements and Other Cost Elements

The primary costs of the project will be the staffing costs of the various participants, comprising:
project management staff, terminology work research staff, and programming staff at CDLR; programming staff at EDINA; terminology expert consultancy work. A breakdown of the tasks involved is shown in the table below.

Project element	Roles
Project Management and set-up, including website	CDLR
Project Plan	CDLR
An in-depth examination of the user interfaces, subject schemes, and subject interoperability needs of the two JISC services chosen to be part of the project.	CDLR, with advice from EDINA.
The subsequent compilation of a requirements document describing user interface functionality development needs, initial screen design needs, and programming language issues, terminologies preparation and loading issues and associated database design questions, HILT requests and responses functional requirements.	CDLR, with advice from EDINA.
The programming and implementation of the user interface routines, database, and requests handler elements of the *initial* version of the entry-level service for the two JISC services.	CDLR, with advice from EDINA.
The creation of high-level mappings between the schemes used by the chosen JISC services and (roughly) the top 1000 DDC sections.	CDLR and terminology experts
The creation of in-depth mappings in a chosen subject area of each of the two JISC services.	CDLR and terminology experts
The design of an evaluation programme to test the functionality of the initial entry-level service.	CDLR, EDINA
The implementation of the functionality evaluation programme and tabulation of the results.	CDLR, EDINA
The design of an evaluation programme to the test retrieval effectiveness of the initial entry-level service, comparing the high-level hierarchy-driven approach with the more in-depth mapping based approach in each of the two JISC services.	CDLR and terminology experts
The implementation of the retrieval evaluation programme and tabulation of the results (*may include EDINA testing of deeper level mappings in the Go Geo! interface developed in Phase III)	CDLR and terminology experts and EDINA*
The design of an evaluation programme to test the effectiveness, helpfulness and ergonomics of the user interface in each of the two clients and their associated service environments and to test performance levels.	CDLR with advice from EDINA
The implementation of the user interface evaluation programme and tabulation of the results.	CDLR, EDINA
The use of the results from the three evaluations to write an improved requirements specification for the entry-level service and its elements.	CDLR with advice from EDINA
The programming and implementation of the client, database, and requests handler elements of an improved *post-evaluation* version of the entry-level service for the two JISC services.	CDLR, EDINA
An evaluation of the implications of allowing for the extension of the clients or the server so that they can use other terminology and	CDLR

interoperability services that might be discovered via IESR or similar services, either now or in future.	
A determination of the likely impact of the need to deal with such terminology and interoperability services on collection and/or service level description requirements.	CDLR
The programming and implementation associated with a 'proof of concept' demonstration of the use of distributed terminology services, using the EDINA-based SRW server as a broker for demonstration purposes.	EDINA, CDLR
The design and creation of an entry-level service dissemination programme to inform JISC service providers likely to benefit from an operational HILT service of the possibilities of the proposed service for their services and users.	All, but led by CDLR
The design of a survey to determine the impact of the dissemination programme on service providers and measure the likely demand for the proposed service.	CDLR
Over the 21 months of the project, conduct research into various selected issues of relevance to the provision of an effective future entry-level service or its further refinement as specified in earlier list .	CDLR
Draw conclusions, propose further R&D work, write Final Report.	CDLR, EDINA
An estimate of the costs of setting up and maintaining an operational service and funding ongoing research and development needs beyond an entry-level service.	CDLR, EDINA
An associated proposal to JISC requesting funding to set up an operational service.	CDLR, EDINA
Dissemination of project outcomes.	CDLR, EDINA

6. Start and Finish Dates, Project Plan, Scheduling

The proposal is for a 21 month project starting March 19th 2007 and ending 19th December 2008.

In line with JISC practice, a detailed Project Plan will be written and submitted to JISC in the first three months of work. This will provide a detailed work plan and schedule. The list of tasks above is already in a roughly logical order and this, together with the work package list below, forms the basis of the draft schedule provided in Appendix B. This, in turn, will be the basis of the scheduling undertaken for the Project Plan.

WP:	Description
0	**Project Setup & Management** (Tasks: Set up and Management; Website Creation /Re-design; Project Plan; Ongoing Project Management; Interim and Final report)
1	**Entry-level service creation** (Tasks: Study relevant needs of 2 services; Compile requirements document; Program/implement initial service; Build demo distributed service; Post evaluation refinements; High-level inter-scheme mappings; In-depth inter-scheme mappings)
2	**Evaluation programme** (Tasks: Functionality evaluation; Retrieval evaluation; Interface evaluation; Distributed service evaluation; Service metadata needs evaluation)
3	**Dissemination and Survey** (Tasks: Dissemination programme plan; Service possibilities dissemination; Likely service interest survey; Project dissemination activities)
4	**Associated Research Programme** (Tasks: Research programme plan; Research programme work/report)
5	**Operational service proposals and costs** (Tasks: Operational service costs; Operational service proposal)

7. Project Management and Evaluation

Day to day management will be the responsibility of the project staff. This **Project Team** will report to a **Project Management Group (PMG)** consisting of the team and a

representative from each participant. There will also be a **Project Steering Group (PSG)** comprising representatives from key stakeholders. Evaluation will be conducted within the project.

8. Risks

Risks	Probability	Severity	Score	Action to manage threat
Staffing	1/5	2/5	2	Use partners to fill any gaps, bring in new staff quickly. EDINA has coverage for CDLR programmer and CDLR have coverage on the terminologies front.
Organisational	1/5	1/5	1	Plan ahead, monitor daily, act early to fix.
Technical	1/5	2/5	2	Adjust pilot as required; note in Final Report.

9. Standards and Accessibility

The project will adhere to appropriate standards where these exist and will be advised in this by other participants, by UKOLN and by JISC generally. The JISC IE standards[40] will be adhered to where they are appropriate. The specific standards that will impact on the project are SRW, SOAP, and SKOS Core (used for terminologies mark-up). The project is aware that the *British Standard for Structured Vocabularies for Information Retrieval* (BS8732), which greatly influenced SKOS Core, is partially published, and merges the *British standard guide to establishment and development of monolingual thesauri* (BS5723:1987) (ISO2788-1986) and the *British standard guide to establishment and development of multilingual thesauri* (BS6723:1985) (ISO5964-1985) and has two members of the revision group involved in the project[41]. It is also aware of current developments with respect to the Z39.19 'thesaurus standard'[42]. Accessibility guidelines will be adhered to and the Technology for Disabilities Service (TechDis, http://www.techdis.ac.uk) will be used for guidance and advice. In addition, HILT will keep track of technical and other relevant developments, such as approaches associated with the Web 2.0 movement.

10. IPR

Should the project be funded, the project partners will comply with the JISC requirements as regards to project deliverables and IPR as agreed in the subsequent letter of award.

11. Dissemination Strategy

Dissemination of information would be via the HILT Phase IV website, postings to appropriate e-mail lists, papers and news items submitted to professional publications and presentations at seminars and conferences. Key progress reports would be sent to relevant organisations, including, but not limited to, MIMAS (for intute and IESR) and UKOLN. An active and successful dissemination programme would be a major aim throughout the project.

12. Proposed Exit Strategy

The project will make recommendations about the possible nature and cost of a future service, if appropriate. The partners will maintain the proposed entry-level service for a reasonable period of time beyond the end of the project, the exact time to be agreed with the JISC.

13. Project Contact

Dennis Nicholson, Director, Centre for Digital Library Research, University of Strathclyde, Livingstone Tower, 26 Richmond Street, Glasgow, G1 1XH
Tel: 0141 548 2102   Fax: 0141 548 4523   Email: d.m.nicholson@strath.ac.uk

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[40] JISC Information Environment: technical standards, version 1.1: http://www.ukoln.ac.uk/distributed-systems/jisc-ie/arch/standards/
[41] Alan Gilchrist and Leonard Will.
[42] Z39.19-2005: Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies: http://www.niso.org/standards/resources/Z39-19-2005.pdf

Appendix A: Glossary

AAT: Art & Architecture Thesaurus

DDC: Dewey Decimal Classification

EDINA: A JISC-funded national datacentre based at Edinburgh University Library, offering the UK tertiary education and research community networked access to a library of data, information and research resources.

FE: Further Education

HE: Higher Education

GCMD: Global Change Master Directory

Go Geo!: A tool designed to help users find details about geo-spatial datasets and related resources within the UK tertiary education sector and beyond. A trial service is provided by EDINA.

HASSET: Humanities and Social Science Electronic Thesaurus

HILT: High-level Thesaurus

IESR: JISC Information Environment Service Registry

intute: intute is a free online service providing access to the very best web resources for education and research. Formerly the Resource Discovery Network (RDN).

IPSV: Integrated Public Sector Vocabulary

JACS: Joint Academic Coding System

JISC: Joint Information Systems Committee

JISC IE: Joint Information Systems Committee Information Environment

LCSH: Library of Congress Subject Headings

MeSH: Medical Subject Headings

M2M: Machine to machine interaction

NMR: National Monuments Records Thesauri

OCLC: Online Computer Library Center

SKOS Core**: Simple Knowledge Organization System (SKOS) Core supports the Resource Description Framework (RDF) description of language-oriented knowledge organisation systems (KOS), such as thesauri, glossaries, controlled vocabularies, taxonomies and classification schemes.**

SOAP: Originally the Simple Object Access Protocol, but now more simply referred to as SOAP. Used to exchange XML-based messages over computer networks, normally using HTTP.

*SQL: **Structured Query Language***

SRW: Search/Retrieve Web Service – Z39.50 Next Generation

SRU: Search & Retrieve URL – Z39.50 Next Generation

UKOLN: A centre of expertise in digital information management, providing advice and services to the library, information, education and cultural heritage communities. Based at the University of Bath and formerly known as the UK Office for Library & Information Networking.

UNESCO Thesaurus: United Nations Educational, Scientific and Cultural Organization subject scheme.

Use Case: A Use Case represents a series of interactions between a user (human or machine) and the system, utilising (in the present case) an M2M link. Typically, the interaction starts with an enquiry and leads to a resource that should answer that enquiry.

Wordmap: A commercially available taxonomy management software application that supports management of multiple controlled vocabularies.

XML: Extensible Mark-up Language

*Z39.50: **An international standard specifying a client/server-based protocol for searching and retrieving information from remote databases.***

Zthes: The Zthes profile is an abstract model for representing and searching thesauri and specifies how this model may be implemented using the Z39.50 and SRW protocols.

Appendix B: Draft Schedule (to be finalised in Project plan)

HILT Phase IV Month = mid Mar '07 – mid Dec'08	0 M	1 A	2 M	3 J	4 J	5 A	6 S	7 O	8 N	9 D	10 J	11 F	12 M	13 A	14 M	15 J	16 J	17 A	18 S	19 O	20 N	21 D
Project Setup & Management																						
Set up and Management	▓	▓																				
Web-site and Wiki		▓	▓						▓						▓						▓	▓
Project Plan	▓	▓				▓							▓					▓				
Ongoing Project Management			Meetings management and related tasks; Interim and Final report →																			
Entry-level Service Creation																						
Study relevant needs of 2 services			▓	▓																		
Compile requirements document				▓	▓	▓																
Program/implement initial service					▓	▓	▓	▓	▓	▓	▓	▓	▓	▓								
Build demo distributed service															▓							
Post evaluation refinements																			▓	▓	▓	▓
High-level inter-scheme mappings			▓	▓	▓	▓	▓	▓	▓													
In-depth inter-scheme mappings			▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓								
Evaluation																						
Functionality evaluation																▓						
Retrieval evaluation																	▓					
Interface evaluation																		▓				
Distributed service evaluation																	▓					
Service metadata needs evaluation															▓							
Dissemination/Survey Activity																						
Dissemination programme plan			▓	▓									▓									
Service possibilities dissemination				▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓								
Likely service interest survey															▓							
Project dissemination activities			▓	▓									▓			▓		▓			▓	▓

Research Programme																								
Research programme plan	▓	▓	▓	▓	▓	▓																		
Research programme work/report				▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓			
Future service proposals/costs																								
Operational service costs																						▓	▓		▓
Operational service proposal																							▓	▓	▓