JISC DEVELOPMENT PROGRAMMES

HILT Phase III: Final report

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> **Final report: HILT (HIgh-Level Thesaurus) Project Phase III**
>
> **Dennis Nicholson; Emma McCulloch; George Macgregor**

Contents

Acknowledgements

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Executive Summary

HILT is a JISC-funded, UK-based, collaborative project with the overall aim of creating a JISC shared service to facilitate the cross-searching of distributed information services by subject in a multi-scheme environment, ideally by identifying a generic approach that allows a service to be built up through distributed collaborative action. Primarily focused on an inter-scheme mapping based approach to providing a subject interoperability service, the project has recently adopted a new distributed model that will also allow it to encompass other approaches to providing interoperability services.

The project has been through a Phase I[2], where it was determined that the community preference for solving the interoperability problem was inter-scheme mapping, a Phase II[3] which built a web-based pilot service for direct user interaction, and a Machine to Machine (M2M) Feasibility Study[4] that looked at the feasibility of turning this pilot into a machine to machine service able to supply terminologies and mapping data for other services to use. This is the Final Report of the most recent phase of the project, HILT Phase III.

A follow-up to the M2M Feasibility Study, HILT Phase III[5] built an M2M pilot interoperability service that:

1. Offers web services access via the (SOAP-based) SRW protocol[6], but is designed so that an extension to other protocols (Z39.50[7], or SRU[8], for example) at a later date remains an option.
2. Uses SKOS Core[9] as the 'mark-up' for sending out terminology sets and classification data but allows other formats such as MARC[10] and Zthes[11] to be added later as alternatives.
3. Provides the pilot datasets[12], mappings, and functionality capable of servicing the 5 use cases agreed in the HILT M2M Feasibility Study (see Appendix B).
4. Bases the pilot on the centralised approach to the provision of mapping services piloted in HILT Phase II, but leaves open the possibility of a future move towards a more distributed model.

Building first of all on the outcomes and recommendations of the earlier feasibility study, progress was managed through the initial creation of an agreed architecture and associated system requirements document (see Appendix D). This was used as a guideline for programming, database design and population, and implementation, but was refined during the process of instantiation as new data and insights emerged as a result of research and development efforts. An evaluation exercise (see Appendix E) was then conducted to ensure that the pilot created met the agreed architectural and functional requirements and further refinements were made on the basis of that exercise to produce the final pilot.

An additional Phase III outcome was the recognition that the model developed allowed local service-based interfaces to build - and users to navigate – subject scheme hierarchies (where they existed). This has opened up the possibility of moving HILT to a **transition to service** phase which would:

1. Build an initial – but extendable - baseline M2M terminologies and subject interoperability service based on high level mappings between schemes and high level DDC captions[13], and with service

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[2] HILT Phase I: http://hilt.cdlr.strath.ac.uk/index1.html
[3] HILT Phase II: http://hilt.cdlr.strath.ac.uk/index2.html
[4] HILT M2M Feasibility Study: http://hilt.cdlr.strath.ac.uk/hiltm2mfs/
[5] HILT Phase III: http://hilt.cdlr.strath.ac.uk/hilt3web/
[6] Search/Retrieve Web service (SRW): http://www.loc.gov/standards/sru/srw/index.html
[7] Z39.50 is no longer being developed by Library of Congress – see http://www.loc.gov/z3950/agency/ for further information.
[8] Search/Retrieve via URL (SRU): http://www.loc.gov/standards/sru/
[9] Simple Knowledge Organization System (SKOS) Core: http://www.w3.org/2004/02/skos/
[10] MARC 21 Concise Format for Authority Data: http://www.loc.gov/marc/authority/
[11] Zthes: http://zthes.z3950.org/
[12] DDC, LCSH, IPSV, AAT, GCMD, HASSET, MeSH, NMR, JACS, UNESCO (see Appendix I for definitions of these abbreviations)
[13] Either the top 1000 high level terms, or a variation on this (the high level terms identified in Phase IV as most useful in a service, for example, or terms identified via WebDewey).

level subject access provided by generating an appropriate scheme hierarchy from a point relevant to a user query[14].

2. Evaluate it for retrieval effectiveness and user interface effectiveness, helpfulness, and ergonomics, then refine its features in line with the results.
3. Extend user interface functionality to allow (via IESR[15]) the identification of terminology and interoperability services other than HILT and their use to provide enhanced user services.
4. Disseminate results to JISC services that might use an operational service and subsequently survey them to determine the level of interest for an operational service.
5. Estimate the set up, maintenance, and ongoing R&D costs of an operational service.

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. It would also offer a more flexible model and one able to encompass a wide range of external interoperability and terminology services, rather than focusing only on local intellectually composed mappings.

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[14] Using the term originally input by the user to narrow down the possibilities to one or a few options, either via the nearest relevant high-level mapping, or by identifying scheme hierarchy elements indexed under the term.
[15] Information Environment Services Registry (IESR): http://www.iesr.ac.uk/

Background

The Problem; HILT I, II, and the M2M Feasibility Study

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). Phases I and II of the HILT project:

1. Established that the preferred approach of the various services in the domain to resolving the issue was one based on mapping the various subject schemes together through a central shared service that would provide users with the correct alternative terms to use in the various different schemes (HILT Phase I[16]).
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).

There are a range of issues that must be resolved before an operational JISC terminologies service can become a reality. Of these, one of the most important is the provision of its facilities via web services protocols to enable M2M interaction between terminology services and other components of the JISC IE architecture (services such as Go-Geo! (http://www.gogeo.ac.uk/), the Glasgow Digital Library (http://gdl.cdlr.strath.ac.uk/) or the intute (http://www.intute.ac.uk/) subject areas, for example). HILT Phase II developed a range of facilities on this front, but offered only direct user interaction with the pilot service. HILT Phase III was funded to build an M2M version of the HILT Phase II pilot terminologies mapping service in line with the outcomes of the HILT M2M Feasibility Study, and also to extend its functionality in a range of ways determined by a number of 'use scenarios' identified in that study (see Appendix B).

Aim and Objectives

The aim in HILT Phase III was to build an M2M version of the pilot demonstrator service built in HILT Phase II. Specific objectives were to:

- Offer web services access via the (SOAP-based) SRW protocol, but design the pilot so that a possible extension offering other protocols (Z39.50, or SRU, for example) at a later date could be an option.
- Use SKOS Core as the 'mark-up' for sending out terminology sets and classification data responses but design the pilot so that adding other formats such as MARC and Zthes would be an option at a later date.
- Provide the pilot datasets, mappings, and functionality capable of servicing the 5 use cases agreed in the HILT M2M Feasibility Study (see Appendix B).
- Base the pilot on the centralised approach to the provision of mapping services piloted in HILT Phase II, but design it so that the possibility of a future move towards a more distributed model is kept open.
- Include a pilot implementation of the SRW 'EXPLAIN' function[17].

The aims and objectives remained the same throughout the project lifetime.

Methodology

A full description of the methodology employed by the project is provided in the Project Plan[18]. In essence, the methodology employed was:

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[16] HILT Phase I Final Report: http://hilt.cdlr.strath.ac.uk/Reports/FinalReport.html
[17] SRU/SRW Explain function: http://www.loc.gov/standards/sru/explain/
[18] HILT Phase III Project Plan: http://hilt.cdlr.strath.ac.uk/hilt3web/reports/h3projectplanweb.pdf

- Utilise the outcomes and recommendations of the M2M Feasibility Study to reach an initial, agreed position as regards the preferred system architecture and an associated set of system functionality requirements (see Requirements Document in Appendix D).
- Use the Requirements Document and architecture to manage research and development efforts, guiding programming, database design and population, and implementation efforts.
- Refine the accepted view of architecture and functional requirements through continuous review during ongoing R&D work and feed this back into system development efforts.
- Conduct an evaluation exercise to ensure that the pilot created met the agreed architectural and functional requirements and make further refinements on the basis of the results.
- Continue to use the Requirements Document as a basis for recording and plotting likely and desirable future developments in architecture and functionality and to inform the developing vision for a distributed collaborative solution to the subject interoperability problem.

Implementation

The high-level description of how the pilot service was designed and implemented is described above under 'Methodology', with further information given in the project plan. Detailed information on how the pilot was developed is provided in the Requirements Document, provided below as Appendix D, and in the detailed description of service functionality encompassed in the Evaluation Report (see Appendix E).

An illustrative description of a 'user/service-eye view' of the pilot and its operation is given in Appendix F.

External input was achieved via a Steering Group consisting of a range of interested parties, including two terminology experts (Alan Gilchrist and Leonard Will), representation of the British Library[19], National Library of Scotland[20], National Library of Wales[21], UKOLN[22], intute[23], and OCLC[24].

Technical work was conducted at both CDLR and EDINA. This was coordinated via email and at various meetings, scheduled as and when the issues to be tackled required it.

Outputs and Results

HILT Phase III outputs were:

- 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 outlined in Appendix B, 10 subject schemes, and SRW clients (embedded in associated user interfaces) to service the needs of two different service environments.
- An outline design for a possible future 'baseline' subject interoperability service (see Conclusions section below).
- A flexible and extendible model for a distributed subject interoperability service able to incorporate a range of external services offered by other terminology sites (see Conclusions section below).
- A better understanding of the working requirements of terminology services, whether centralized or distributed.
- A Requirements Document and an associated ongoing means of managing the development process within and beyond HILT Phase III (see Appendix D).
- An Evaluation Report (presented below as Appendix E).
- This Final Report on the project, together with details of future research and development requirements leading towards a future operational service (see Phase IV proposal in Appendix G).
- Dissemination of project progress and findings was conducted via accepted papers to Ibersid 2005, the European Conference on Digital Libraries (ECDL) 2006 and the International Conference on Digital Libraries (ICDL) 2006. A further conference paper has been accepted by

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[19] British Library (BL): http://www.bl.uk/
[20] National Library of Scotland (NLS): http://www.nls.uk/
[21] National Library of Wales (NLW): http://www.llgc.org.uk/
[22] UKOLN: http://www.ukoln.ac.uk/
[23] intute: http://www.intute.ac.uk/
[24] OCLC Online Computer Library Center: http://www.oclc.org/

the International Conference on Semantic Web and Digital Libraries (ICSD-2007) to be held in Bangalore, India in February 2007 and an invited paper is to be given in Berlin in February 2007 at a conference to mark Germany's Presidency of the Council of the European Union ("Europe's cultural and scientific heritage in a digital world"). In addition, a research paper was published in Cataloging & Classification Quarterly 42(3/4) 2006 (pp.187-200) and a second paper has been accepted by the Journal of Information Science, following revisions.

Outcomes

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 specifications, 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[25] (see Appendix H).

Conclusions

The primary conclusion that can be drawn from HILT Phase III is that the subject interoperability services developed in HILT phase II are not only transferable to the M2M environment, but can be enhanced by leveraging the possibilities of this environment.

HILT Phase III met its primary aim of building an M2M version of the pilot demonstrator service built in HILT Phase II[26], designing, implementing, testing, and refining an M2M pilot service that:

- Offers web services access via the (SOAP-based) SRW protocol, but is designed so that a possible extension offering other protocols (Z39.50, or SRU, for example) at a later date could be an option.
- Uses SKOS Core 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 and Zthes would be possible at a later date.
- Provides the pilot datasets (DDC, LCSH, IPSV, AAT, GCMD, HASSET, MeSH, NMR, JACS, UNESCO), illustrative mappings (between the DDC spine and the other schemes), and functionality capable of servicing the 5 use cases agreed in the HILT M2M Feasibility Study (see Appendix B).
- Is based on the centralised approach to the provision of mapping services piloted in HILT Phase II, but is designed so that the possibility of a future move towards a more distributed model is kept open.
- Includes a pilot implementation of the SRW 'EXPLAIN' function.

Work on the pilot service showed that it was possible to implement the Phase II pilot in an M2M environment but also helped identify the wider possibilities inherent in the client – server approach. Two points were of particular note.

1. It was recognised that, in addition to providing mappings between subject schemes, the service could also respond to client requests for information from specific schemes, such as detailed terminological data: broader terms, narrower terms, scope notes, and so on. As well as enabling the enrichment of user search terms via query expansion techniques (as demonstrated in the GoGeo! HILT Keyword Demonstrator[27]), this opened up the possibility of local information

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[25] W3C Semantic Web Deployment Working Group (SWDWG): http://www.w3.org/2006/07/SWD/
[26] HILT Phase II pilot terminology server: http://hiltpilot.cdlr.strath.ac.uk/pilot/top.php
[27] GoGeo! HILT Keyword Demonstrator: http://nevis.ed.ac.uk:9200/gogeo_hilt2.html

services using HILT data to build - and allow users to navigate – subject scheme hierarchies, and this, in turn, opened up the possibility of taking HILT to the transition to service stage proposed for Phase IV. If services can generate scheme-specific hierarchies from HILT data, an initial – but extendable - service based on top level mappings between schemes in the first instance (using the top 1000 DDC captions, for instance), would render the creation of hierarchically based collection level subject retrieval feasible. This would not only provide a useful service to users and services interested in cross-searching services using different subject schemes, but could be the basis of an improved future service that added deeper levels of mapping as and when feasible and as and when specific retrieval requirements made it economically justifiable.

2. It was recognised that, by extending the use of the collections and services database[28], it was possible to design a distributed version of the service in which other 'players' within and beyond JISC also offered M2M terminology and interoperability services. This would permit the functionality of a future service to be extended in a faster and more economic fashion than previously envisaged. It would also allow approaches to interoperability other than intellectual mapping to be brought into the model, making it at once more flexible and less dependent on a particular approach.

Other project conclusions worth noting were that:

- The SKOS Core Mapping Vocabulary Specification (MVS) was probably inadequate to express equivalence relationships between mapped terms from different terminologies since the five types of relationship within the SKOS Core MVS are conceptually based and broad, and so do not account for more subtle variations relating to lexical differences such as spelling variations or singular/plural matches. The HILT team propose to offer feedback to the SKOS Core team when it reviews the MVS in the near future.

- Terminologies are not always available in appropriate formats for ease of use within a terminology server. Where data was not available in e.g. xml, terminologies occasionally had to be extracted from web pages, which was not always straightforward due to the nature of web instantiations, all of which were different, with different levels of granularity, inconsistent layout and so on. The organisation of data provided by scheme maintainers was also found to be sub-standard in some areas. For example, within AAT, 'guide' terms and 'concept' terms are presented together, although guide terms would not be used directly as index terms so they have to be stored/coded differently for the purposes of HILT. It follows that significant investment of time is required, in any follow-up development of a service, to ensure that terminology data within the JISC IE is both usable and correct.

- As indicated at the end of Phase II, terminology mapping work is complex and requires further research, with particular issues identified being: 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; mapping types required for effective user services at different service levels; and mapping grading and coding.

Implications

It is now possible for HILT to move to the transition to service phase as outlined above and as proposed in the bid for HILT Phase IV presented in Appendix G. The proposed baseline – and potentially distributed – service requires further research and development as detailed in the bid. It also requires the active interaction with JISC services proposed in order to identify user needs and make any future HILT facility of value to services.

In respect of more immediate implications for the JISC communities, three points are worth noting:

1. Although the work undertaken by HILT built pilot facilities only, services wishing to explore the possibilities of M2M inter-working with a future service should be able to do so using the pilot facilities. Interested parties should contact the HILT team in the first instance. This may also be of interest to those wishing to explore the use of M2M services generally.

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[28] Currently only used to identify JISC information services relevant to a user's subject query and the schemes they use.

2. JISC community members aiming to build terminology sets or offer terminology or mapping services should consider interacting with the HILT team with a view to ensure future compatibility between the services and HILT, and vice versa.
3. HILT Phase IV is likely to inform future IESR or JISC Terminologies Registry development needs in terms of recording and describing terminology services so as to facilitate intelligent interaction between information services and terminology services.

Recommendations

It is recommended that HILT now be funded to move to a **transition to service** phase which would:

1. Build an initial – but extendable - baseline M2M terminologies and subject interoperability service based on top level mappings between schemes with collection level access provided by generating an appropriate scheme hierarchy from a point relevant to a user query.
2. Evaluate it for retrieval effectiveness and user interface effectiveness, helpfulness, and ergonomics, then refine its features in line with the results
3. Extend user interface functionality to allow (via IESR or a terminologies registry) the identification of terminology and interoperability services other than HILT and their use to provide enhanced user services.
4. Disseminate results to JISC services that might use an operational service and subsequently survey them to determine the level of interest for an operational service.
5. Estimate the set up, maintenance, and ongoing R&D costs of an operational service.

The full proposal is provided in Appendix G and also includes, of necessity, an associated Phase IV research programme.

In addition, it is recommended that JISC community members engaged in terminologies work take note of point 2 of the above 'Implications' section and that IESR and the Terminologies Registry project take note of point 3.

References

Please refer to footnotes.

Appendix A: Individual Project Participants

- **Edward Boyle**, EDINA (HILT project team member and Project Management Group);
- **Alan Danskin**, British Library (Steering Group);
- **Gordon Dunsire**, Centre for Digital Library Research (Steering Group);
- **Graeme Forbes**, National Library of Scotland (Steering Group);
- **Alan Gilchrist**, Cura Consortium (terminology consultant and Steering Group);
- **Rachel Heery**, MIMAS(IESR)/UKOLN (Steering Group);
- **Kathy Hughes**, National Library Wales (Steering Group);
- **Anu Joseph**, Centre for Digital Library Research (HILT project team member);
- **Linda Kerr**, EEVL (representing intute) (Project Management Group);
- **George Macgregor**, Centre for Digital Library Research (HILT project team member – project management);
- **Emma McCulloch**, Centre for Digital Library Research (HILT project team member – project management);
- **Joan Mitchell**, OCLC and Editor in Chief of the Dewey Decimal Classification (DDC) (Steering Group);
- **Dennis Nicholson**, Centre for Digital Library Research (HILT project team member – project director);
- **Omolade Oduyemi**, Centre for Digital Library Research (HILT project team member – temporary programmer);
- **Christine Rees**, EDINA (HILT project team member and Project Management Group);
- **Ben Soares**, EDINA (HILT project team member and Project Management Group);
- **Tim Stickland**, EDINA (HILT project team member and Project Management Group);
- **Phil Vaughan**, JISC (Steering Group);
- **Diane Vizine-Goetz**, OCLC Research (Steering Group);
- **Leonard Will**, Willpower Information (terminology consultant and Steering Group).

Appendix B: Use Cases and Pilot Functions

Use Case 1:

Emulate the Phase II pilot: use the user's search term to identify DDC captions that might cover his or her topic and get user to 'disambiguate' captions (IE identify which does cover his or her topic) (Function: get_ddc_records); use DDC number associated with caption to identify collections that cover the subject area in which the user's topic 'sits' and the subject schemes they use and get user to choose collection to search and, in so doing, identify the subject scheme to use when searching (Function: get_collections); identify term in the scheme in question to use when searching for user's topic; search for it and return hits to user (Function: get_non_ddc_records).

Use Cases 2/3:

Provide enriched set of search terms so users can use (selectively or otherwise) to improve searches of local service database; includes term expansion, singular/plural mappings, spelling/typos correction (Google 'did you mean?') – (Function: either get_all_records or get_filtered_set).

Use Case 4:

Scheme hierarchy browse in 'no hits from HILT' or user/service request situation (Function: get_filtered_set).

Use Case 5:

Improved precision use cases, either via browsing scheme hierarchies, disambiguation or specific requests for narrower/related terms (Function: other use cases plus get_filtered_set).

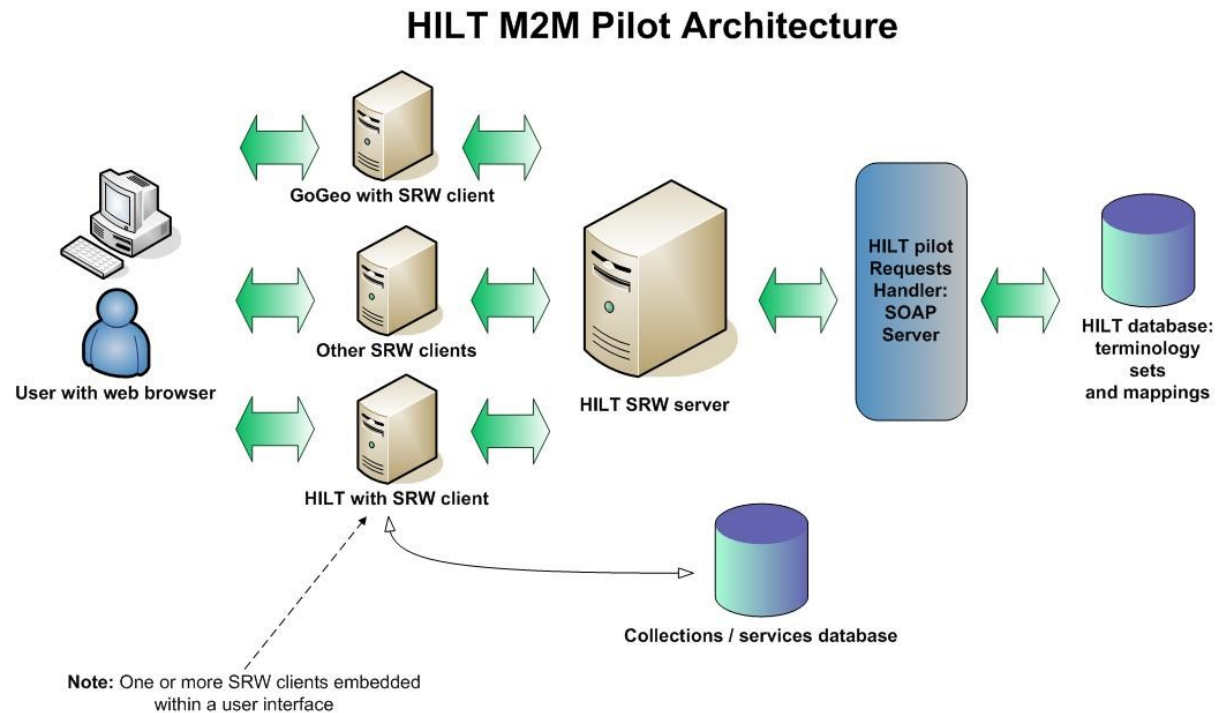|	Function name	Description	Use Case	Notes
1	explain	Get HILT service Explain file (covers requirements 2-7)	All	If at CDLR (not clear)
2	get_collections	Get collections classified under specified DDC number or its stem (covers requirement 9 - retrieval here is from separate collections database and might ultimately be IESR)	Specific usage in is #1 but might be used in other contexts	May not be necessary if collections database accessed directly or via (CDLR-based) SRW rather than SOAP.
3	get_all_records	Get records that include – or are directly or indirectly mapped to records that include – specified term or term phrase (covers requirement 10)	#1, probably not used in other contexts.	
4	get_ddc_records	Get any DDC record that either includes the term specified, or that is mapped to by a record	#1, but might be used in other contexts	

	Function name	Description	Use case	Notes
		that includes the term specified (covers requirement 11).		
5	get_non_ddc_records	Get any non-DDC record that includes a mapping to the DDC number sent (covers requirement 12).	#1, but might be used in other contexts.	
6	get_filtered_set	Get record and fields set that meets the specified parameters (covers requirement 13)	Various different parameter sets needed for use cases #2 to #5.	Filters would be by things such as subject scheme (UNESCO and LCSH only, say), or specified fields (mappings only, say, or broader terms and narrower terms only, say) and so on.

Functions resulting from evaluation findings:

	Function name	Description	Use case	Notes
7	get_parents	Retrieve **all** broader terms (parent terms) in response to a submitted term identifier (via m2m).	#5, but could feasibly be invoked in a variety of other potential user searching scenarios, or combined with other existing HILT functions.	The use of this function is to invoke a scheme specific browsable hierarchy for the user.
8	get_children	Retrieve the narrow terms (children terms) in response to a submitted term identifier (via m2m).	#5, but – like get_parents - could feasibly be invoked in a variety of other potential user searching scenarios, or combined with other existing HILT functions.	Unlike get_parents which requests all broader terms, get_children can only request those terms that feature at the next level of the terminological hierarchy (or equivalent) since the number of all possible children across all hierarchical levels would in many cases prove too sizable.

Appendix C: Phase II and Phase III Architectures

This diagram below shows the architecture that is the basis of the machine to machine SRW version of the service built in HILT Phase III. The blue boxes show roughly the basis of the Phase II user-accessible service. Users with web browsers access a web-accessible PHP-based HILT requests handler directly and this interacts with the terminologies and collections and services databases and uses the data returned to produce the provide users with appropriate hits from collections identified as relevant to their topic using terms from the schemes used in those collectons.

HILT M2M Pilot Architecture

GoGeo with SRW client

Other SRW clients

User with web browser

HILT with SRW client

HILT SRW server

HILT pilot
Requests
Handler:
SOAP
Server

HILT database:
terminology
sets
and mappings

Collections / services database

Note: One or more SRW clients embedded
within a user interface

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 service user interfaces using embedded SRW clients invisible to their users. The project developed two SRW clients, a HILT SRW client to emulate the Phase II pilot, but also offer additional facilities, and a Go-Geo! SRW client to offer functionality specific to the Go-Geo! service. These were embedded in user interfaces to illustarte functionality.

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, and 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.

Appendix D: Requirements Document

Requirements document background

HILT Phase III is funded to build an M2M version of the HILT Phase II pilot terminologies mapping service, but also to extend its functionality in the various ways described below. The Phase III pilot will not use the Wordmap software used in Phase II, but will employ a simpler-to-use and work on SQL Server based clone as the core of the M2M approach.

At a general level, the requirement is to build an M2M pilot demonstrator service that will:

- Offer web services access via the (SOAP-based) SRW protocol, but be designed so that a possible extension offering other protocols (Z39.50, or SRU, for example) at a later date could be an option.
- Use SKOS Core as the 'mark-up' for sending out terminology sets and classification data responses but be designed so that adding other formats such as MARC and Zthes would be an option at a later date.
- Provide the pilot datasets, mappings, and functionality capable of servicing the 5 use cases[29] agreed in the HILT M2M Feasibility Study (see Appendix B).
- Be based on the centralised approach to the provision of mapping services piloted in HILT Phase II, but be designed so that the possibility of a future move towards a more distributed model is kept open.
- Include a pilot implementation of the SRW 'EXPLAIN' function.

This document is intended to specify the requirement in more detail. Some of the detail of the requirement may be amended at any time up to the project end date. Future (IE post-Phase III) requirements will also be specified here (Appendix A). Further detail can be found in the HILT Phase III Evaluation Report.

Note that the primary aim is to specify what the functional requirements are, rather than how they will be met.

Version[30]	Date	Comments	Notes
Version 1	25.11.2005	Initial draft - Dennis Nicholson (DN).	
Version 2	07.03.2006	DN (post discussions with Edina).	
Version 3	20.04.2006	DN	
Version 4	28.08.2006	George Macgregor (GM)	Addition of HILT M2M SOAP functions table
Version 5	20.10.2006	Updated and revised by GM	Updated and standardised SOAP function labels
Version 6	27.10.2006	Updated Emma McCulloch (EM)	Addition of DN's Functions and use cases document
Version 7	14.12.2006	Updated (GM/EM)	Addition of two new SOAP functions

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[29] Note that the original use cases suggested that Phase III investigate whether certain use case functionality elements would be best provided at the client end or at the HILT end. On this front, it has been determined that it is more in keeping with the architecture to assume that, in the main, functionality will be provided at the client end unless there is good reason to do otherwise.

[30] Versions 1-9 are available via the HILT website and contain significant detail on functional requirements and use cases. See for details: http://hilt.cdlr.strath.ac.uk/hilt3web/requirements.html

Version 8	30.01.2007	Updated (DN)	Final Phase III full version
Version 9	30.01.2007	Updated (DN)	Final Phase III summary version for Final report
Version 10	06.02.2007	Updated and revised by GM	Addition of title and contents pages; changes to text and formatting for JISC submission

HILT M2M Pilot Architecture

GoGeo with SRW client

Other SRW clients

User with web browser

HILT with SRW client

HILT SRW server

HILT pilot Requests Handler: SOAP Server

HILT database: terminology sets and mappings

Collections / services database
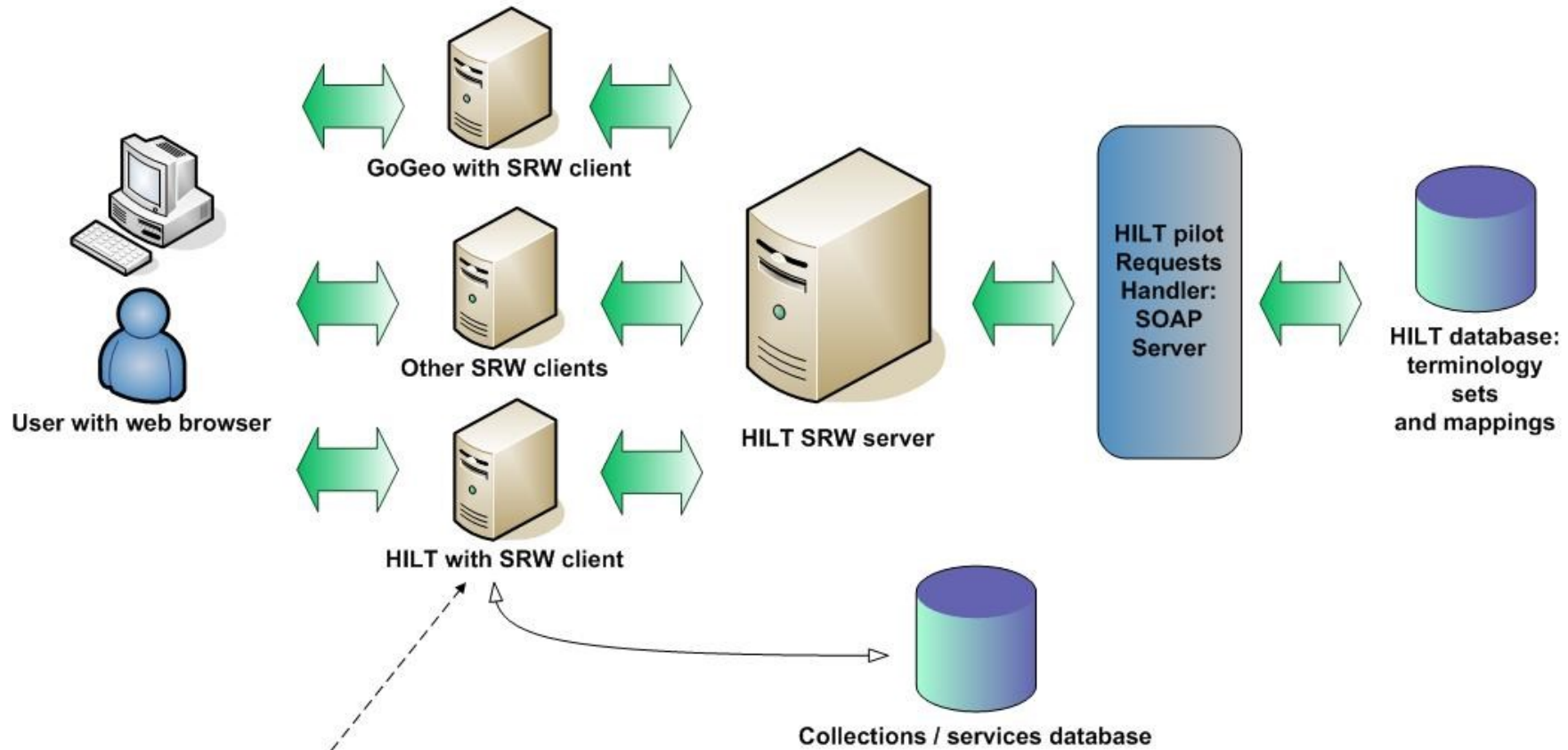
Note: One or more SRW clients embedded within a user interface

Section 1

Introduction

The diagram on above shows the primary elements of the M2M pilot, together with a rough representation of their inter-relationships. This section - Section 1 - provides an overview of the functions performed by each component, together with some associated top level requirements and explanatory notes. Detailed functional requirements for the whole (pilot) system are dealt with in the appendices provided in Section 2 below.

Web Browsers

Users will not access HILT directly as they did in the Phase II pilot. They will use web browsers to access services such as GoGeo! or Biome and these services will interact with HILT via service-based SRW clients and a HILT SRW server. In the planned Phase III pilot, the aim will be to simulate the embedding of the SRW clients in service user interfaces by creating web pages accessible via web browsers to simulate service user interfaces. Since this is a pilot implementation only, the current assumption is that these web pages will support only Internet Explorer 6x. Since web browsers are not part of the pilot proper, and this is the only requirement associated with them, they are not included in the tables showing the detailed requirement (Appendix A below).

GoGeo! Service SRW Client

This SRW client will entail two kinds of requirements:

• Generic requirements likely to be incorporated in any client - requirements related to the sending of requests to, and the displaying or using of responses from, the HILT terminologies mapping service in servicing any of the 5 use cases relevant to Go Geo!.
• GoGeo! specific requirements – special requirements related to the specific needs of the service and its users.

Its functions are:

• To translate service mediated requests that 'interpret' user needs, into Common Query Language (CQL) requests and 'wrap' them in SOAP-like SRW mark-up for sending to HILT via the SRW server.
• To deal with and, as appropriate, display the responses to these requests.

The GoGeo! Service SRW client programming language is Perl.

HILT Service SRW Client

In the first instance, this SRW client will emulate the current user interface to HILT but extend its functionality to cover the detail of all 5 use cases. However, it may also be extended to explore additional service specific requirements of a few representative services in UK HE and/or FE.

Its functions are:

- To translate either direct user requests for terminological information or, in the case of service specific functions, service mediated requests that 'interpret' user needs, into Common Query Language (CQL) requests and 'wrap' them in SOAP-like SRW mark-up for sending to HILT via the SRW server.
- To deal similarly with queries to the collections database for collections information.
- To deal with and, as appropriate, display the responses to these requests.

HILT Service SRW Client programming language is Perl. A facility that uses the Google 'did you mean' API to provide a level of spell-check and typo checking is also included in the pilot version of this client.

SRW Server

This will:

- Take the SOAP-like SRW-wrapped CQL requests coming from the clients, unwrap them, determine whether they are Explain requests or terminology requests, translate the CQL commands and syntax into commands and syntax recognised by the SRW Explain function, or the HILT requests and responses handler (The SRW server parses the query to obtain the search terms, and uses these in a call to the appropriate SOAP server function), and send them on to the service function in question.
- Take responses from these various services, translate them into CQL responses and syntax, wrap them in SRW mark-up, and send them back to the client with labels to indicate their source. In the case of responses from the main HILT database, which will be wrapped in SKOS Core, the SRW mark-up will encompass the SKOS Core mark-up rather than replace it.

Requests and Responses Handler (SOAP Server)

This is where the functionality relating to querying the HILT terminologies database will reside. It will:

- Take requests from the SRW server, map these to appropriate SOAP functions (see list and descriptions in Appendix C) designed to optimise searching/retrieving from the various terminology sets, mappings, and other data, and, via these functions, send SQL search requests to the HILT terminologies database.

- Take responses from the database, wrap them in SKOS Core mark-up, process them as (and if) required, and send the responses back to the SRW server for passing on to the client(s). In some cases – possibly in all – it would also pass on information regarding the subject scheme that was the source of a term or terms sent back. In a future implementation, it should be possible for the requesting site to specify which mark-up is required from a range available via HILT (e.g. Zthes) and use the mark-up chosen. In this event, the range available will presumably be specified in the SRW Explain file. The details of the mark-ups themselves might be available from the HILT database (we should assume so in the pilot and think about putting SKOS Core details in the database), although it could be sensible for a range of standard mark-ups to be available in some kind of separate registry.
- In some cases, react to a 'no hits from HILT' response from the database by offering the ability to browse DDC or an individual scheme, and/or a Google-type 'did you mean…' response (IE was that a spelling mistake?).

In many cases a given service-mediated user query may entail a number of connected interactions with the database, but the current assumption is that it will be possible to handle this situation without the requests and responses handler having to keep track of the 'thread' of an individual query. Ideally, the design of the overall system would be such that any keeping track required could be handled at the client end and the requests and responses handler need only handle apparently unrelated requests. Presumably, though, it would have to keep information regarding the source of the original query and some kind of query number assigned by the client/querying service. This would mean it could keep track of a query if necessary, and could, for example, produce query-related statistics should this be required at some future date. At the moment, however, the assumption is that, functionality-wise, keeping track of a query is a client end function.

In the pilot at least, it will probably make sense for it to handle requests to and responses from the Explain service also. Dealing with the Explain service in this way may still make sense in an operational situation in the longer term.

A facility that uses the Google 'did you mean' API to provide a level of spell-check and typo checking was included in the pilot version of the HILT client rather than at the database server end.

HILT Terminologies Database

This is where the various terminologies sets, mappings and other data available through HILT are held. Schemes held will be DDC (spine for mapping to), LCSH, MeSH, UNESCO, JACS, HASSET, GCMD, IPSV, AAT, and NMR. Various illustrative mappings are held, with most notable being to DDC from LCSH (including OCLC provided mappings), MeSH, UNESCO, and AAT. Other mappings included are IPSV and GCMD.

The database will also hold information on relationships between terms in schemes and, for mappings between schemes, information on the type of mapping (exact match, singular-plural etc).

Collections Description Service

This is intended to be a stand-in for IESR. In the pilot, it should be based on the version used in HILT Phase II but should probably use the multiple DDC assignations now used in IESR to give a better identification of service. Where appropriate, IESR now lists more than one DDC number for some services. Ideally, this would also be SRW-compliant, but it is not essential for the pilot that it should be.

SRW Explain

This should ideally hold data on the subject schemes used, the functions offered, the kinds of queries supported, the kinds of terminologies mark-ups offered (SKOS Core only at present), and so on. More research is needed into what is permitted by the protocol and what is needed for the service in both a centralised, standalone mode, and a distributed one, before full details of the requirement can be specified.

Section 2 – Requirements Document Appendices

Requirements Document Appendix A: Future Functionality Requirements

Function	Note
Utilise SRW, SOAP, and SKOS to build a baseline or entry-level[31] terminologies and subject interoperability shared service offering machine to machine 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.	This is the basis of the HILT Phase IV bid. It needs working out in detail at an early stage of Phase IV, should it be funded.
If it is allowed by the SRW Explain function, there may be a case for the SRW server being able to download data on the HILT command and response language via the SOAP Explain function.	
A likely future need is for the SRW server to be able to identify all of the terminology servers in a distributed HILT (or, indeed, elsewhere) in a service like IESR and download information on their command and response language from via an SRW Explain request sent to the appropriate SRW server (which might either be the HILT SRW server, a server based at the site of the distributed element of the service, or a mix of both).	
Keeping track of linked queries for statistical reporting purposes.	
Investigate developing SRW Explain to encompass schemes offered.	

Requirements Document Appendix B: HILT Use Cases and Functions

Use Case 1:

Emulate the Phase II pilot: use the user's search term to identify DDC captions that might cover his or her topic and get user to 'disambiguate' captions (IE identify which does cover his or her topic) (get_ddc_records function);   use DDC number associated with caption to identify collections that cover the subject area in which the user's topic 'sits' and the subject schemes they use and get user to choose collection to search and, in so doing, identify the subject scheme

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[31] 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.

to use when searching(Get_collections function);; identify term in the scheme in question to use when searching for user's topic; search for it and return hits to user (get_non_ddc_records function).

Also, get_all_records combines get_ddc_records and get_non_ddc_records

Use Cases 2/3:

Provide enriched set of search terms so users can use (selectively or otherwise) to   improve searches of local service database; includes term expansion, singular/plural mappings, spelling/typos correction (Google 'did you mean?') – either get_all_records function or get_filtered_set function.

Use Case 4:

Scheme hierarchy browse in 'no hits from HILT' or user/service request situation (get_filtered_set function).

Use Case 5:

Improved precision use cases, either via browsing scheme hierarchies, disambiguation or specific requests for narrower/related terms (other use cases plus get_filtered_set function or (post evaluation) get_parents and get_children).

Note: See Appendix C below for more detail on the functions referred to above.

Requirements Document Appendix C: HILT SOAP Functions Table

	Function name	Description	Use Case	Notes
1	explain	Get HILT service Explain file (covers requirements 2-7)	All	If at CDLR (not clear)
2	get_collections	Get collections classified under specified DDC number or its stem (covers requirement 9 - retrieval here is from separate collections database and might ultimately be IESR)	Specific usage in is #1 but might be used in other contexts	May not be necessary if collections database accessed directly or via (CDLR-based) SRW rather than SOAP.
3	get_all_records	Get records that include – or are directly or indirectly mapped to records that include – specified term or term phrase (covers requirement 10)	#1, probably not used in other contexts.	
4	get_ddc_records	Get any DDC record that either includes the term specified, or that is mapped to by a record that includes the term specified (covers requirement 11).	#1, but might be used in other contexts	
5	get_non_ddc_records	Get any non-DDC record that includes a mapping to the DDC number sent (covers requirement 12).	#1, but might be used in other contexts.	
6	get_filtered_set	Get record and fields set that meets the specified parameters (covers requirement 13)	Various different parameter sets needed for use cases #2 to #5.	Filters would be by things such as subject scheme (UNESCO and LCSH only, say), or specified fields (mappings only, say, or broader terms and narrower terms only, say) and so on.

Functions resulting from evaluation findings:

	Function name	Description	Use case	Notes
7	get_parents	Retrieve **all** broader terms (parent terms) in response to a submitted term identifier (via m2m).	#5, but could feasibly be invoked in a variety of other potential user searching scenarios, or combined with other existing HILT functions.	The use of this function is to invoke a scheme specific browsable hierarchy for the user.
8	get_children	Retrieve the narrow terms (children terms) in response to a submitted term identifier (via m2m).	#5, but – like get_parents - could feasibly be invoked in a variety of other potential user	Unlike get_parents which requests all broader terms, get_children can only request those terms that

			searching scenarios, or combined with other existing HILT functions.	feature at the next level of the terminological hierarchy (or equivalent) since the number of all possible children across all hierarchical levels would in many cases prove too sizable.

Appendix E: Evaluation Report

1. Introduction

An evaluation stage of the HILT Phase III pilot M2M demonstrator was to be undertaken following completion of the main development work (November/December 2006). The aim was to determine whether the pilot demonstrator operates as specified in the requirements document and, hence, whether it correctly delivers the functionality needed to meet the five use cases (devised during the preceding feasibility study). Outcomes will be used to inform the system refinement process, due to occur in January 2007. Six SOAP functions were designed to meet the functionality required by each of the use cases, either singly or in combination, and the working pilot is best tested by examining whether each part of the system architecture (see Figure 1) operates as specified in the requirements document when any given one of the functions is called.
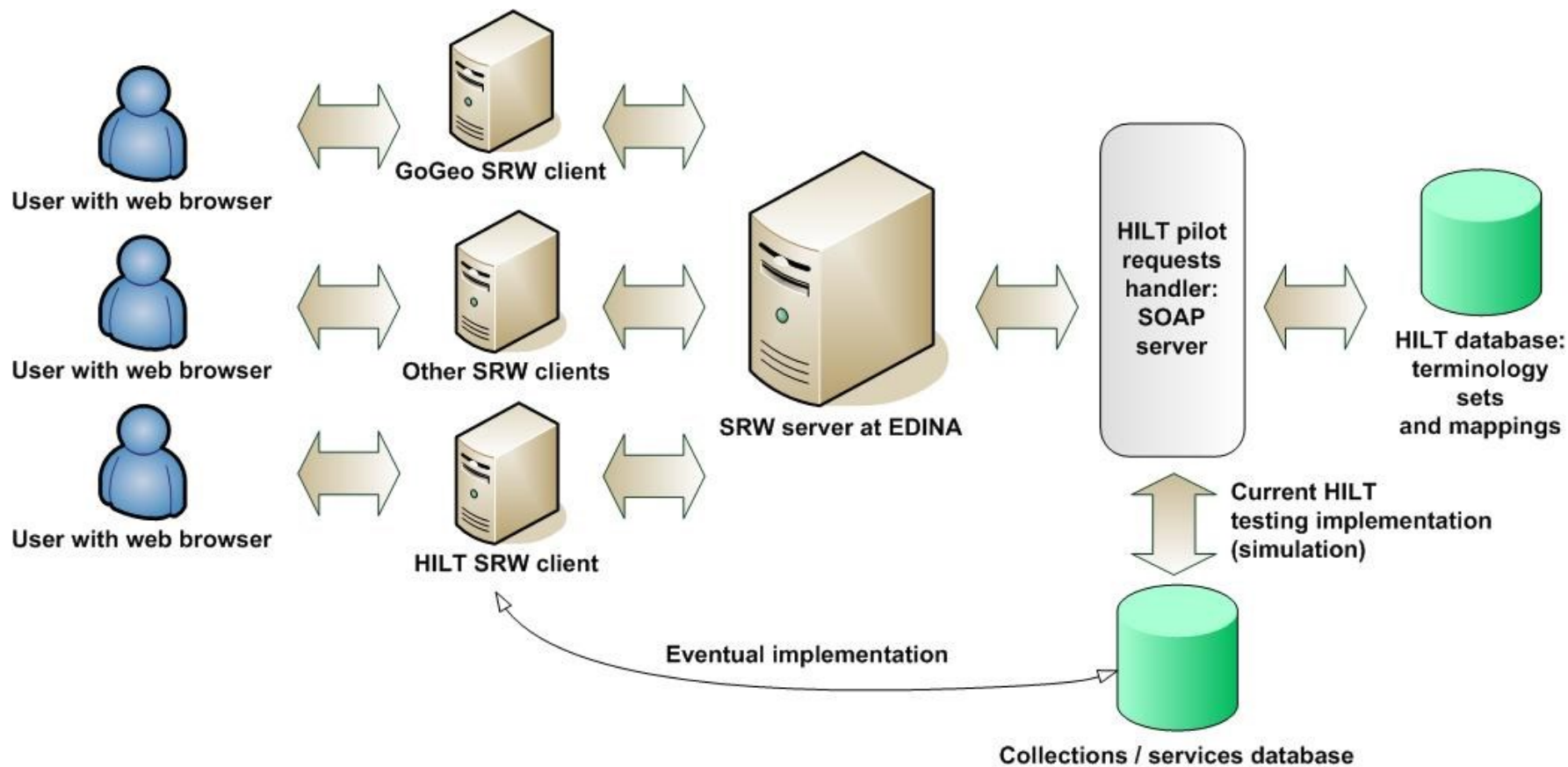
This report documents the use cases being addressed, the nature of the functions designed to meet the use cases, how each part of the system is required to operate when a function is called, methodologies determined to assess the satisfactory performance of functions, and associated results. It is **not** the intention of this evaluation to study the quality of mappings or retrieval performance. Results presented will enable the identification of issues or errors within the system as it is currently implemented (or requirements as currently specified) and any additional requirements for development beyond Phase III will be noted.

It should be noted that elements of the system's development, including performance, conformance to standards and efficacy of programming have been monitored and evaluated by the project team on a regular basis throughout the project lifetime. Technical aspects of the project have also been evaluated on a continuous basis by CDLR and EDINA programming staff. Table 1 summarises how each of the functions relate to the five use cases in HILT Phase III. Note that, in a user session involving more than one use case, the explain function would probably only be used once at the start of the session since it enables configuration of the client service.

Use cases	Functions					
	explain	get_collections	get_all_records	get_ddc_records	get_non_ddc_records	get_filtered_set
1	✓	✓		✓	✓	
2/3	✓					✓
4	✓					✓
5	✓		✓	✓	✓	✓

Table 1: Functions as they feature within use cases

1.2. Architecture

Figure 1: HILT M2M Pilot Architecture

The figure contains the following labels:

User with web browser

User with web browser

User with web browser

GoGeo SRW client

Other SRW clients

HILT SRW client

SRW server at EDINA

HILT pilot requests handler: SOAP server

HILT database: terminology sets and mappings

Current HILT testing implementation (simulation)

Eventual implementation

Collections / services database

Note: Where there is interaction with the collections and services database, it is between any given client and the database. In the current pilot only the HILT SRW client interacts in this way.

1.3   General Methodology

The following methodology will be used to assess whether each part of the system architecture (see Figure 1) operates as specified in the requirements document when any given one of the functions is called.

Verify and record a) the SRW client screen that initiates the function call b) the screen that shows the end results of the function call c) that each step in between the initiation and end results screen operates as specified in the requirements document, so that:

1. The user request is interpreted by an SRW client (a component of the requesting service interface) and this sends a query to the SRW server (a SOAP message that conveys an SRW request that includes a CQL search query).
2. The SRW server parses the query to obtain the search terms, and uses these in a call to the appropriate SOAP server function (the SOAP server translates the request into SQL for querying the database).
3. The response from the database to the SOAP server contains appropriate data (test using a SOAP client[32], not shown in Figure 1) and this is returned to the SRW server wrapped in SKOS, the SKOS Mapping Vocabulary Specification (MVS) and Dublin Core Collection Description Application Profile (DC CD AP), as appropriate; the SRW server returns the data to the SRW client using SOAP.
4. The client service uses the wrapped data to provide a response to the user.

Since the operation of each function differs, the above methodology will be supplemented for each of the six SOAP functions. Additional methodology specific to the testing of each function is detailed in the relevant sections below. Note that the general methodology will not be used in evaluating the explain function, as described in 3.1 below.

2   Use case definitions

2.1   Use case #1

Emulate the Phase II pilot:

- Use the user's search term to identify DDC captions that might cover his or her topic and get user to 'disambiguate' captions (IE identify which does cover his or her topic) (get_ddc_records);
- Use DDC number associated with caption to identify collections that cover the subject area in which the user's topic 'sits' and the subject schemes they use and get user to choose collection to search and, in so doing, identify the subject scheme to use when searching (get_collections);
- Identify term in the scheme in question to use when searching for user's topic;
- Search for it and return hits to user (get_non_ddc_records).

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[32] Note that this is a tool for testing, *not* a normal part of the architecture. See the HILT SOAP client demonstrator at: http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/hiltsoapclient.php

2.2   Use case #2/3

Provide enriched set of search terms that users can use (selectively or otherwise) to improve searches of local service database; includes term expansion, singular/plural mappings, spelling/typos correction (Google 'did you mean?') – (either get_all_records or get_filtered_set).

2.3   Use case #4

Scheme hierarchy browse in 'no hits from HILT' or user/service request situation (get_filtered_set).

2.4   Use case #5

Improved precision use cases, either via browsing scheme hierarchies, disambiguation or specific requests for narrower/related terms (other use cases plus get_filtered_set).

3   Functions

3.1   explain

Function name: explain

Description: A request to return a file holding data on the subject schemes used, the kinds of queries supported, the kinds of terminologies mark-ups offered, and so on, to enable distributed clients to interact with the service.

Methodology: The general methodology described in 1.3, used throughout the rest of the evaluation, will not be used for the explain function. All that needs to be shown for this function is that the SRW server responds to an explain request by returning an explain file that meets the standard for SRW explain in a way relevant to the current instantiation of the HILT pilot. The following steps will be applied here (and only here):

1.   Obtain details of what information should be included in an SRW explain file (http://www.loc.gov/standards/sru/explain/) and determine which of these details are relevant to the current instantiation of the HILT pilot.

2.   Obtain, from a client sending an SRW explain request results of using the SOAP function to populate the file sent back in response to SRW explain request. Check SRW client can send an SRW explain request. Check that response shown on screen to this request meets the details identified under 1 (above)

3.2   get_collections

Function name: get_collections

Description: get_collections classified under a specified DDC number or its stem. This covers requirement 9 as documented in the requirements document. In this instance retrieval is from a separate collections database hosted at the CDLR. Such retrieval in the future will be from the Information Environment Services Registry (IESR) and other similar registries external to JISC as they appear.

Use case: Will normally be used to help satisfy use case #1. In an operational situation, the assumption is that the collections and services database will be the IESR which has its own SRW server so that interaction would be between an SRW client and the IESR SRW server and database. In the HILT pilot, however, the process will be as follows:

1. A DDC number identified during the disambiguation stage is sent from the SRW client service to the SRW server.
2. The SRW server sends an appropriate request for get_collections via the SOAP server.
3. The get_collections function queries the database using successive truncations of the DDC number sent.
4. The SOAP requests handler receives back collections' connection details and scheme information.
5. The SOAP requests handler wraps the results in Dublin Core Collection Description Application Profile (DC CD AP) and sends the results back to the SRW server.
6. The SRW server sends the results back to the client service.
7. The client service processes the results to offer the user a set of collections relevant to their query.

Methodology: The general methodology (1.3) will be used to evaluate the above scenario, supplemented with the stages below.

1. Since there is no requirement for random selection, the identification of a suitable DDC number (300) was purposive, based on known collections database content. Obtain copy of messages sent from and to the SRW client and SRW server.
2. Illustrate 1) collections returned for DDC number 300; 000 and 700 will also be input to assess the reliability of the get_collectiosn functions, and, 2) collections returned that match truncated DDC numbers if there are no hits in the collection database directly matching the inputted number. Such output will be verified by a summary of known collection database content and assigned DDC numbers (see Table 3). The SOAP client will then be examined to ensure the requested DDC number retrieves the known collection information (including URL, connection information details and scheme information) and that such information is wrapped appropriately (IE in DC CD AP). This output will be copied for verification purposes and documented in the findings section. Screen shots will also be provided for those tests designed to demonstrate the truncation of DDC numbers (see below for further details).

Known collections database content. Table 2 below provides details of collections (e.g. number of collections/services, their name, and with which DDC number they are associated) by the DDC ten main classes. Although the collections database contains numerous collections and services classified to many numbers after the decimal point, it is convenient to test collections classified in the ten main classes since the purpose of the current study is to evaluate system processes only, irrespective of the number entered. 000 (Generalities) is included to demonstrate 'no hits'.

DDC number	Number of collections associated with DDC number	Description of associated collection(s) in database

000	0	- No hits -
100	1	BUBL LINK: Philosophy
200	1	BUBL LINK: Religion
300	3	Euro-barometer Survey Series; SOSIG; UK Data Archive
400	1	BUBL LINK: Language
500	2	Natural Selection; Web of Science
600	1	BUBL LINK: Technology
700	2	ADAM: Art, Design, Architecture and Media; VADS: Visual Arts Data Service
800	1	BUBL LINK: Literature
900	2	HDS: History Data Service; History Online

Table 2: DDC numbers according to the ten main classes and their associated collection(s) from the HILT collections database
Note: Recall that DDC number 300 was used for testing. Other DDC numbers in the ten main classes have been provided to enable external verification. Also note that since the number used for the first stage of the get_collections evaluation is in the ten main classes, truncation is not being tested since it will not be invoked for these numbers.

Truncation in get_collections: As noted in point 2 of the methodology above, it is necessary to test that get_collections - aside from retrieving the correct database content in response to a corresponding DDC number – truncates DDC numbers correctly when no match is found against the input number or where low recall is experienced. Table 3 (below) provides details of collections (e.g. number of collections/services, their name, and the DDC number with which they have been classified). Since each of these DDC numbers only has one collection associated with it, HILT should truncate the extended number input (column 5) to provide details of this collection, but also (via truncation) other related collections where they exist. Known related collections identified in the database via manual truncation are noted in column 4.

1	2	3
Number inputted to demonstrate truncation	**Description of associated collection(s) in database (retrieved following initial truncation)**	**Related collection(s) in database with associated DDC number (retrieved following subsequent truncations)**
620.2	EEVL (620)	Not Applicable (no truncation beyond 620)
912.411	Digimap (912.41)	BUBL LINK: Maps (912); BUBL LINK: Geography (910)
780.79422	PATRON: Performing Arts Teaching Resources Online (780.7)	BUBL LINK: Music (780)

Table 3: DDC numbers according and their associated collection(s) from the HILT collection and services database, and known related collections (derived via truncation)

3.3 get_all_records

Function name: get_all_records

Description: Retrieves records that include – or are mapped to records that include – the term or term phrase specified.

Use case: This function covers requirement 10 as documented in the requirements document and satisfies aspects of use case #1, where it can perform the combined functions of get_ddc_records and get_non_ddc_records. It works as follows:

1. User enters term via the embedded SRW client service, and a resultant request is sent to the SRW server.
2. The SRW server parses the request to obtain search terms and uses these to call the SOAP get_all_records function.
3. The get_all_records function queries the database to find (1) all DDC records that either include the user term or that are mapped to from other non-DDC records that include the term (2) all non-DDC records mapped from the DDC records retrieved under (1) and returns these records to the SOAP server.
4. The SOAP requests handler wraps the results in SKOS Core with the SKOS Mapping Vocabulary Specification (MVS) and sends the results to the SRW server.
5. The SRW server sends the results back to the client service.
6. The client service processes the results to offer DDC and non-DDC records to the user.

Methodology: The general methodology (1.3) will be used to evaluate the above scenario, supplemented with the stages below.

1. Earlier in Phase III, 30 (approx.) concepts were mapped to the DDC spine from a number of terminologies to enable testing and development of the GoGeo! SRW client. To ensure a valid evaluation, terms were selected from this group because they were mapped to DDC from a number of schemes. Five terms were randomly identified for testing purposes. Those terms were as follows:

    - *Environmental impacts* (GCMD)
    - *Shore protection* (DDC)
    - *Plant genetics* (HASSET)
    - *Civil emergencies* (IPSV)
    - *Land use site* (NMR)

    Details of the selected existing mappings for the above terms are detailed in Table 4. Occurrence of these terms within the SOAP client demonstrator output will prove that the function is operating as originally specified. To ensure that indirectly mapped terms are being retrieved, equivalent terms from other terminologies are used. These can be seen in Table 4.

DDC number	DDC caption	GCMD	NMR	HASSET	IPSV
363.73	Pollution	**Environmental impacts**	-	Pollution	Pollution
627.58	**Shore protection**	Erosion	-	Coastal	Coastal erosion and

				protection	protection
631.53	Plant propagation	Plant breeding and genetics	-	**Plant genetics**	-
363.34	Disasters	Natural hazards	-	Hazards, accidents and disasters	**Civil emergencies**
333	Economics of land and energy	Land use/Land cover	**Land use site**	Land use	Planning (town and country)

Table 4: Selected terms, with mappings

2. Verify that a) terms matching user term are returned, b) mapped terms, where applicable, from a number of schemes are returned. Such output will be verified by a summary of known mappings (see Table 4). The SOAP client will then be examined to ensure the requested term (IE plant genetics) receives the known mappings from other schemes and that such information is wrapped appropriately (IE in SKOS Core). This output, which should include DDC numbers, mapped terms with source scheme information and mapping match type (type of equivalence) details will be copied for verification purposes and documented in the findings section.

3.4 get_ddc_records

Function name: get_ddc_records

Description: Retrieves any DDC record that either includes the terms specified, or that is mapped to by a record that includes the terms specified.

Use case: This function meets requirement 11 of the requirements document and satisfies aspects of use case #1, but could be deployed in other contexts.

- User enters term via embedded SRW client service, and a resultant request is sent to the SRW server.
- The SRW server parses the request to obtain search terms and uses these in a call to the SOAP get_DDC_records function.
- The get_DDC_records function queries the database for DDC records that include the user term entered or that are mapped to by non DDC records that include the term.
- The SOAP requests handler receives DDC numbers and associated DDC captions, wraps the results in SKOS Core, and sends them back to the SRW server.
- The SRW server sends the results back to the client service.
- The client service processes the results to offer the user terms possibly relevant to their query from DDC with corresponding DDC numbers.

Methodology: The general methodology (1.3) will be used to evaluate the above scenario, supplemented with the stages below. The SOAP client demonstrator will be interrogated using the same test terms as in 3.3 (get_all_records). To prove the function is searching both DDC records directly and records mapped to DDC, terms taken from DDC and other schemes will be searched for.

1. Illustrate that terms returned in response to a term entered are entirely instances of that term found within DDC. DDC captions, together with corresponding numbers should be returned. Such output will be verified by comparing results with known DDC captions and terms from other schemes mapped to DDC, as detailed in Table 4. If when searching for a non DDC term, a DDC number and caption are returned, this information is being retrieved via a mapping. The SOAP client will then be examined to ensure the requested DDC records are wrapped appropriately (IE in SKOS Core). This output will be copied for verification purposes and documented in the findings section.

3.5 get_non_ddc_records

Function name: get_non_ddc_records

Description: Retrieves any non-DDC record that includes a mapping to the DDC number sent. That is, the system retrieves records from other schemes (non-DDC) that have been mapped to an input DDC number. Only the non-DDC records mapped to the DDC number sent are retrieved.

Use case: This function meets requirement 12 of the requirements document and satisfies aspects of use case #1, as follows:

- User chooses DDC number on screen and embedded SRW client service sends an appropriate request to the SRW server.
- The SRW server parses the request and sends an appropriate query to the SOAP get_non_DDC_records function.
- The get_non_DDC_records function searches the database to find non-DDC records containing a mapping to the DDC number sent and returns the results to the SOAP server.
- The SOAP server wraps the results in SKOS Core and SKOS MVS and returns them to the SRW server.
- The SRW server sends the results back to the client service; results comprise DDC number entered, terms from other schemes mapped to that DDC number, with the name of the scheme and match type information defining the relationship between a scheme's term and the DDC number entered.
- The client service processes the results and provides the user (via the service interface) with information on which term to use for individual schemes used by individual JISC collections.

Methodology: The general methodology (1.3) will be used to evaluate the above scenario, supplemented with the stages below. To retain consistency throughout the evaluation, DDC numbers detailed in Table 4 will be used to test this function. Each DDC number will be entered in turn. Results should indicate that mapped terms, with corresponding scheme information, are returned in response to a query for the DDC number to which they are mapped. No DDC captions should be returned in this instance.

1. Illustrate that results comprise mapped terms from all schemes (see Table 4 to verify results are as expected). The only DDC information that should be presented within this results set is the initial number input and its corresponding caption. Such output will be verified by ensuring all mapped terms in

Table 4 are returned in response to a query for a DDC number. The SOAP client will then be examined to ensure the requested non-DDC records are wrapped appropriately (IE in SKOS Core, using MVS). This output will be copied for verification purposes and documented in the findings section.

3.6   get_filtered _set

Function name: get_filtered_set

Description: Retrieves records that meet the specified parameters; that is, the search term entered but 'filtered' by scheme name(s) and /or field name(s). Functionality to filter a search by scheme, and/or to search preferred and non-preferred terms will be in-built.

Use case: This function meets requirement 13 of the requirements document and satisfies aspects of use cases #2, 3, 4 and 5, but could be deployed in other contexts. It operates as follows:

- User enters term via embedded SRW client service, and a resultant request is sent to the SRW server.
- The SRW server parses the request and uses the results to send an appropriate query to the SOAP get_filtered_set function.
- The get_filtered_set function queries the database for records that match the terms and the specified filters and the results are sent back to the SOAP server.
- The SOAP server wraps the results in SKOS Core and returns them to the SRW server.
- The SRW server sends the results back to the client service; results comprise terms together with information about each term's source scheme, notation (DDC) or ID (other schemes), and broader, narrower and related terms, where applicable.
- The client service processes the results to provide the service interface with terms from specific schemes relevant to the query and with any relevant additional data on the terms (e.g. related terms).

Methodology: The general methodology (1.3) will be used to evaluate the above scenario, supplemented with the stages below. Again to retain consistency throughout the evaluation, Table 4 will form the basis of the testing of the get_filtered_set function to ensure use cases are met. A single term (extracted from Table 4) for which equivalences across four schemes are known will be used, as detailed in Table 5. get_filtered_set can be used to search for preferred and/or non-preferred terms and/or related for a given concept directly within any scheme, providing details of broader, narrower and related terms. Each term recorded in Table 5 will be searched for in turn, varying the scheme parameter (to that in which we know the term appears) by which to filter results sets in each case. Results should include information on broader, narrower and related terms for the given preferred term, as well as corresponding non-preferred terms. Such results will be verified using the predetermined data in Table 5.

1. Illustrate that results comprise terms from selected schemes. The SOAP client will then be examined to ensure the requested records are wrapped appropriately (IE in SKOS Core). This output will be copied for verification purposes and documented in the findings section.

Filter	DDC caption	GCMD	NMR	HASSET	IPSV
Preferred terms	Economics of land and energy	Land use/Land cover	Land use site[33]	LAND USE	Planning (town and country)
Broader term	Economics of labor, finance, land, energy	Human Dimensions	-	LAND	Land and premises
Narrower term	Philosophy and theory; Standard subdivisions*; Theories; Land surveys; Ownership of land; Natural resources and energy	Land Management; Land Tenure; Land Use Classes	-	N/A	Planning applications; compulsory purchase; Green belts; Structure plans; Town planning; District planning; Rural planning; Unitary development plans; Minerals local plan; Residential planning; Zoning; Street numbering and naming; Regional planning; Planning appeals; Urban development; Waste local plan; Planning regulations
Non-preferred term	-	-	Land use site	IDLE LAND	Property planning (land or buildings); Planning (land use); Development control; Building planning; Planning enforcement; Sites and projects policies (planning): Planning policy; Land use planning; Planning control; Local plans (land use); Development (planning applications)
Related term	-		-	AGRICULURAL LAND; ENVIRONMENTAL PLANNING; LAND ECONOMICS; LAND RESOURCES; LAND TYPES; PUBLIC ACCESS RIGHTS	Urban communities; Rural communities; town centre management; Community development; Civic societies;

* DDC subdivisions

Table 5: Selected terms, with details of broader, narrower and related terms. Non-preferred terms are also listed.

A second element to test is multiple scheme selection. Where more than one scheme is selected using the get_filtered_set function, relevant information should be returned for all schemes selected (where it is available). This should include preferred, non-preferred and related terms where appropriate. To assess the functionality of get_filtered_set the example in Table 6 will be used. The term 'Plant genetics' will be entered and all five schemes in Table 6 will

---

[33] While running the evaluation it was discovered that 'Land use site' is no longer a valid term within NMR therefore this term will be omitted from the test for get_filtered_set. The effect of omitting this test term is thought to be minimal since it had no broader or narrower terms, and no related or non-preferred terms.

be selected. Results should be returned for HASSET and GCMD within a single SKOS record; but not for DDC, IPSV, GCMD or NMR since the submitted search term does not feature in these terminologies. Additional detail (broader terms, etc), matching those shown in Table 6, should also be provided.

Filter	DDC caption	GCMD	NMR	HASSET	IPSV
Preferred terms	Plant propagation (631.53)	Plant breeding and genetics	-	PLANT GENETICS	-
Broader term	Cultivation and harvesting (631.5)	Agricultural Plant Science; Agriculture	-	BIOLOGY; BOTANY; GENETICS	-
Narrower term	Propagation from seeds (Sowing)(631.531); Propagation from bulbs and tubers (631.532); Propagation from suckers, runners, buds (631.533); Propagation by layering (631.534); Propagation from cuttings and slips (631.535); Transplanting (631.536)	-	-	-	-
Non-preferred term	-	-	-	PLANT BREEDING; PLANT REPRODUCTION	-
Related term	-	-	-	GENETICALLY MODIFIED CROPS	-

Table 6: Selected terms, with details of broader, narrower and related terms. Non-preferred terms are also listed.

A third aspect to test is filtering by preferred and non-preferred terms. These filters will be selected and deselected in turn to illustrate that non-preferred terms can be retrieved; such a search should provide the corresponding preferred term in each case. The accuracy/completeness of non-preferred terms returned will be verified by the output of an SQL query requesting non-preferred terms of a known preferred term within the HILT database. Table 6 will be used for this. Preferred terms from each scheme will be entered in turn, filtered by the source scheme only, with a request to search non-preferred terms only. The reverse will then be conducted (where applicable).

4   Results

This section documents the results of the testing detailed in section 3. Recall that the general methodology was used for most functions, supplemented with function-specific methodologies. Please note:

- Calling the SOAP server from the SRW client and the way in which client parses CQL functions does not alter between functions. As such, code for these steps in the general methodology is only reproduced once.
- Where code is largely identical within any one function (only differing, for example, in search value (DDC number or search term)) code will only be reproduced once.
- Where appropriate, lengthy SKOS records have been truncated to aid readability.
- Some lines of code have been modified in order to remove information which could potentially (if used by external agents) compromise HILT system components. In all cases this has simply meant replacing database names, table names, connection details, etc. with 'dummy' equivalents. This does not affect code validity.

4.1   explain

HILT is using a basic ZeeRex[34] explain record for the SRW server. Details obtained of what comprises an explain file are quoted below.

"…an XML document with an <explain> element at the top level, a <serverInfo> element within it, and <host>, <port> and <database> elements within that, containing the hostname, IP port number and database name respectively of a Z39.50 database which may be on the same server as the ZeeRex record or a different one … In addition to the <serverInfo> section also found in F&N records, full records *may* also include the following sections:

- `<databaseInfo>`: contains human-readable information about the database: its title, a description, the address of a contact person, etc.
- `<metaInfo>`: information about the ZeeRex record itself: when it was created or last modified, when it was aggregated if at all, etc.
- `<indexInfo>`: information about how to search in the database: which indexes exist and what combinations of attributes may be used to search against them, which indexes can be used for sorting, scan, etc.
- `<recordInfo>`: information about which record syntaxes the database can serve records in, and which element sets are supported"[35].

In the current instantiation of the HILT pilot, the following is returned in response to a call for the explain function:

---

[34] ZeeRex: http://explain.z3950.org/
[35] ZeeRex: An Overview, Sections 3.1 and 3.2. Available: http://explain.z3950.org/overview/index.html

```
<zs:explainResponse>
        <zs:version>1.1</zs:version>
                <zs:record>
                <zs:recordSchema>http://explain.z3950.org/dtd/2.0/</zs:recordSchema>
                <zs:recordPacking>xml</zs:recordPacking>
                <zs:recordData>
                        <explain>
                                <serverInfo protocol="SRW/U" transport="http">
                                        <host>bodach.ucs.ed.ac.uk</host>
                                        <port>18111</port>
                                        <database>hilt</database>
                                </serverInfo>
                                <databaseInfo>
                                        <title primary="true">HILT</title>
                                        <description/>
                                        <author>CDLR, University of Strathclyde</author>
                                        <contact>http://cdlr.strath.ac.uk/</contact>
                                </databaseInfo>
                                <indexInfo>
                                        <set name="hilt"/>
                                        <index search="true">
                                                <title>Get Collections</title>
                                                <map>
                                                        <name set="hilt">get_collections</name>
                                                </map>
                                        </index>
                                        <index search="true">
                                                <title>Get All Records</title>
                                                <map>
                                                        <name set="hilt">get_all_records</name>
                                                </map>
                                        </index>
                                        <index search="true">
                                                <title>Get Ddc Records</title>
                                                <map>
                                                        <name set="hilt">get_ddc_records</name>
                                                </map>
                                        </index>
                                        <index search="true">
                                                <title>Get Non Ddc Records</title>
                                                <map>
                                                        <name set="hilt">get_non_ddc_records</name>
                                                </map>
                                        </index>
                                        <index search="true">
                                                <title>Get Filtered Set</title>
                                                <map>
                                                        <name set="hilt">get_filtered_set</name>
```

```
                                        </map>
                                </index>
                                <index search="true">
                                        <title>Get Parents</title>
                                        <map>
                                                <name set="hilt">get_parents</name>
                                        </map>
                                </index>
                                <index search="true">
                                        <title>Get Children</title>
                                        <map>
                                                <name set="hilt">get_children</name>
                                        </map>
                                </index>
                                <index search="true">
                                        <title>Explain</title>
                                        <map>
                                                <name set="hilt">explain</name>
                                        </map>
                                </index>
                        </indexInfo>
                        <schemaInfo>
                                <schema identifier="http://www.w3.org/2004/02/skos/core#"/>
                        </schemaInfo>
                        <configInfo>
                                <default type="contextSet">hilt</default>
                                <supports type="resultSets"/>
                        </configInfo>
                </explain>
        </zs:recordData>
    </zs:record>
</zs:explainResponse>
```

4.2   get_collections

The SRW client sends a query to the SRW server. Our test uses DDC numbers 300, 000 and 700 in the first instance; then 620.2, 912.411 and 780.79422 for truncation testing. Since the code used to execute this query remains constant irrespective of the number input, this code has only been provided once. The code below details a query for DDC 300:

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");

my $query ='hilt.get_collections=300';
my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

```perl
use HILT::CQL::Parser;
use HILT::Client::SOAP;

my @obj_fields = qw(cql client);
our $functions;
our $parameters;
our $parameter_defaults;
our @parameter_list;
our $serverChoice;
our $AUTOLOAD;

# set the $paramater_list to be all those listed in $parameters values.
BEGIN {
  $functions = [ @HILT::Client::SOAP::METHODS ];
  $parameters = {
    %HILT::Client::SOAP::PARAMS
  };
  $parameter_defaults = {
    %HILT::Client::SOAP::PARAM_DEFAULTS
  };
  my %tmp_hash = ();
  for my $key (keys(%$parameters)) {
    my @list = @{$parameters->{$key}};
    @tmp_hash{@list} = (1) x @list;
  }
  @parameter_list = keys(%tmp_hash);
  $serverChoice = "get_all_records";
}

# ...
sub translate {
  my ($self, %hash) = @_;
  my $cql = $hash{cql}||$self->cql();
  my $client = $hash{client}||$self->client();

  my $parser = HILT::CQL::Parser->new();
  my ($qualifiers,$terms,$operators) = $parser->parse($cql);

  my @results = ();

  my %given_params = ();
  @given_params{@parameter_list} = map([],@parameter_list);
  my @calls = ();

  for (my $i = 0; $i <= $#{@$qualifiers}; $i++) {
    my $qualifier = $qualifiers->[$i];
    my $term = $terms->[$i];
```

```perl
    my $namespace = "hilt";
    my $function = $serverChoice;
    if ($qualifier =~ m/(.*)\.(.*)/) {
      $namespace = $1;
      $function = $2;
    } else {
      $function = $qualifier;
    }

    if ($namespace eq "srw" and $qualifier eq "serverChoice") {
      $namespace = "hilt";
      $qualifier = $serverChoice;
    }

    if ($namespace eq "hilt") {
      #gather parameters
      if (grep ($function eq $_,@parameter_list)) {
        push(@{$given_params{$function}},$term);
      } else {
      # gather functino calls
        push(@calls,[$function,$term]);
      }

    }

  }

  for my $pair (@calls) {
    my ($function,$term) = @$pair;
    my $result;
    if (exists($parameters->{$function})) {
      my @set_params = @{$parameters->{$function}};
      my %hash = (shift(@set_params) => $term);
      for my $param (@set_params) {
        my $default = $HILT::Client::SOAP::PARAM_DEFAULTS{$param};
        my $given = $given_params{$param};
        if (ref($given) eq "ARRAY" and $#{@$given} >= 0) {
# $given is always an array ref, but it a scalar might be needed.
          if (ref($default) eq ref($given)) {
            $hash{$param} = $given;
          } else {
            $hash{$param} = @$given[0];
          }
        } else {
          $hash{$param} = $default;
        }
      }
      $result = $client->${function}(%hash);
```

```
        } else {
          $result = $client->${function}($term);
        }

        if ($result =~ m/<.*>/) {
          push(@results,$result);
        } else {
          warn("SOAP RESPONSE: $result\n");
        }
    }

    return @results;
}
# ...
```

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

```
# ...
use vars(qw($AUTOLOAD $PACKAGE $URI $PROXY $AUTOTYPE $READABLE @SCHEMES
@METHODS %PARAMS %PARAM_DEFAULTS %PARAM_SEP));

@METHODS = qw(
    get_collections
    get_all_records
    get_DDC_records
    get_non_DDC_records
    get_filtered_set
    get_parents
    get_children
    explain
    );
@SCHEMES = qw(AAT DDC GCMD HASSET IPSV LCSH MeSH NMR SPEIR UNESCO);
# All params for the following methods should be set for a SOAP call.
# If they are not set from the PARAM_DEFAULTS then they are mandatory
for the client to set.
# The first parameter is the CQL "term" (or equivalent).
%PARAMS = (
    get_filtered_set => [ qw(term scheme preferred related non_preferred
is_id) ],
    get_children => [ qw(id scheme) ],
    get_parents => [ qw(id scheme) ],
    );
%PARAM_DEFAULTS = (
    scheme => [@SCHEMES],
    preferred => "true",
    related => "true",
    non_preferred => "true",
    is_id => "false",
```

```perl
    );
%PARAM_SEP = (_default=>":");

$PACKAGE = '';
$URI     = "http://tempuri.org/$PACKAGE";
$PROXY   = "http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/soapserver.php";

# ...
# this AUTOLOAD sub deals with most of the SOAP calls.
# to add a new one, add to the @METHODS list above.
sub AUTOLOAD {
  my $self = shift;
  my ($class, $method) = ($AUTOLOAD =~ m/(.*::)?(\w+)$/);
  $class =~ s/::$//;

  die("$method not defined for $class") unless grep($_ eq $method,
@METHODS);

  my @soapArgs;
  # deal with methods that require parameters
  if (exists($PARAMS{$method})) {
    my %hash = @_;
    if ($hash{args}) {
      @soapArgs = @{$hash{args}};
    } else {
      @soapArgs = ();
      for my $param_name (@{$PARAMS{$method}}) {
        my $param_val = defined($hash{$param_name})?
          $hash{$param_name}:$PARAM_DEFAULTS{$param_name};

        die("must pass '$param_name' parameter to $method()") unless
defined($param_val);
        # deal with array refs passed in
        if (ref($param_val) eq "ARRAY") {
          my $sep = defined($PARAM_SEP{$param_name})?
            $PARAM_SEP{$param_name}:$PARAM_SEP{_default};
          $param_val = join($sep,@$param_val);
          warn("param_val=$param_val\n");
        }
        push(@soapArgs,$param_val);
      }
    }
  } else {
    @soapArgs = @_
  }

  $self->som($self->soap()->${method}(@soapArgs));
  return ($self->result_as_xml());
}
```

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```
# ...
```

Response from database to the SOAP server is returned to the SRW server wrapped in DC CD AP and forwarded to the SRW client. Given that there is knowledge of database content, results returned were checked against Table 2 (as detailed in 3.2). Tests using 300, 000 and 700 were successful and correct database content was retrieved. Copies of the returned query results (wrapped in DC CD AP) are detailed below.

Collections returned for DDC number 300:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:31:51 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 5509

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<metadata
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:dcmitype="http://purl.org/dc/dcmitype/"
xmlns:iesr="http://iesr.ac.uk/terms/#usesControlledList"
xmlns:cld="http://purl.org/cld/terms/">
<dcmitype:Collection>
        <dc:title>Euro-barometer Survey Series</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.data-archive.ac.uk/findingData/snDescription.asp?sn=4392</dc:identifier>
        <dcterms:abstract>Surveys designed to measure public awareness of, and attitudes toward, the Common Market and other European Community
institutions; and, since 1974, to provide a regular monitoring of the social and political attitudes of the publics of the member
nations.</dcterms:abstract>
        <dc:creator>University of Essex</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">300</dc:subject>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">HASSET</iesr:usesControlledList>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">UNESCO</iesr:usesControlledList>
        <cld:isAccessedVia>http://www.data-archive.ac.uk/search/indexSearch.asp?ct=xmlKeywords&amp;amp;q1=</cld:isAccessedVia>
</dcmitype:Collection>
<dcmitype:Collection>
```

```
        <dc:title>SOSIG</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.sosig.ac.uk/</dc:identifier>
        <dcterms:abstract>A free Web-based portal to Internet resources worldwide supporting learning and research. Search or browse the
Internet Catalogue for thousands of resources, hand-picked, described and classified by subject specialists. Undertake wider searches with the
Social Science Search Engine and find departments, courses, conferences and like-minded colleagues on the SOSIG Grapevine. My Account offers
email updates, news channels and publication of your research profile. SOSIG provides the Social Science, Business and Law hub for the RDN.
Freely available.</dcterms:abstract>
        <dc:creator>SOSIG, intute</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">300</dc:subject>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">APA</iesr:usesControlledList>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">CareData</iesr:usesControlledList>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">HASSET</iesr:usesControlledList>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">IBSS</iesr:usesControlledList>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">LIR</iesr:usesControlledList>
        <cld:isAccessedVia>http://www.sosig.ac.uk/roads/cgi-
bin/search.pl?attrib1=ANY&amp;&amp;boolean=and&amp;&amp;ranking=on&amp;&amp;referrals=on&amp;&amp;stemming=on&amp;&amp;maxserver=8&amp;&amp;method=any&
amp;&amp;view=batched&amp;&amp;bsize=10&amp;&amp;categories=on&amp;&amp;templatetype=all&amp;&amp;highlight=on&amp;&amp;database=SOSIG+ZPlugin&amp;&amp;
term1=</cld:isAccessedVia>
</dcmitype:Collection>
<dcmitype:Collection>
        <dc:title>UK Data Archive</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.data-archive.ac.uk/</dc:identifier>
        <dcterms:abstract>Catalogue of social science data held by the Data Archive at the University of Essex, including the subject areas of
economics, education, employment and labour, environment, conservation and land use, government, leadership and elites, health, health services
and medical care, history, housing, industry and management, international systems, relationships and events, media, communication and language,
political behaviour and attitudes, population, vital statistics and censuses, psychology, reference and instructional, science and technology,
social issues, attitudes and behaviour, social structure and stratification, and travel and transport.</dcterms:abstract>
        <dc:creator>University of Essex</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">300</dc:subject>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">UNESCO</iesr:usesControlledList>
        <cld:isAccessedVia>http://www.data-archive.ac.uk/search/indexSearch.asp?ct=xmlKeywords&amp;&amp;q1=</cld:isAccessedVia>
</dcmitype:Collection>
</metadata>
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Collections returned for DDC number 000 (note that 'no hits' was the expected result for 000):

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:53:18 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
```

```
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 616


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
No match found
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Collections returned for DDC number 700:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:54:19 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 2611


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<metadata
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:dcmitype="http://purl.org/dc/dcmitype/"
xmlns:iesr="http://iesr.ac.uk/terms/#usesControlledList"
xmlns:cld="http://purl.org/cld/terms/">
<dcmitype:Collection>
        <dc:title>ADAM: Art, Design, Architecture and Media</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.adam.ac.uk/</dc:identifier>
```

```
        <dcterms:abstract>Information gateway to quality assured Internet resources for the general areas of art, design, architecture, and
media.</dcterms:abstract>
        <dc:creator>Surrey Institute of Art and Design</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">700</dc:subject>
        <iesr:usesControlledList xsi:type="iesr:CtrldVocabsList">AAT</iesr:usesControlledList>
</dcmitype:Collection>
<dcmitype:Collection>
        <dc:title>VADS: Visual Arts Data Service</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://vads.ahds.ac.uk/</dc:identifier>
        <dcterms:abstract>VADS provides the UK higher education community with access to digital research data appropriate for re-use, by
building an on-line archive of electronic resources created by and of use to the visual arts community. These resources will adhere to agreed
standards of best practice for the creation, management, preservation and access of electronic information.</dcterms:abstract>
        <dc:creator>VADS, Surrey Institute of Art and Design University College</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">700</dc:subject>
</dcmitype:Collection>
</metadata>
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Testing of truncation was also undertaken using additional DDC numbers. Given that there is knowledge of database content, results returned were checked against Table 3 (as detailed in 3.2). Tests using 620.2, 912.411 and 780.79422 were successful. Appropriate database content was retrieved and truncation was confirmed as functioning properly. Copies of the returned query results (wrapped in DC CD AP) are detailed below.

Collections returned using 620.2 employing truncation:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:56:53 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 2065

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
```

```
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<metadata
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:dcmitype="http://purl.org/dc/dcmitype/"
xmlns:iesr="http://iesr.ac.uk/terms/#usesControlledList"
xmlns:cld="http://purl.org/cld/terms/">
<dcmitype:Collection>
        <dc:title>EEVL</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.eevl.ac.uk/</dc:identifier>
        <dcterms:abstract>Provides quick and reliable access to the best engineering (including chemical and material engineering),
mathematics, and computing information available on the Internet. Services include an online catalogue of Internet resources that have been
selected, evaluated and classified by subject specialists. The resources include bibliographic, reference and research information, software and
home pages of key organisations. The EEVL service, one of the hubs of the RDN, also provides a number of additional information services,
including targeted engineering search engines and bibliographic databases.  Freely available.</dcterms:abstract>
        <dc:creator>Heriot Watt University</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">620</dc:subject>
</dcmitype:Collection>
</metadata>
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Collections returned using 912.411 employing truncation:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:45:50 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 2994

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<metadata
```

```
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:dcmitype="http://purl.org/dc/dcmitype/"
xmlns:iesr="http://iesr.ac.uk/terms/#usesControlledList"
xmlns:cld="http://purl.org/cld/terms/">
<dcmitype:Collection>
        <dc:title>Digimap</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://edina.ac.uk/digimap/</dc:identifier>
        <dcterms:abstract>Project aiming to provide access to Ordnance Survey digital data as electronic maps, enabling users to produce paper
copies of the maps or download digital map data to a local computer. The experimental service is only available to registered users at six
institutions.</dcterms:abstract>
        <dc:creator>Edinburgh University</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">912.41</dc:subject>
</dcmitype:Collection>
<dcmitype:Collection>
        <dc:title>BUBL LINK: Maps</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://bubl.ac.uk/link/</dc:identifier>
        <dcterms:abstract>Catalogue of selected Internet resources.</dcterms:abstract>
        <dc:creator>BUBL Information Service</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">912</dc:subject>
        <cld:isAccessedVia>http://hilt.cdlr.strath.ac.uk/bublsearch/bubl.cfm?queryString=</cld:isAccessedVia>
</dcmitype:Collection>
<dcmitype:Collection>
        <dc:title>BUBL LINK: Geography</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://bubl.ac.uk/link/</dc:identifier>
        <dcterms:abstract>Catalogue of selected Internet resources.</dcterms:abstract>
        <dc:creator>BUBL Information Service</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">910</dc:subject>
        <cld:isAccessedVia>http://hilt.cdlr.strath.ac.uk/bublsearch/bubl.cfm?queryString=</cld:isAccessedVia>
</dcmitype:Collection>
</metadata>
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Collections returned using 780.79422 employing truncation:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 04 Dec 2006 14:58:10 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
```

```
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 2460


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_collectionsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<metadata
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:dcmitype="http://purl.org/dc/dcmitype/"
xmlns:iesr="http://iesr.ac.uk/terms/#usesControlledList"
xmlns:cld="http://purl.org/cld/terms/">
<dcmitype:Collection>
        <dc:title>PATRON: Performing Arts Teaching Resources Online</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://www.lib.surrey.ac.uk/Patron/Patron.htm</dc:identifier>
        <dcterms:abstract>PATRON is a pilot project to develop a multimedia electronic library system to deliver on-demand digital audio,
video, scores and text in the areas of music and dance across high-speed broadband networks to the desktop. The project is driven by the need to
improve access to audio, video and scores in the library.</dcterms:abstract>
        <dc:creator>University of Surrey</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">780.7</dc:subject>
</dcmitype:Collection>
<dcmitype:Collection>
        <dc:title>BUBL LINK: Music</dc:title>
        <dc:identifier xsi:type="dcterms:URI">http://bubl.ac.uk/link/</dc:identifier>
        <dcterms:abstract>Catalogue of selected Internet resources.</dcterms:abstract>
        <dc:creator>BUBL Information Service</dc:creator>
        <dc:type xsi:type="dcterms:DCMIType">Collection</dc:type>
        <dc:subject xsi:type="dcterms:DDC">780</dc:subject>
        <cld:isAccessedVia>http://hilt.cdlr.strath.ac.uk/bublsearch/bubl.cfm?queryString=</cld:isAccessedVia>
</dcmitype:Collection>
</metadata>
</item>
</return>
</ns1:get_collectionsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

4.3   get_all_records

The SRW client sends a query to the SRW server. Testing uses five terms from different terminologies (as detailed in the supplementary methodology in 3.3). Those terms are as follows: *Environmental impacts* (GCMD), *Shore protection* (DDC), *Plant genetics* (HASSET), *Civil emergencies* (IPSV), *Land use site* (NMR). The code used by the client is as follows (note that connection information remains the same and has only been reproduced once):

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");

my $query = 'hilt.get_all_records= "environmental impacts"';
my $rs=$conn->search(new ZOOM::Query::CQL($query));

my $query = 'hilt.get_all_records= "shore protection"';
my $rs=$conn->search(new ZOOM::Query::CQL($query));

$query = 'hilt.get_all_records= "plant genetics"';
$rs=$conn->search(new ZOOM::Query::CQL($query));

$query = 'hilt.get_all_records= "civil emergencies"';
$rs=$conn->search(new ZOOM::Query::CQL($query));

$query = 'hilt.get_all_records= "land use"';
$rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

See reproduction of this step in section 4.2.

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

See reproduction of this step in section 4.2.

Response from database to the SOAP server is returned to the SRW server wrapped in SKOS Core and using the SKOS MVS, and forwarded to the SRW client. Given that there is knowledge of database content, results returned were checked against Table 4 (as detailed in 3.3).

Tests using the selected terms were successful and appropriate database content was retrieved. Mapped terms from a number of schemes (as in Table 4, but also other schemes) were retrieved and verified as correct. Results were also wrapped correctly and contained the necessary supplementary information (e.g. DDC number, mapped terms with source scheme information, mapping match type, etc.). Copies of the returned query results (wrapped in SKOS Core and SKOS MVS) are detailed below.

Results returned for 'Environmental impacts' (GCMD):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:02:11 GMT
Server: Microsoft-IIS/6.0
```

```
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 3843

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_all_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.73">
        <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
        <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104530"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104531"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104532"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#2582"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#708"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#4794"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#1037"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104530">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#sh 85104531">
        <skos:prefLabel xml:lang="en">Pollution--Economic aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104532">
        <skos:prefLabel xml:lang="en">Pollution--Environmental aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2582">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#708">
        <skos:prefLabel xml:lang="en">Environmental Impacts</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4794">
        <skos:prefLabel xml:lang="en">POLLUTION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1037">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_all_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Shore protection' (DDC):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:05:50 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 4609

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
```

```
<ns1:get_all_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#627.58">
        <skos:prefLabel xml:lang="zxx">627.58</skos:prefLabel>
        <skos:altLabel xml:lang="en">Shore protection</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 99014448"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85027432"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85121794"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 99014447"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#556"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#1038"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#1122"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#7439"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 99014448">
        <skos:prefLabel xml:lang="en">Beach erosion--Monitoring</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85027432">
        <skos:prefLabel xml:lang="en">Coastal engineering</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85121794">
        <skos:prefLabel xml:lang="en">Shore protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#sh 99014447">
        <skos:prefLabel xml:lang="en">Shorelines--Monitoring</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#556">
        <skos:prefLabel xml:lang="en">Coastal protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1038">
        <skos:prefLabel xml:lang="en">Erosion</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1122">
        <skos:prefLabel xml:lang="en">COASTAL PROTECTION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#7439">
        <skos:prefLabel xml:lang="en">Coastal erosion and protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.91716">
        <skos:prefLabel xml:lang="zxx">333.91716</skos:prefLabel>
        <skos:altLabel xml:lang="en">Shore protection, . . .</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_all_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Plant genetics' (HASSET):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:07:25 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 9541

<?xml version="1.0" encoding="ISO-8859-1"?>
```

```
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_all_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#631.5233">
        <skos:prefLabel xml:lang="zxx">631.5233</skos:prefLabel>
        <skos:altLabel xml:lang="en">Agricultural genetics</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 99003210"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 96007794"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 87000678"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 86003906"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 00004757"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102743"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102780"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 90003137"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#81"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 99003210">
        <skos:prefLabel xml:lang="en">Agricultural genome mapping</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#sh 96007794">
        <skos:prefLabel xml:lang="en">Clones (Plants)</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 87000678">
        <skos:prefLabel xml:lang="en">Crops--Genetic engineering</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 86003906">
        <skos:prefLabel xml:lang="en">Crops--Genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 00004757">
        <skos:prefLabel xml:lang="en">Plant gene silencing</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102743">
        <skos:prefLabel xml:lang="en">Plant genetic engineering</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102780">
        <skos:prefLabel xml:lang="en">Plant mutation breeding</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 90003137">
        <skos:prefLabel xml:lang="en">Transgenic plants</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#81">
        <skos:prefLabel xml:lang="en">Agricultural genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#581.35">
        <skos:prefLabel xml:lang="zxx">581.35</skos:prefLabel>
        <skos:altLabel xml:lang="en">Genetics</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102745"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85016002"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102745">
        <skos:prefLabel xml:lang="en">Plant genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85016002">
```

```
        <skos:prefLabel xml:lang="en">Plants--Variation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.53">
        <skos:prefLabel xml:lang="zxx">631.53</skos:prefLabel>
        <skos:altLabel xml:lang="en">Plant propagation</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102702"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102705"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102803"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102780"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102802"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 97003502"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#2539"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#17"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#4712"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102702">
        <skos:prefLabel xml:lang="en">Plant breeding</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102705">
        <skos:prefLabel xml:lang="en">Plant cell culture</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102803">
        <skos:prefLabel xml:lang="en">Plant micropropagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102780">
```

```
        <skos:prefLabel xml:lang="en">Plant mutation breeding</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102802">
        <skos:prefLabel xml:lang="en">Plant propagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 97003502">
        <skos:prefLabel xml:lang="en">Vegetative propagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2539">
        <skos:prefLabel xml:lang="en">Plant genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#17">
        <skos:prefLabel xml:lang="en">Plant Breeding and Genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_all_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Civil emergencies' (IPSV):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:11:27 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 3858

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_all_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
```

```
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.34">
        <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
        <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85038303"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 91000441"/>
        </map:exactMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#sh 85090214"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#2256"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#762"/>
        </map:narrowMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#2696"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#143"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85038303">
        <skos:prefLabel xml:lang="en">Disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 91000441">
        <skos:prefLabel xml:lang="en">Emergency management</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85090214">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2256">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#762">
        <skos:prefLabel xml:lang="en">Natural Hazards</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2696">
        <skos:prefLabel xml:lang="en">HAZARDS, ACCIDENTS AND DISASTERS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#143">
        <skos:prefLabel xml:lang="en">Civil emergencies</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_all_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

4.4   get_ddc_records

The SRW client sends a query to the SRW server. Tests use the same five terms to assess the functionality of get_all_records. These terms belong to different terminologies (as detailed in the supplementary methodology in 3.3) and are as follows: *Environmental impacts* (GCMD), *Shore protection* (DDC), *Plant genetics* (HASSET), *Civil emergencies* (IPSV), *Land use* (NMR). The code used by the client is as follows (note that connection information remains the same and has only been reproduced once):

```
        my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
        $conn->option(preferredRecordSyntax => "xml");

        my $query = 'hilt.get_ddc_records= "environmental impacts"';
        my $rs=$conn->search(new ZOOM::Query::CQL($query));

        my $query = 'hilt.get_ddc_records= "shore protection"';
        my $rs=$conn->search(new ZOOM::Query::CQL($query));

        $query = 'hilt.get_ddc_records= "plant genetics"';
        $rs=$conn->search(new ZOOM::Query::CQL($query));

        $query = 'hilt.get_ddc_records= "civil emergencies"';
        $rs=$conn->search(new ZOOM::Query::CQL($query));

        $query = 'hilt.get_ddc_records= "land use"';
        $rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

See reproduction of this step in section 4.2.

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

See reproduction of this step in section 4.2.

Response from the database to the SOAP server is returned to the SRW server wrapped in SKOS Core and forwarded to the SRW client. Given that there is knowledge of database content and DDC numbers to which terms from different terminologies are mapped, results from the query were checked against Table 4 (as detailed in 3.3).

Tests using the selected terms were successful and appropriate results were retrieved. Results returned in response to any term entered (DDC number(s) with associated caption(s)) were verified as correct. Results were also wrapped correctly (in SKOS Core). Copies of the returned query results are detailed below.

Results returned 'Environmental impacts' (GCMD):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:17:06 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1165

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#363.73">
        <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
        <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
</skos:Concept>
```

```
</rdf:RDF>
</item>
</return>
</ns1:get_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Shore protection' (DDC):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:17:36 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1421

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#627.58">
        <skos:prefLabel xml:lang="zxx">627.58</skos:prefLabel>
        <skos:altLabel xml:lang="en">Shore protection</skos:altLabel>
</skos:Concept>
<skos:Concept rdf:about="#333.91716">
        <skos:prefLabel xml:lang="zxx">333.91716</skos:prefLabel>
        <skos:altLabel xml:lang="en">Shore protection, . . .</skos:altLabel>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Plant genetics' (HASSET):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:18:06 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1646


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#631.5233">
        <skos:prefLabel xml:lang="zxx">631.5233</skos:prefLabel>
        <skos:altLabel xml:lang="en">Agricultural genetics</skos:altLabel>
</skos:Concept>
<skos:Concept rdf:about="#581.35">
        <skos:prefLabel xml:lang="zxx">581.35</skos:prefLabel>
        <skos:altLabel xml:lang="en">Genetics</skos:altLabel>
</skos:Concept>
<skos:Concept rdf:about="#631.53">
        <skos:prefLabel xml:lang="zxx">631.53</skos:prefLabel>
        <skos:altLabel xml:lang="en">Plant propagation</skos:altLabel>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Civil emergencies' (IPSV):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:18:30 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1165

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#363.34">
        <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
        <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for 'Land use site' (NMR):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:18:49 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1178
```

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#333">
        <skos:prefLabel xml:lang="zxx">333</skos:prefLabel>
        <skos:altLabel xml:lang="en">Economics of land and energy</skos:altLabel>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

4.5   get_non_ddc_records

The SRW client sends a query to the SRW server. Our test uses DDC numbers 363.73, 627.58, 363.34, 333, as detailed in Table 4. Since the code used to execute this query remains constant irrespective of the number input, this code has only been provided once. The code below details a query for 363.73:

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");
my $query ='hilt.get_non_ddc_records=363.73';
my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

> *See reproduction of this step in section 4.2.*

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

See reproduction of this step in section 4.2.

Response from the database to the SOAP server is returned to the SRW server wrapped in SKOS Core and SKOS MVS, and forwarded to the SRW client. Since there is knowledge of database content and which terms from terminologies are mapped to the input DDC numbers, results from the query were checked against Table 4 (as detailed in 3.3).

Tests using the selected numbers were successful and appropriate results were retrieved. Results returned in response to any DDC number entered were verified as correct. Results included the initial DDC number input (and associated caption) and details of non-DDC mappings, as provided in Table 4. Results were also wrapped correctly (in SKOS Core and SKOS MVS). Copies of the returned query results are detailed below.

Results returned for DDC 363.73:

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:24:43 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 3851


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_non_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.73">
        <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
        <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104530"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104531"/>
```

```
            </map:exactMatch>
            <map:exactMatch>
                    <skos:Concept rdf:about="#sh 85104532"/>
            </map:exactMatch>
            <map:exactMatch>
                    <skos:Concept rdf:about="#2582"/>
            </map:exactMatch>
            <map:exactMatch>
                    <skos:Concept rdf:about="#708"/>
            </map:exactMatch>
            <map:exactMatch>
                    <skos:Concept rdf:about="#4794"/>
            </map:exactMatch>
            <map:exactMatch>
                    <skos:Concept rdf:about="#1037"/>
            </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104530">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104531">
        <skos:prefLabel xml:lang="en">Pollution--Economic aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104532">
        <skos:prefLabel xml:lang="en">Pollution--Environmental aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2582">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#708">
        <skos:prefLabel xml:lang="en">Environmental Impacts</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4794">
        <skos:prefLabel xml:lang="en">POLLUTION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1037">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_non_ddc_recordsResponse>
```

```
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for DDC 627.58:

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:25:13 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 4261


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_non_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#627.58">
        <skos:prefLabel xml:lang="zxx">627.58</skos:prefLabel>
        <skos:altLabel xml:lang="en">Shore protection</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 99014448"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85027432"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85121794"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 99014447"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#556"/>
        </map:exactMatch>
```

```
                    <map:exactMatch>
                            <skos:Concept rdf:about="#1038"/>
                    </map:exactMatch>
                    <map:exactMatch>
                            <skos:Concept rdf:about="#1122"/>
                    </map:exactMatch>
                    <map:exactMatch>
                            <skos:Concept rdf:about="#7439"/>
                    </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 99014448">
        <skos:prefLabel xml:lang="en">Beach erosion--Monitoring</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85027432">
        <skos:prefLabel xml:lang="en">Coastal engineering</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85121794">
        <skos:prefLabel xml:lang="en">Shore protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 99014447">
        <skos:prefLabel xml:lang="en">Shorelines--Monitoring</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#556">
        <skos:prefLabel xml:lang="en">Coastal protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1038">
        <skos:prefLabel xml:lang="en">Erosion</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1122">
        <skos:prefLabel xml:lang="en">COASTAL PROTECTION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#7439">
        <skos:prefLabel xml:lang="en">Coastal erosion and protection</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_non_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for DDC 631.53:

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:26:09 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 4654


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_non_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#631.53">
        <skos:prefLabel xml:lang="zxx">631.53</skos:prefLabel>
        <skos:altLabel xml:lang="en">Plant propagation</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102702"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102705"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102803"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102780"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85102802"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 97003502"/>
        </map:exactMatch>
```

```
                <map:exactMatch>
                        <skos:Concept rdf:about="#2539"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#17"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#4712"/>
                </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102702">
        <skos:prefLabel xml:lang="en">Plant breeding</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102705">
        <skos:prefLabel xml:lang="en">Plant cell culture</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102803">
        <skos:prefLabel xml:lang="en">Plant micropropagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102780">
        <skos:prefLabel xml:lang="en">Plant mutation breeding</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85102802">
        <skos:prefLabel xml:lang="en">Plant propagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 97003502">
        <skos:prefLabel xml:lang="en">Vegetative propagation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2539">
        <skos:prefLabel xml:lang="en">Plant genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#17">
        <skos:prefLabel xml:lang="en">Plant Breeding and Genetics</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
```

```
</ns1:get_non_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for DDC 363.34:

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:26:43 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 3866


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_non_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.34">
        <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
        <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85038303"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 91000441"/>
        </map:exactMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#sh 85090214"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#2256"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#762"/>
```

```
              </map:narrowMatch>
              <map:exactMatch>
                        <skos:Concept rdf:about="#2696"/>
              </map:exactMatch>
              <map:exactMatch>
                        <skos:Concept rdf:about="#143"/>
              </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85038303">
        <skos:prefLabel xml:lang="en">Disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 91000441">
        <skos:prefLabel xml:lang="en">Emergency management</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85090214">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2256">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#762">
        <skos:prefLabel xml:lang="en">Natural Hazards</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2696">
        <skos:prefLabel xml:lang="en">HAZARDS, ACCIDENTS AND DISASTERS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#143">
        <skos:prefLabel xml:lang="en">Civil emergencies</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_non_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results returned for DDC 333:

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:27:12 GMT
Server: Microsoft-IIS/6.0
```

```
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 3849


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_non_ddc_recordsResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#333">
        <skos:prefLabel xml:lang="zxx">333</skos:prefLabel>
        <skos:altLabel xml:lang="en">Economics of land and energy</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>

        <map:narrowMatch>
                <skos:Concept rdf:about="#sh 85074345"/>
        </map:narrowMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85090254"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#1838"/>
        </map:exactMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#757"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#3387"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#1152"/>
        </map:narrowMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#92443"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85074345">
        <skos:prefLabel xml:lang="en">Land use</skos:prefLabel>
```

```
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85090254">
          <skos:prefLabel xml:lang="en">Natural resources</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1838">
          <skos:prefLabel xml:lang="en">Land economics</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#757">
          <skos:prefLabel xml:lang="en">Land Use/Land Cover</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3387">
          <skos:prefLabel xml:lang="en">LAND USE</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1152">
          <skos:prefLabel xml:lang="en">Planning (town and country)</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#92443">
          <skos:prefLabel xml:lang="en">LAND USE SITE</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/NMR.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_non_ddc_recordsResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

4.6   get_filtered_set

The SRW client sends a query to the SRW server. Recall that the system tests for get_filtered_set were divided into three distinct sections (general filtered set test, multiple scheme selection, and filtering searches by preferred and non-preferred terms). Testing for 'general filtered set' uses five terms from different terminologies (as detailed in the supplementary methodology in 3.6), each of which were searched for in turn. Terms are: *Economics of land and energy* (DDC), *Land use/Land cover* (GCMD), *Land use* (HASSET), *Planning (town and country)* (IPSV). The code used by the client alter slightly depending on the parameters selected and has therefore been reproduced for each search.

'Economics of land and energy' (DDC), with filter set to DDC:

```
          my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
          $conn->option(preferredRecordSyntax => "xml");
```

```
my $query = 'hilt.scheme = DDC and hilt.get_filtered_set = "Economics of land and energy"';

my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

'Land use/Land cover (GCMD), with filter set to GCMD:

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");

my $query = 'hilt.scheme = GCMD and hilt.get_filtered_set = "land use/land cover"';
$rs=$conn->search(new ZOOM::Query::CQL($query));
```

'Land use' (HASSET), with filter set to HASSET:

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");

my $query = 'hilt.scheme = HASSET and hilt.get_filtered_set = "land use"';
$rs=$conn->search(new ZOOM::Query::CQL($query));
```

'Planning (town and country)', with filter set to IPSV:

```
my $conn = ZOOM::Connection->new("http://bodach.ucs.ed.ac.uk:18111/hilt",);
$conn->option(preferredRecordSyntax => "xml");

my $query = 'hilt.scheme = NMR and hilt.get_filtered_set = "planning(town and country)"';
$rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

```
use HILT::CQL::Parser;
use HILT::Client::SOAP;

my @obj_fields = qw(cql client);
our $functions;
our $parameters;
our $parameter_defaults;
our @parameter_list;
our $serverChoice;
our $AUTOLOAD;

# set the $paramater_list to be all those listed in $parameters values.
BEGIN {
  $functions = [ @HILT::Client::SOAP::METHODS ];
  $parameters = {
    %HILT::Client::SOAP::PARAMS
  };
```

```
    $parameter_defaults = {
      %HILT::Client::SOAP::PARAM_DEFAULTS
    };
    my %tmp_hash = ();
    for my $key (keys(%$parameters)) {
      my @list = @{$parameters->{$key}};
      @tmp_hash{@list} = (1) x @list;
    }
    @parameter_list = keys(%tmp_hash);
    $serverChoice = "get_all_records";
  }

  # ...
  sub translate {
    my ($self, %hash) = @_;
    my $cql = $hash{cql}||$self->cql();
    my $client = $hash{client}||$self->client();

    my $parser = HILT::CQL::Parser->new();
    my ($qualifiers,$terms,$operators) = $parser->parse($cql);

    my @results = ();

    my %given_params = ();
    @given_params{@parameter_list} = map([],@parameter_list);
    my @calls = ();

    for (my $i = 0; $i <= $#{@$qualifiers}; $i++) {
      my $qualifier = $qualifiers->[$i];
      my $term = $terms->[$i];

      my $namespace = "hilt";
      my $function = $serverChoice;
      if ($qualifier =~ m/(.*)\.(.*)/) {
        $namespace = $1;
        $function = $2;
      } else {
        $function = $qualifier;
      }

      if ($namespace eq "srw" and $qualifier eq "serverChoice") {
        $namespace = "hilt";
        $qualifier = $serverChoice;
      }

      if ($namespace eq "hilt") {
        #gather parameters
        if (grep ($function eq $_,@parameter_list)) {
          push(@{$given_params{$function}},$term);
```

```
            } else {
            # gather functino calls
              push(@calls,[$function,$term]);
            }

        }

      }

    for my $pair (@calls) {
      my ($function,$term) = @$pair;
      my $result;
      if (exists($parameters->{$function})) {
        my @set_params = @{$parameters->{$function}};
        my %hash = (shift(@set_params) => $term);
        for my $param (@set_params) {
          my $default = $HILT::Client::SOAP::PARAM_DEFAULTS{$param};
          my $given = $given_params{$param};
          if (ref($given) eq "ARRAY" and $#{@$given} >= 0) {
# $given is always an array ref, but it a scalar might be needed.
            if (ref($default) eq ref($given)) {
              $hash{$param} = $given;
            } else {
              $hash{$param} = @$given[0];
            }
          } else {
            $hash{$param} = $default;
          }
        }
        $result = $client->${function}(%hash);
      } else {
        $result = $client->${function}($term);
      }

      if ($result =~ m/<.*>/) {
        push(@results,$result);
      } else {
        warn("SOAP RESPONSE: $result\n");
      }
    }

    return @results;
}
# ...
```

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

```
        # ...
```

```perl
use vars(qw($AUTOLOAD $PACKAGE $URI $PROXY $AUTOTYPE $READABLE @SCHEMES
@METHODS %PARAMS %PARAM_DEFAULTS %PARAM_SEP));

@METHODS = qw(
    get_collections
    get_all_records
    get_DDC_records
    get_non_DDC_records
    get_filtered_set
    get_parents
    get_children
    explain
    );
@SCHEMES = qw(AAT DDC GCMD HASSET IPSV LCSH MeSH NMR SPEIR UNESCO);
# All params for the following methods should be set for a SOAP call.
# If they are not set from the PARAM_DEFAULTS then they are mandatory
for the client to set.
# The first parameter is the CQL "term" (or equivalent).
%PARAMS = (
    get_filtered_set => [ qw(term scheme preferred related non_preferred
is_id) ],
    get_children => [ qw(id scheme) ],
    get_parents => [ qw(id scheme) ],
    );
%PARAM_DEFAULTS = (
    scheme => [@SCHEMES],
    preferred => "true",
    related => "true",
    non_preferred => "true",
    is_id => "false",
    );
%PARAM_SEP = (_default=>":");

$PACKAGE = '';
$URI     = "http://tempuri.org/$PACKAGE";
$PROXY   = "http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/soapserver.php";

# ...
# this AUTOLOAD sub deals with most of the SOAP calls.
# to add a new one, add to the @METHODS list above.
sub AUTOLOAD {
  my $self = shift;
  my ($class, $method) = ($AUTOLOAD =~ m/(.*::)?(\w+)$/);
  $class =~ s/::$//;

  die("$method not defined for $class") unless grep($_ eq $method,
@METHODS);

  my @soapArgs;
```

```perl
        # deal with methods that require parameters
        if (exists($PARAMS{$method})) {
          my %hash = @_;
          if ($hash{args}) {
            @soapArgs = @{$hash{args}};
          } else {
            @soapArgs = ();
            for my $param_name (@{$PARAMS{$method}}) {
              my $param_val = defined($hash{$param_name})?
                $hash{$param_name}:$PARAM_DEFAULTS{$param_name};

              die("must pass '$param_name' parameter to $method()") unless
defined($param_val);
              # deal with array refs passed in
              if (ref($param_val) eq "ARRAY") {
                my $sep = defined($PARAM_SEP{$param_name})?
                  $PARAM_SEP{$param_name}:$PARAM_SEP{_default};
                $param_val = join($sep,@$param_val);
                warn("param_val=$param_val\n");
              }
              push(@soapArgs,$param_val);
            }
          }
        } else {
          @soapArgs = @_
        }

        $self->som($self->soap()->${method}(@soapArgs));
        return ($self->result_as_xml());
      }
      # ...
```

Response from database to the SOAP server is returned to the SRW server wrapped in SKOS Core and forwarded to the SRW client. Results returned were checked against Table 5 (as detailed in 3.6) for appropriate broader and narrower terms, related terms and non-preferred terms (where applicable). Tests using the selected terms were successful and appropriate database content was retrieved. Results were also wrapped correctly. Copies of the returned query results (wrapped in SKOS Core) are detailed below.

Search for 'Economics of land and energy' (DDC):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:48:51 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
```

```
Content-Length: 4050

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#333">
        <skos:prefLabel xml:lang="zxx">333</skos:prefLabel>
        <skos:altLabel xml:lang="en">Economics of land and energy</skos:altLabel>
        <skos:broader rdf:resource="#331-333"/>
        <skos:narrower rdf:resource="#333.001"/>
        <skos:narrower rdf:resource="#333.002-.009"/>
        <skos:narrower rdf:resource="#333.01"/>
        <skos:narrower rdf:resource="#333.08"/>
        <skos:narrower rdf:resource="#333.1-.5"/>
        <skos:narrower rdf:resource="#333.7-.9"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#331-333">
        <skos:prefLabel xml:lang="zxx">331-333</skos:prefLabel>
        <skos:altLabel xml:lang="en">Economics of labor, finance, land, energy</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.001">
        <skos:prefLabel xml:lang="zxx">333.001</skos:prefLabel>
        <skos:altLabel xml:lang="en">Philosophy and theory</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.002-.009">
        <skos:prefLabel xml:lang="zxx">333.002-.009</skos:prefLabel>
        <skos:altLabel xml:lang="en">Standard subdivisions</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.01">
        <skos:prefLabel xml:lang="zxx">333.01</skos:prefLabel>
        <skos:altLabel xml:lang="en">Theories</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.08">
        <skos:prefLabel xml:lang="zxx">333.08</skos:prefLabel>
```

```
                <skos:altLabel xml:lang="en">Land surveys</skos:altLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.1-.5">
                <skos:prefLabel xml:lang="zxx">333.1-.5</skos:prefLabel>
                <skos:altLabel xml:lang="en">Ownership of land</skos:altLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#333.7-.9">
                <skos:prefLabel xml:lang="zxx">333.7-.9</skos:prefLabel>
                <skos:altLabel xml:lang="en">Natural resources and energy</skos:altLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Search for 'Land use/Land cover' (GCMD):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:49:55 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 4215


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#757">
                <skos:prefLabel xml:lang="en">Land Use/Land Cover</skos:prefLabel>
                <skos:broader rdf:resource="#695"/>
                <skos:narrower rdf:resource="#759"/>
```

```
        <skos:narrower rdf:resource="#760"/>
        <skos:narrower rdf:resource="#761"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#930">
        <skos:prefLabel xml:lang="en">Land Use/Land Cover</skos:prefLabel>
        <skos:broader rdf:resource="#888"/>
        <skos:narrower rdf:resource="#932"/>
        <skos:narrower rdf:resource="#933"/>
        <skos:narrower rdf:resource="#934"/>
        <skos:narrower rdf:resource="#935"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#695">
        <skos:prefLabel xml:lang="en">Human Dimensions</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#759">
        <skos:prefLabel xml:lang="en">Land Management</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#760">
        <skos:prefLabel xml:lang="en">Land Tenure</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#761">
        <skos:prefLabel xml:lang="en">Land Use Classes</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#888">
        <skos:prefLabel xml:lang="en">Land Surface</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#932">
        <skos:prefLabel xml:lang="en">Land Cover</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#933">
        <skos:prefLabel xml:lang="en">Land Productivity</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#934">
        <skos:prefLabel xml:lang="en">Land Resources</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#935">
        <skos:prefLabel xml:lang="en">Land Use Classes</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
```

```
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Search for 'Land use' (HASSET):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 10:55:48 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 94422

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

/*RESULT TRUNCATED */

<skos:Concept rdf:about="#3387">
        <skos:prefLabel xml:lang="en">LAND USE</skos:prefLabel>
        <skos:broader rdf:resource="#3373"/>
        <skos:related rdf:resource="#106"/>
        <skos:related rdf:resource="#2044"/>
        <skos:related rdf:resource="#3377"/>
        <skos:related rdf:resource="#3383"/>
        <skos:related rdf:resource="#3386"/>
        <skos:related rdf:resource="#4985"/>
        <skos:altLabel xml:lang="en">IDLE LAND</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>

/*RESULT TRUNCATED */
```

```
<skos:Concept rdf:about="#3377">
        <skos:prefLabel xml:lang="en">LAND ECONOMICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3383">
        <skos:prefLabel xml:lang="en">LAND RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3373">
        <skos:prefLabel xml:lang="en">LAND</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#106">
        <skos:prefLabel xml:lang="en">AGRICULTURAL LAND</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2044">
        <skos:prefLabel xml:lang="en">ENVIRONMENTAL PLANNING</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3386">
        <skos:prefLabel xml:lang="en">LAND TYPES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4985">
        <skos:prefLabel xml:lang="en">PUBLIC ACCESS RIGHTS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>

/*RESULT TRUNCATED */

</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Search for 'Planning (town and country)' (IPSV) (Note an additional related term was found in results set (Building and construction). This extra term was found in the database, indicating that the term had been accidentally omitted during the construction of Table 5.):

```
HTTP/1.1 200 OK
Connection: close
Date: Wed, 06 Dec 2006 11:04:54 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
```

```
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 22085

<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#579">
        <skos:prefLabel xml:lang="en">Building and construction</skos:prefLabel>
        <skos:broader rdf:resource="#685"/>
        <skos:narrower rdf:resource="#686"/>
        <skos:narrower rdf:resource="#2301"/>
        <skos:narrower rdf:resource="#2308"/>
        <skos:narrower rdf:resource="#2796"/>
        <skos:narrower rdf:resource="#5254"/>
        <skos:narrower rdf:resource="#5255"/>
        <skos:narrower rdf:resource="#5256"/>
        <skos:narrower rdf:resource="#5260"/>
        <skos:related rdf:resource="#1468"/>
        <skos:related rdf:resource="#576"/>
        <skos:related rdf:resource="#1138"/>
        <skos:related rdf:resource="#3022"/>
        <skos:related rdf:resource="#5125"/>
        <skos:related rdf:resource="#1713"/>
        <skos:related rdf:resource="#342"/>
        <skos:related rdf:resource="#1713"/>
        <skos:altLabel xml:lang="en">Construction industry</skos:altLabel>
        <skos:altLabel xml:lang="en">Building work</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5906">
        <skos:prefLabel xml:lang="en">Civic societies</skos:prefLabel>
        <skos:broader rdf:resource="#2647"/>
        <skos:broader rdf:resource="#4550"/>
        <skos:related rdf:resource="#1138"/>
        <skos:related rdf:resource="#4579"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4705">
        <skos:prefLabel xml:lang="en">Community development</skos:prefLabel>
```

```
            <skos:broader rdf:resource="#642"/>
            <skos:related rdf:resource="#1138"/>
            <skos:altLabel xml:lang="en">Local development</skos:altLabel>
            <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1138">
            <skos:prefLabel xml:lang="en">Planning (town and country)</skos:prefLabel>
            <skos:broader rdf:resource="#496"/>
            <skos:narrower rdf:resource="#12"/>
            <skos:narrower rdf:resource="#13"/>
            <skos:narrower rdf:resource="#1137"/>
            <skos:narrower rdf:resource="#2207"/>
            <skos:narrower rdf:resource="#2209"/>
            <skos:narrower rdf:resource="#2210"/>
            <skos:narrower rdf:resource="#2211"/>
            <skos:narrower rdf:resource="#2212"/>
            <skos:narrower rdf:resource="#2215"/>
            <skos:narrower rdf:resource="#2220"/>
            <skos:narrower rdf:resource="#2221"/>
            <skos:narrower rdf:resource="#2238"/>
            <skos:narrower rdf:resource="#2244"/>
            <skos:narrower rdf:resource="#2247"/>
            <skos:narrower rdf:resource="#2779"/>
            <skos:narrower rdf:resource="#5898"/>
            <skos:narrower rdf:resource="#6643"/>
            <skos:related rdf:resource="#579"/>
            <skos:related rdf:resource="#671"/>
            <skos:related rdf:resource="#865"/>
            <skos:related rdf:resource="#3150"/>
            <skos:related rdf:resource="#4705"/>
            <skos:related rdf:resource="#5906"/>
            <skos:altLabel xml:lang="en">Property planning (land or buildings)</skos:altLabel>
            <skos:altLabel xml:lang="en">Planning (land use)</skos:altLabel>
            <skos:altLabel xml:lang="en">Development control</skos:altLabel>
            <skos:altLabel xml:lang="en">Building planning</skos:altLabel>
            <skos:altLabel xml:lang="en">Planning enforcement</skos:altLabel>
            <skos:altLabel xml:lang="en">Sites and projects policies (planning)</skos:altLabel>
            <skos:altLabel xml:lang="en">Planning policy</skos:altLabel>
            <skos:altLabel xml:lang="en">Land use planning</skos:altLabel>
            <skos:altLabel xml:lang="en">Planning control</skos:altLabel>
            <skos:altLabel xml:lang="en">Local plans (land use)</skos:altLabel>
            <skos:altLabel xml:lang="en">Development (planning applications)</skos:altLabel>
            <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#865">
            <skos:prefLabel xml:lang="en">Rural communities</skos:prefLabel>
            <skos:broader rdf:resource="#642"/>
            <skos:narrower rdf:resource="#1409"/>
            <skos:narrower rdf:resource="#4552"/>
```

```
        <skos:related rdf:resource="#450"/>
        <skos:related rdf:resource="#1138"/>
        <skos:related rdf:resource="#4583"/>
        <skos:related rdf:resource="#7084"/>
        <skos:altLabel xml:lang="en">Farming communities</skos:altLabel>
        <skos:altLabel xml:lang="en">Communities (rural)</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3150">
        <skos:prefLabel xml:lang="en">Town centre management</skos:prefLabel>
        <skos:broader rdf:resource="#476"/>
        <skos:related rdf:resource="#1138"/>
        <skos:related rdf:resource="#2647"/>
        <skos:related rdf:resource="#3064"/>
        <skos:related rdf:resource="#3142"/>
        <skos:altLabel xml:lang="en">Pedestrianisation</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#671">
        <skos:prefLabel xml:lang="en">Urban communities</skos:prefLabel>
        <skos:broader rdf:resource="#642"/>
        <skos:related rdf:resource="#496"/>
        <skos:related rdf:resource="#969"/>
        <skos:related rdf:resource="#1138"/>
        <skos:altLabel xml:lang="en">Brownfield sites</skos:altLabel>
        <skos:altLabel xml:lang="en">Towns</skos:altLabel>
        <skos:altLabel xml:lang="en">Communities (urban)</skos:altLabel>
        <skos:altLabel xml:lang="en">Cities</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#685">
        <skos:prefLabel xml:lang="en">Business sectors</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#686">
        <skos:prefLabel xml:lang="en">Building regulations</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2301">
        <skos:prefLabel xml:lang="en">Builders</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2308">
        <skos:prefLabel xml:lang="en">Self build projects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2796">
        <skos:prefLabel xml:lang="en">Building sites</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#5254">
        <skos:prefLabel xml:lang="en">Carpentry</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5255">
        <skos:prefLabel xml:lang="en">Bricklaying</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5256">
        <skos:prefLabel xml:lang="en">Plumbing</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5260">
        <skos:prefLabel xml:lang="en">Electrical installation and servicing</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1468">
        <skos:prefLabel xml:lang="en">Non-residential property</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#576">
        <skos:prefLabel xml:lang="en">Architecture</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1138">
        <skos:prefLabel xml:lang="en">Planning (town and country)</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3022">
        <skos:prefLabel xml:lang="en">Road building</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5125">
        <skos:prefLabel xml:lang="en">Do It Yourself</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1713">
        <skos:prefLabel xml:lang="en">Engineering</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#342">
        <skos:prefLabel xml:lang="en">Housing repairs and renovation</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2647">
        <skos:prefLabel xml:lang="en">Built environment</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#4550">
        <skos:prefLabel xml:lang="en">Community associations</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4579">
        <skos:prefLabel xml:lang="en">Conservation groups</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#642">
        <skos:prefLabel xml:lang="en">Life in the community</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#496">
        <skos:prefLabel xml:lang="en">Land and premises</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#12">
        <skos:prefLabel xml:lang="en">Planning applications</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#13">
        <skos:prefLabel xml:lang="en">Compulsory purchase</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1137">
        <skos:prefLabel xml:lang="en">Green belts</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2207">
        <skos:prefLabel xml:lang="en">Structure plans</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2209">
        <skos:prefLabel xml:lang="en">Town planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2210">
        <skos:prefLabel xml:lang="en">District planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2211">
        <skos:prefLabel xml:lang="en">Rural planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2212">
        <skos:prefLabel xml:lang="en">Unitary development plans</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2215">
```

```
        <skos:prefLabel xml:lang="en">Minerals local plan</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2220">
        <skos:prefLabel xml:lang="en">Residential planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2221">
        <skos:prefLabel xml:lang="en">Zoning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2238">
        <skos:prefLabel xml:lang="en">Street numbering and naming</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2244">
        <skos:prefLabel xml:lang="en">Regional planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2247">
        <skos:prefLabel xml:lang="en">Planning appeals</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2779">
        <skos:prefLabel xml:lang="en">Urban development</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5898">
        <skos:prefLabel xml:lang="en">Waste local plan</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6643">
        <skos:prefLabel xml:lang="en">Planning regulations</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#579">
        <skos:prefLabel xml:lang="en">Building and construction</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#671">
        <skos:prefLabel xml:lang="en">Urban communities</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#865">
        <skos:prefLabel xml:lang="en">Rural communities</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3150">
        <skos:prefLabel xml:lang="en">Town centre management</skos:prefLabel>
```

```
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4705">
        <skos:prefLabel xml:lang="en">Community development</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5906">
        <skos:prefLabel xml:lang="en">Civic societies</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1409">
        <skos:prefLabel xml:lang="en">Villages</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4552">
        <skos:prefLabel xml:lang="en">Village societies</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#450">
        <skos:prefLabel xml:lang="en">Countryside</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4583">
        <skos:prefLabel xml:lang="en">Young farmers clubs</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#7084">
        <skos:prefLabel xml:lang="en">Rural economy</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#476">
        <skos:prefLabel xml:lang="en">Public administration</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3064">
        <skos:prefLabel xml:lang="en">Traffic management</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3142">
        <skos:prefLabel xml:lang="en">Transport planning</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#969">
        <skos:prefLabel xml:lang="en">Regeneration</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
```

```
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Where more than one scheme is selected using the get_filtered_set function, relevant information should be return for all schemes selected (where applicable). This should include preferred, non-preferred and related terms.The test for the 'multiple scheme selection' function used one term (*Plant genetics*) from HASSET (as detailed in the supplementary methodology in 3.6 and Table 6). The code used by the client to execute/send this query is as follows (Note: the selection of all terminologies is the default implementation. It is therefore unnecessary to specify that the search should be initiated across all terminologies):

```
my $query = 'hilt.get_filtered_set = "plant genetics"';
$rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

See reproduction of this step above (section 4.6).

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

See reproduction of this step above (section 4.6).

Response from the database to the SOAP server is returned to the SRW server wrapped in SKOS Core and forwarded to the SRW client. Results from the query were checked against Table 6 (as detailed in 3.6). Results should be returned for HASSET and GCMD within a single SKOS record, but not for DDC, NMR or IPSV since the submitted term does note feature in these terminologies.

The test was successful in that the system functions as specified in the requirements document; however, retrieved results were not as originally expected. Appropriate results were retrieved as expected for HASSET, with correct broader terms, related terms and non-preferred terms. Results were also wrapped correctly (in SKOS Core). The expected result from GCMD was not retrieved since the system does not Boolean 'AND' search terms. The addition of an intermediary search stage using Boolean AND for phrase searching will be recommended in section 5.

A truncated copy of the returned query results are detailed below:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 11 Dec 2006 12:10:01 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 358044
```

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

/*RESULT TRUNCATED */

<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:broader rdf:resource="#624"/>
        <skos:broader rdf:resource="#2467"/>
        <skos:related rdf:resource="#2465"/>
        <skos:altLabel xml:lang="en">PLANT BREEDING</skos:altLabel>
        <skos:altLabel xml:lang="en">PLANT REPRODUCTION</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>

/*RESULT TRUNCATED */

<skos:Concept rdf:about="#624">
        <skos:prefLabel xml:lang="en">BOTANY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2467">
        <skos:prefLabel xml:lang="en">GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2465">
        <skos:prefLabel xml:lang="en">GENETICALLY MODIFIED CROPS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>

/*RESULT TRUNCATED */
```

The third and final aspect of get_filtered_set is filtering searches by preferred and non-preferred terms. The test for the 'multiple scheme selection ' used the preferred and non-preferred terms detailed in Table 6. The client code used to execute this query - for preferred and non-preferred terms respectively - is reproduced below.

- ***Filter set to preferred***

'Plant reproduction' (HASSET), filter set to preferred:

```
my $query = 'hilt.get_filtered_set = "plant reproduction" and hilt.scheme = HASSET and hilt.preferred = true and hilt.related = false
and hilt.non_preferred = false';

my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

'Plant propagation' (DDC), filter set to preferred:

```
my $query = 'hilt.get_filtered_set = "plant propagation" and hilt.scheme = DDC and hilt.preferred = true and hilt.related = false and
hilt.non_preferred = false';

my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

'Plant breeding and genetics' (GCMD), filter set to preferred:

```
my $query = 'hilt.get_filtered_set = "plant breeding and genetics" and hilt.scheme = GCMD and hilt.preferred = true and hilt.related =
false and hilt.non_preferred = false';

my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

- ***Filter set to non-preferred***

  'Plant genetics' (HASSET), filter set to non-preferred:

```
my $query = 'hilt.get_filtered_set = "plant genetics" and hilt.scheme = HASSET and hilt.preferred = false and hilt.related = false and
hilt.non_preferred = true';

my $rs=$conn->search(new ZOOM::Query::CQL($query));
```

The SRW server parses the client query to obtain the search values:

See reproduction of this step above (section 4.6).

The SRW server uses the values obtained from parsing the query to call the appropriate SOAP server function:

See reproduction of this step above (section 4.6).

Response from the database to the SOAP server is returned to the SRW server wrapped in SKOS Core and forwarded to the SRW client. Results from the query were checked against Table 6 (as detailed in 3.6). The tests were successful and results were retrieved as expected with correct preferred and non-

preferred terms. Results were also wrapped correctly (in SKOS Core). However – as found in the 'multiple scheme selection test' - since the system is implemented to find any instance of any term input (rather than the phrase 'Plant genetics'), retrieved results were occasionally lengthy and often irrelevant (see section 5 for further details). A truncated copy of the returned query results are detailed below:

Results for 'Plant reproduction' (HASSET), filter set to preferred:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 11 Dec 2006 14:32:21 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 11810


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#1517">
        <skos:prefLabel xml:lang="en">DECORATIVE PLANTS</skos:prefLabel>
        <skos:broader rdf:resource="#4716"/>
        <skos:altLabel xml:lang="en">CUT FLOWERS</skos:altLabel>
        <skos:altLabel xml:lang="en">DECORATIVE SHRUBS</skos:altLabel>
        <skos:altLabel xml:lang="en">FLOWERS</skos:altLabel>
        <skos:altLabel xml:lang="en">HOUSEPLANTS</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3016">
        <skos:prefLabel xml:lang="en">INDUSTRIAL PLANTS</skos:prefLabel>
        <skos:narrower rdf:resource="#3962"/>
        <skos:narrower rdf:resource="#4851"/>
        <skos:related rdf:resource="#2163"/>
        <skos:altLabel xml:lang="en">FACTORIES</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:broader rdf:resource="#624"/>
        <skos:broader rdf:resource="#2467"/>
        <skos:related rdf:resource="#2465"/>
        <skos:altLabel xml:lang="en">PLANT BREEDING</skos:altLabel>
        <skos:altLabel xml:lang="en">PLANT REPRODUCTION</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4713">
        <skos:prefLabel xml:lang="en">PLANT RESOURCES</skos:prefLabel>
        <skos:broader rdf:resource="#4157"/>
        <skos:narrower rdf:resource="#2340"/>
        <skos:related rdf:resource="#4716"/>
        <skos:altLabel xml:lang="en">RARE PLANTS</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4716">
        <skos:prefLabel xml:lang="en">PLANTS</skos:prefLabel>
        <skos:broader rdf:resource="#6658"/>
        <skos:narrower rdf:resource="#1389"/>
        <skos:narrower rdf:resource="#1517"/>
        <skos:narrower rdf:resource="#6500"/>
        <skos:related rdf:resource="#624"/>
        <skos:related rdf:resource="#4713"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#5216">
        <skos:prefLabel xml:lang="en">REPRODUCTION (BIOLOGICAL)</skos:prefLabel>
        <skos:broader rdf:resource="#4685"/>
        <skos:narrower rdf:resource="#211"/>
        <skos:narrower rdf:resource="#2222"/>
        <skos:narrower rdf:resource="#3878"/>
        <skos:narrower rdf:resource="#3879"/>
        <skos:narrower rdf:resource="#4864"/>
        <skos:narrower rdf:resource="#4984"/>
        <skos:related rdf:resource="#2236"/>
        <skos:related rdf:resource="#2237"/>
        <skos:related rdf:resource="#2467"/>
        <skos:related rdf:resource="#2618"/>
        <skos:related rdf:resource="#4357"/>
        <skos:related rdf:resource="#6177"/>
        <skos:related rdf:resource="#6621"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4716">
        <skos:prefLabel xml:lang="en">PLANTS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#3962">
        <skos:prefLabel xml:lang="en">MILLS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4851">
        <skos:prefLabel xml:lang="en">POTTERIES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2163">
        <skos:prefLabel xml:lang="en">FACTORY OCCUPATIONS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#624">
        <skos:prefLabel xml:lang="en">BOTANY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2467">
        <skos:prefLabel xml:lang="en">GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2465">
        <skos:prefLabel xml:lang="en">GENETICALLY MODIFIED CROPS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4157">
        <skos:prefLabel xml:lang="en">NATURAL RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2340">
        <skos:prefLabel xml:lang="en">FOREST RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6658">
        <skos:prefLabel xml:lang="en">VEGETATION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1389">
        <skos:prefLabel xml:lang="en">CROPS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1517">
        <skos:prefLabel xml:lang="en">DECORATIVE PLANTS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6500">
        <skos:prefLabel xml:lang="en">TREES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4713">
```

```
        <skos:prefLabel xml:lang="en">PLANT RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4685">
        <skos:prefLabel xml:lang="en">PHYSIOLOGY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#211">
        <skos:prefLabel xml:lang="en">ANIMAL BREEDING</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2222">
        <skos:prefLabel xml:lang="en">FECUNDITY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3878">
        <skos:prefLabel xml:lang="en">MENOPAUSE</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#3879">
        <skos:prefLabel xml:lang="en">MENSTRUATION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4864">
        <skos:prefLabel xml:lang="en">PREGNANCY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4984">
        <skos:prefLabel xml:lang="en">PUBERTY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2236">
        <skos:prefLabel xml:lang="en">FERTILITY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2237">
        <skos:prefLabel xml:lang="en">FERTILITY TREATMENT</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2618">
        <skos:prefLabel xml:lang="en">GYNAECOLOGY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4357">
        <skos:prefLabel xml:lang="en">OBSTETRICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6177">
        <skos:prefLabel xml:lang="en">SURROGATE MOTHERS</skos:prefLabel>
```

```
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6621">
        <skos:prefLabel xml:lang="en">UROGENITAL SYSTEM</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results for 'Plant propagation' (DDC), filter set to preferred:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 11 Dec 2006 14:33:50 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 5714


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#634.0441">
        <skos:prefLabel xml:lang="zxx">634.0441</skos:prefLabel>
        <skos:altLabel xml:lang="en">Grafting (Plant propagation)--fruit crops</skos:altLabel>
        <skos:broader rdf:resource="#634.04"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#635.91541">
        <skos:prefLabel xml:lang="zxx">635.91541</skos:prefLabel>
        <skos:altLabel xml:lang="en">Grafting (Plant propagation)--ornamental plants</skos:altLabel>
```

```
        <skos:broader rdf:resource="#635.91"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.53">
        <skos:prefLabel xml:lang="zxx">631.53</skos:prefLabel>
        <skos:altLabel xml:lang="en">Plant propagation</skos:altLabel>
        <skos:broader rdf:resource="#631.5"/>
        <skos:narrower rdf:resource="#631.531"/>
        <skos:narrower rdf:resource="#631.532"/>
        <skos:narrower rdf:resource="#631.533"/>
        <skos:narrower rdf:resource="#631.534"/>
        <skos:narrower rdf:resource="#631.535"/>
        <skos:narrower rdf:resource="#631.536"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#634.04">
        <skos:prefLabel xml:lang="zxx">634.04</skos:prefLabel>
        <skos:altLabel xml:lang="en">Cultivation, harvesting, related topics of orchards, of fruits, of trees</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#635.91">
        <skos:prefLabel xml:lang="zxx">635.91</skos:prefLabel>
        <skos:altLabel xml:lang="en">Specific techniques; apparatus, equipment, materials</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.5">
        <skos:prefLabel xml:lang="zxx">631.5</skos:prefLabel>
        <skos:altLabel xml:lang="en">Cultivation and harvesting</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.531">
        <skos:prefLabel xml:lang="zxx">631.531</skos:prefLabel>
        <skos:altLabel xml:lang="en">Propagation from seeds (Sowing)</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.532">
        <skos:prefLabel xml:lang="zxx">631.532</skos:prefLabel>
        <skos:altLabel xml:lang="en">Propagation from bulbs and tubers</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.533">
        <skos:prefLabel xml:lang="zxx">631.533</skos:prefLabel>
        <skos:altLabel xml:lang="en">Propagation from suckers, runners, buds</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.534">
        <skos:prefLabel xml:lang="zxx">631.534</skos:prefLabel>
        <skos:altLabel xml:lang="en">Propagation by layering</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#631.535">
        <skos:prefLabel xml:lang="zxx">631.535</skos:prefLabel>
        <skos:altLabel xml:lang="en">Propagation from cuttings and slips</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#631.536">
        <skos:prefLabel xml:lang="zxx">631.536</skos:prefLabel>
        <skos:altLabel xml:lang="en">Transplanting</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results for 'Plant breeding and genetics' (GCMD), filter set to preferred:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 11 Dec 2006 14:46:03 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 1437


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#17">
        <skos:prefLabel xml:lang="en">Plant Breeding and Genetics</skos:prefLabel>
        <skos:broader rdf:resource="#12"/>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#12">
        <skos:prefLabel xml:lang="en">Agricultural Plant Science</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Results 'Plant genetics' (HASSET), filter set to non-preferred:

```
HTTP/1.1 200 OK
Connection: close
Date: Mon, 11 Dec 2006 14:52:26 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: PHP/5.1.4
Server: NuSOAP Server v0.7.2
X-SOAP-Server: NuSOAP/0.7.2 (1.95)
Content-Type: text/xml; charset=ISO-8859-1
Content-Length: 7355


<?xml version="1.0" encoding="ISO-8859-1"?>
<SOAP-ENV:Envelope SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<ns1:get_filtered_setResponse xmlns:ns1="http://tempuri.org">
<return xsi:type="SOAP-ENC:Array" SOAP-ENC:arrayType="xsd:string[1]">
<item xsi:type="xsd:string">
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:Concept rdf:about="#624">
        <skos:prefLabel xml:lang="en">BOTANY</skos:prefLabel>
        <skos:broader rdf:resource="#546"/>
        <skos:narrower rdf:resource="#4687"/>
        <skos:narrower rdf:resource="#4688"/>
        <skos:narrower rdf:resource="#4712"/>
        <skos:related rdf:resource="#4155"/>
        <skos:related rdf:resource="#4716"/>
        <skos:related rdf:resource="#6658"/>
        <skos:altLabel xml:lang="en">PLANT BIOLOGY</skos:altLabel>
```

```
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4687">
        <skos:prefLabel xml:lang="en">PHYTOGEOGRAPHY</skos:prefLabel>
        <skos:broader rdf:resource="#624"/>
        <skos:broader rdf:resource="#4675"/>
        <skos:altLabel xml:lang="en">DISTRIBUTION OF PLANTS</skos:altLabel>
        <skos:altLabel xml:lang="en">PLANT GEOGRAPHY</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4688">
        <skos:prefLabel xml:lang="en">PHYTOPATHOLOGY</skos:prefLabel>
        <skos:broader rdf:resource="#624"/>
        <skos:related rdf:resource="#4548"/>
        <skos:altLabel xml:lang="en">PLANT DISEASES</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:broader rdf:resource="#624"/>
        <skos:broader rdf:resource="#2467"/>
        <skos:related rdf:resource="#2465"/>
        <skos:altLabel xml:lang="en">PLANT BREEDING</skos:altLabel>
        <skos:altLabel xml:lang="en">PLANT REPRODUCTION</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4713">
        <skos:prefLabel xml:lang="en">PLANT RESOURCES</skos:prefLabel>
        <skos:broader rdf:resource="#4157"/>
        <skos:narrower rdf:resource="#2340"/>
        <skos:related rdf:resource="#4716"/>
        <skos:altLabel xml:lang="en">RARE PLANTS</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#546">
        <skos:prefLabel xml:lang="en">BIOLOGY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4687">
        <skos:prefLabel xml:lang="en">PHYTOGEOGRAPHY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4688">
        <skos:prefLabel xml:lang="en">PHYTOPATHOLOGY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4712">
        <skos:prefLabel xml:lang="en">PLANT GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
```

```
</skos:Concept>
<skos:Concept rdf:about="#4155">
        <skos:prefLabel xml:lang="en">NATURAL HISTORY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4716">
        <skos:prefLabel xml:lang="en">PLANTS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#6658">
        <skos:prefLabel xml:lang="en">VEGETATION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#624">
        <skos:prefLabel xml:lang="en">BOTANY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4675">
        <skos:prefLabel xml:lang="en">PHYSICAL GEOGRAPHY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4548">
        <skos:prefLabel xml:lang="en">PATHOLOGY</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2467">
        <skos:prefLabel xml:lang="en">GENETICS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2465">
        <skos:prefLabel xml:lang="en">GENETICALLY MODIFIED CROPS</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4157">
        <skos:prefLabel xml:lang="en">NATURAL RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2340">
        <skos:prefLabel xml:lang="en">FOREST RESOURCES</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
</rdf:RDF>
</item>
</return>
</ns1:get_filtered_setResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

4.7 Results summary for get_all_records, get_ddc_records & get_non_ddc_records

DDC No.	DDC caption	GCMD	NMR	HASSET	IPSV	Get _ all _ records	Get _ ddc _ records	Get _ non _ ddc _ records
363.73	Pollution	**Environmental impacts**	-	Pollution	Pollution	✓	✓	✓
627.58	**Shore protection**	Erosion	-	Coastal protection	Coastal erosion and protection	✓	✓	✓
631.53	Plant propagation	Plant breeding and genetics	-	**Plant genetics**	-	✓	✓	✓
363.34	Disasters	Natural hazards	-	Hazards, accidents and disasters	**Civil emergencies**	✓	✓	✓
333	Economics of land and energy	Land use/Land cover	**Land use site**	Land use	Planning (town and country)	✓	✓	✓

Table 7: Results summary of the get_all_records, get_ddc_records and get_non_ddc_records. Tick denotes a successful test using the appropriate test term or DDC number.

5.   Recommendations

5.1   Phrase searching

The current search algorithm is as follows:
Step 1: exact matches sought for phrase e.g. 'plant genetics'
Step 2: exact matches sought for individual terms within a phrase e.g. 'plant'; 'genetics'.
The result of step 2 is that, currently, some irrelevant material is being returned. For example, a user searching for 'plant genetics' using get_all_records is unlikely to find resources relating to the broad topic of 'genetics' useful, as currently being returned. Similarly, a query for 'plant reproducton' using get_filtered_set returns terms such as 'puberty', 'menopause' and similar, which are obviously irrelevant to the query.

It is recommended that further research be conducted to assess the wider effects of Step 2's inclusion in the search parameters. It is considered likely that this second step produces unnecessary noise in results sets and that the service will return more appropriate results sets in its absence. A better second step may involve the use of Boolean 'AND'. Step 2 above could then become a 'step 3'.

5.2   Scheme specific browse

Use case 4 states "Scheme hierarchy browse in 'no hits from HILT' or user/service request situation (get_filtered_set)". This means that in a scenario where no hits are retrieved from HILT for any given term, the browse interface of an appropriate scheme will be presented to the user. This is not currently happening. Although HILT has already implemented scheme specific browsing for DDC, AAT, GCMD, NMR, IPSV and an area of UNESCO. This work has not yet been integrated because a) the HILT SRW client has been designed to emulate the HILT Phase II pilot and therefore does not use any of the aforementioned vocabularies (except DDC as the spine) and b) the remit of the GoGeo! SRW client was to offer query expansion functionality to the user; as such, the scheme specific browse feature has not been built in.

In addition, due to the architectural set-up of the pilot server, the get_filtered_set function operates on the SOAP server requests handler * while the scheme browse information is held on a separate Linux machine. This means that a user must be switched from one to the other in the event of 'no hits' in response to a query. It is recommended that this 're-rerouting' be programmed. Even although this will be largely artificial in terms of the desired architecture, it will, at this stage, enable us to show proof of concept to meet the 'no hits' aspect of use case 4.

5.3   New functions

Experimentation with the creation of scheme specific browse interfaces led to the suggestion that two new functions be created – get_children and get_parents. When a term is selected the get_children function will be used to identify the immediate narrower terms, thus leading the user down the hierarchy; similarly, the get_parents function will facilitate the identification of all broader terms, leading the user up the hierarchy.

Get_filtered_set was originally envisaged as incorporating this functionality but closer examination of performance issues and general efficiency of the system justifies the proposed creation of these two additional functions.

6.   Future work

6.1   Match types

Further research into match types should be conducted to establish how best to express the nature of equivalence relationships between terms. Currently, five mapping types are in use, in line with the SKOS Mapping Vocabulary Specification (MVS). These are exact match, narrow match, broad match, major match and minor match. It is thought likely that further match types may prove useful although this theory must be considered in the context of user testing.

6.2   Use cases and functions

It is considered likely that a range of additional use cases, and therefore functions, will prove valuable within the HILT service. A survey of potiential users of HILT (both services/collections and individuals) should be undertaken to inform the HILT team on what these use cases might be. Appropriate functionality can then be designed and built in to the system.

6.3   Mapping work

The DDC-LCSH mappings provided by OCLC are not always appropriate. It is envisaged that a review of existing mappings will be required to enhance the service in the future. A methodology for determining new mappings should also be devised as part of the programme of future work.

Appendix F: Illustrative Description of Phase III Pilot

Several demonstrators were created for the purposes of the HILT Phase III research and development work. This appendix provides an illustrative description these using screenshots and annotations.

Not all the demonstrators are conducive to such an illustration. For example, the HILT SOAP client demonstrator allowed project team members to invoke the HILT functions via a mock client and to observe the return of terminological data wrapped in SKOS Core. This client does not have a suitable user interface and, in practice, such a client would not exist as the HILT functions would be invoked transparently by a client service in the JISC IE, or elsewhere. The illustrative descriptions therefore focus on those that parse the returned SKOS Core data and use it to create functionality within a demonstration user interface. All demonstrators are available via the 'demonstrator' page of the HILT Phase III project website.

- HILT SOAP client demonstration:
  http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/hiltsoapclient.php

- HILT SRW client demonstration (HILT II emulation using SRW and SKOS Core):
  http://hilt3.cdlr.strath.ac.uk/

- HILT SRW client 'scheme specific browse' demonstrator (using SKOS Core):
  http://hilt3.cdlr.strath.ac.uk/hilt_srw.cgi

- GoGeo! keyword search demonstrator: http://nevis.ed.ac.uk:9200/gogeo_hilt2.html

(**Please note:** these demonstrators are under development and may therefore be temporarily unavailable, altered at any time, or may experience sub-optimal performance)

HILT Phase II emulation, using SRW and SKOS Core

The HILT Phase II emulation is a client demonstrator that replicates work undertaken during Phase II[36] using the HILT Phase III technical architecture and a test collections database. As such, the demonstrator is an SRW client that parses returned terminological data wrapped in SKOS Core sent from the HILT SRW server.
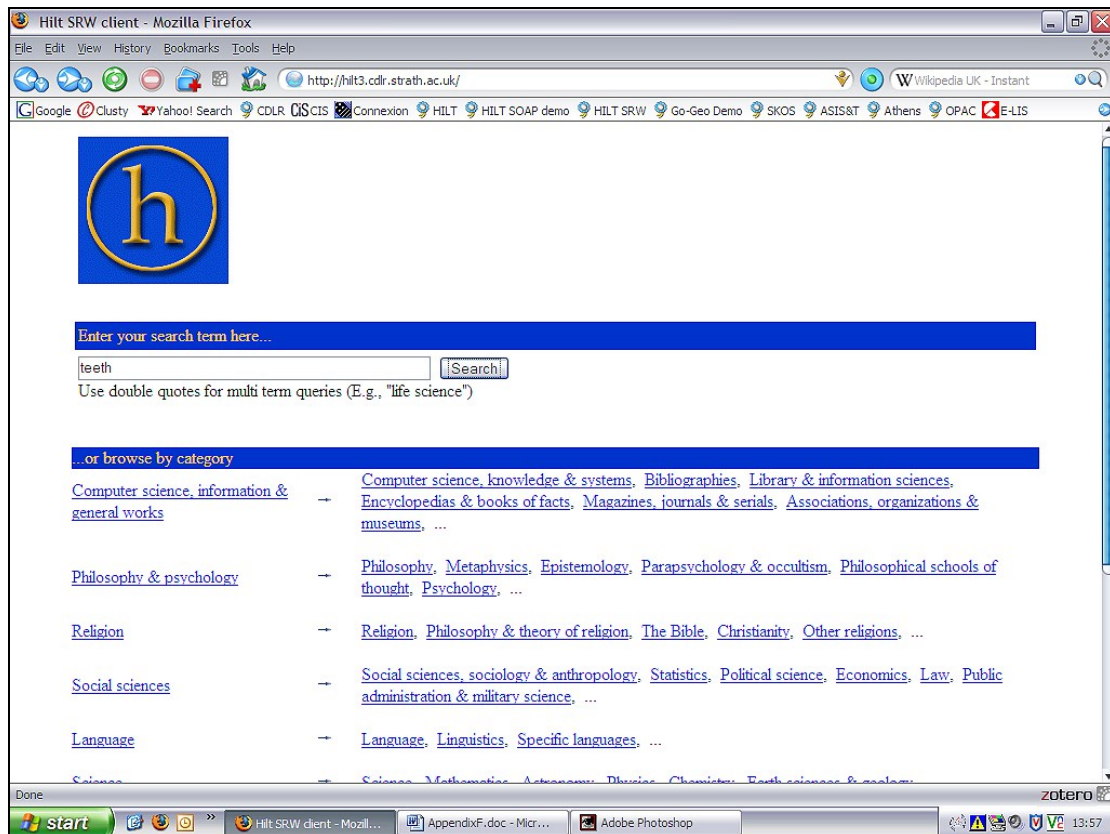

Figure 1: Home page of HILT Phase II emulation, with term 'teeth' entered in search form.

Figure 1 (above) is a screenshot of the home page of the HILT Phase II emulation. The term 'teeth' provides a good illustrative example of the HILT disambiguation process and this term has therefore been entered into the search form as a potential user query.

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[36] HILT Phase II pilot terminology server: http://hiltpilot.cdlr.strath.ac.uk/pilot/top.php
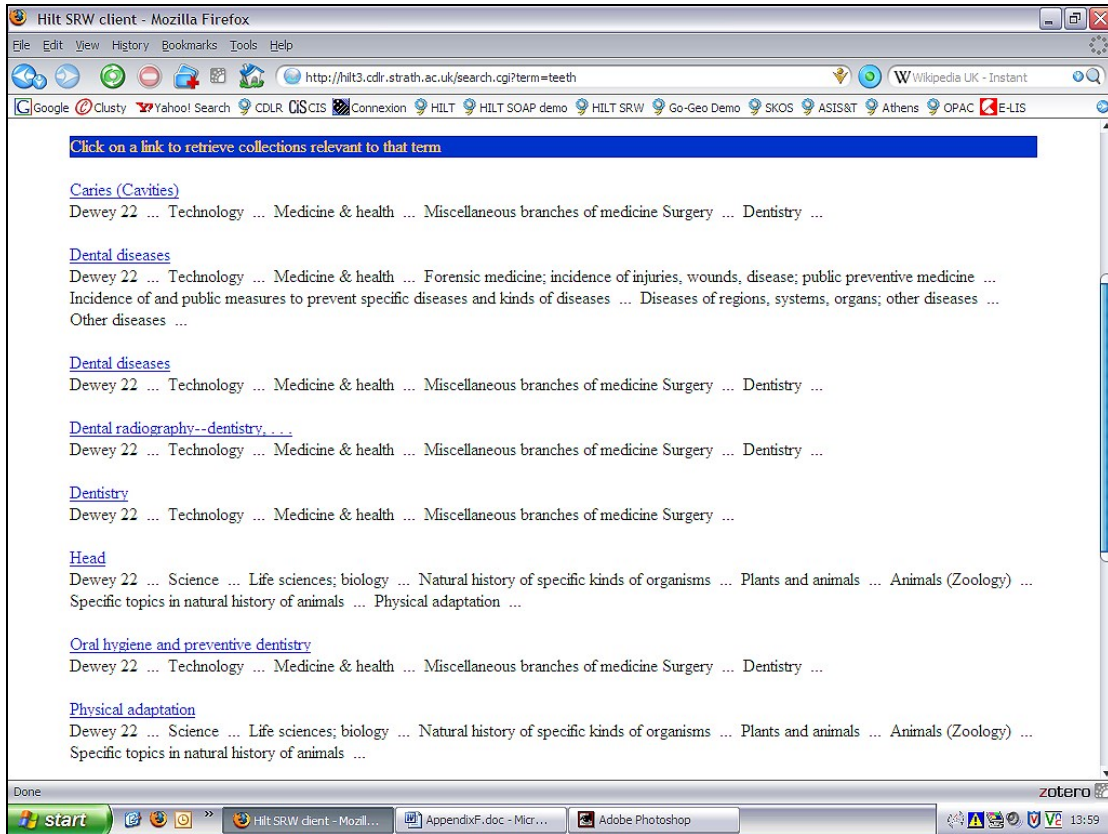
Figure 2: Screenshot of HILT disambiguation stage.

Figure 2 (above) is a screenshot of the HILT disambiguation stage. Since the term 'teeth' can relate to concepts within a variety of disciplines and subject areas (e.g. medicine, biology, engineering, etc.), as well as concepts held by HILT, the system provides the user with an opportunity to refine the information need. The user can achieve this by reviewing the simplified DDC caption information provided and 'clicking' on the one that matches their information need best.

Figure 3 (below) provides a screenshot snippet of the selection made by our fictional user during the 'teeth' disambiguation stage:

Medicine & health > Human anatomy, cytology, histology > Gross anatomy > Digestive tract organs > Mouth
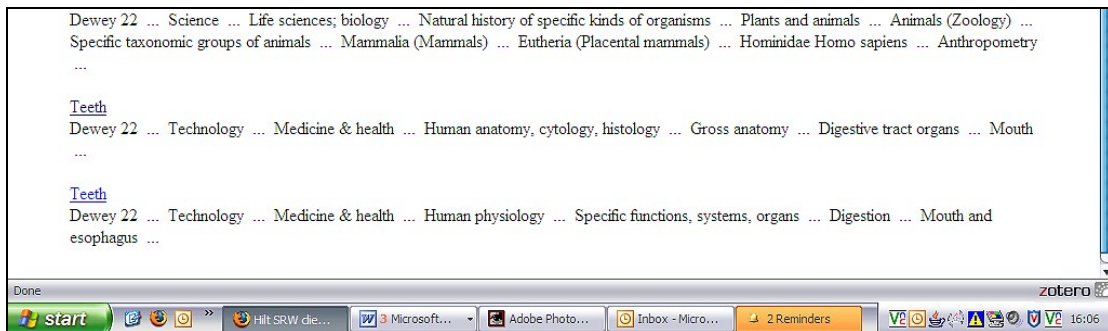

Figure 3: Screenshot snippet of 'teeth' disambiguation selection.

Figure 4: Screenshot of post-disambiguation results.

Figure 4 (above) illustrates the post-disambiguation search results. Results include details of potentially relevant collections and details of preferred terminology for that collection (e.g. Bristol Biomedical Image Archive: 'Tooth'). Where OpenURL is supported at a JISC service (or other), the relevant subject term for a collection is hyperlinked (see Figure 5 below) allowing users to search JISC collections dynamically. If not, users can simply link to the service in question and search using the suggested subject term.
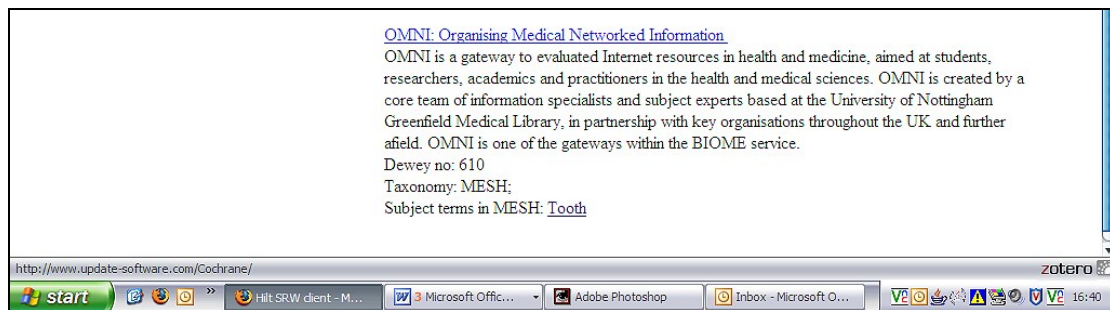

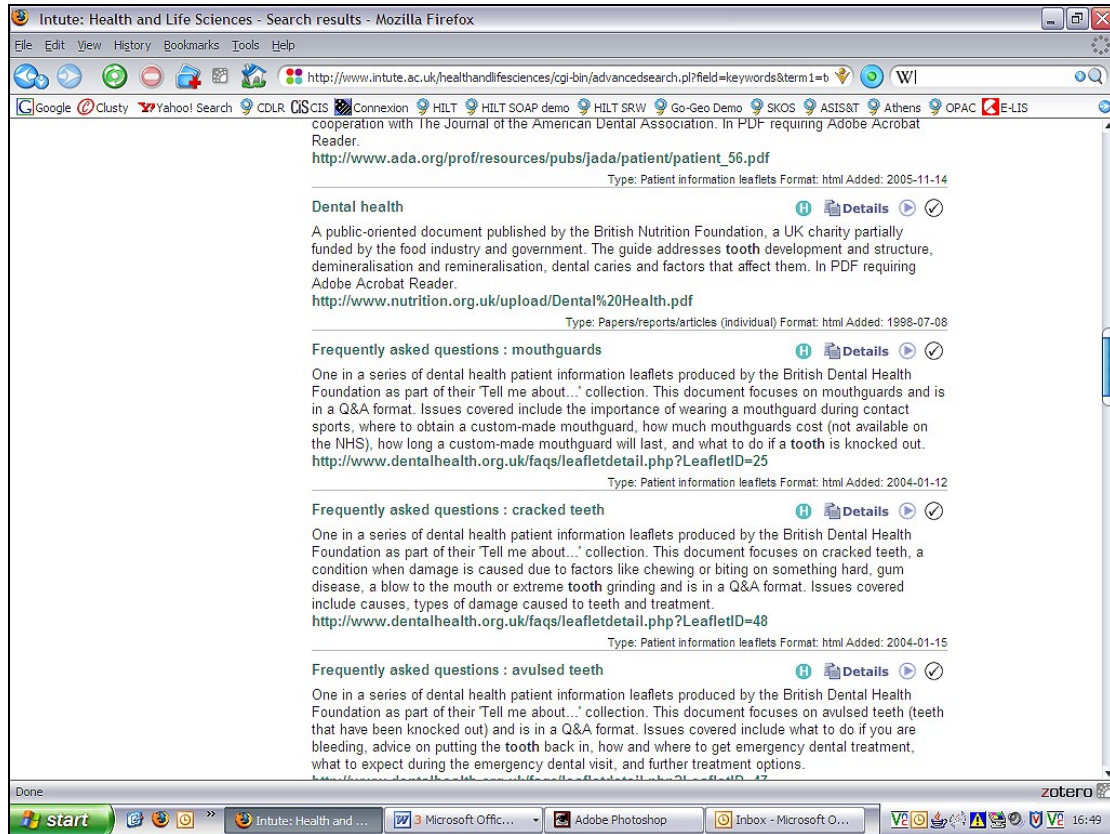**Figure 5:** Screenshot snippet of OpenURL supported service.

Figure 6: Screenshot of intute: Health & Life Science service.

Figure 6 (above) illustrates some of the surrogates retrieved from conducting a subject search of the intute: Health & Life Sciences services, formerly known as BIOME (containing OMNI, NMAP, AgriFor, VetGate, BioRes and Nature) using the HILT suggested MeSH term, 'Tooth'.

HILT Phase III scheme specific browse demonstrator

The HILT Phase III scheme specific browse demonstrates how an SRW client can request and use SKOS Core data returned from the HILT SRW server to create hierarchical browse trees and incorporate them within services and user interfaces. Since HILT had no client service with which to experiment using scheme specific browsing for a variety of terminologies, a custom SRW client was built. This illustrates the technical functionality of the scheme specific browse for a number of terminologies and also the relative ease with which such browsing tools can be created using the HILT functions.

The screenshots below illustrate two different instances of the scheme specific browsing: the first shows how browsing scheme hierarchies, related terms and non-preferred terms can be deployed in a user interface; the second demonstrates the simple way in which scheme specific browsing can be invoked by services in response to a search returning 'no hits' by users, thus allowing them to browse scheme headings and refine search queries using the correct terminology.
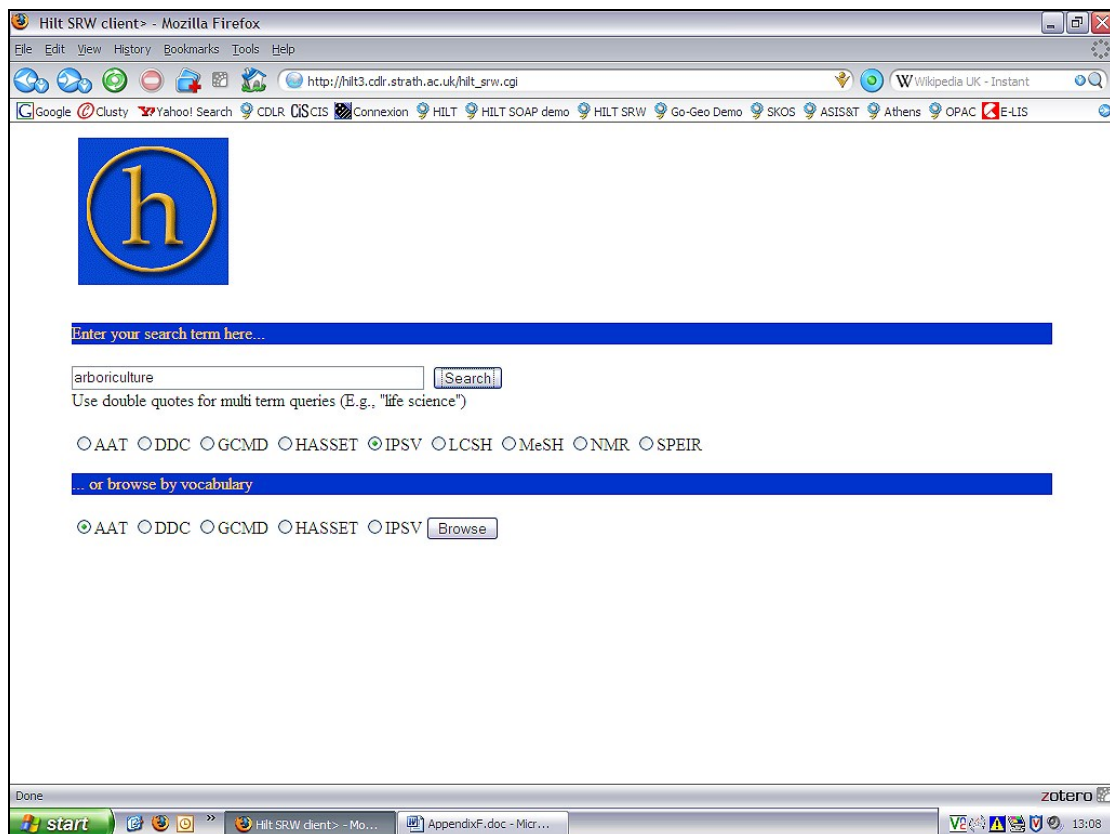

Figure 1: Screenshot of the scheme specific browse custom client demonstrator home page.

Figure 1 (above) is a screenshot of the home page of the HILT Phase III scheme specific browse demonstrator. The term 'arboriculture' has been entered into the search form as a potential user query and the Integrated Public Sector Vocabulary (IPSV) has been selected as the scheme. It is worth nothing that such a scheme selection is rather artificial since in practice client services would have a particular scheme selected as their default terminology. Our selection process has been incorporated in our custom client to allow and demonstrate the browsing of a variety of schemes.
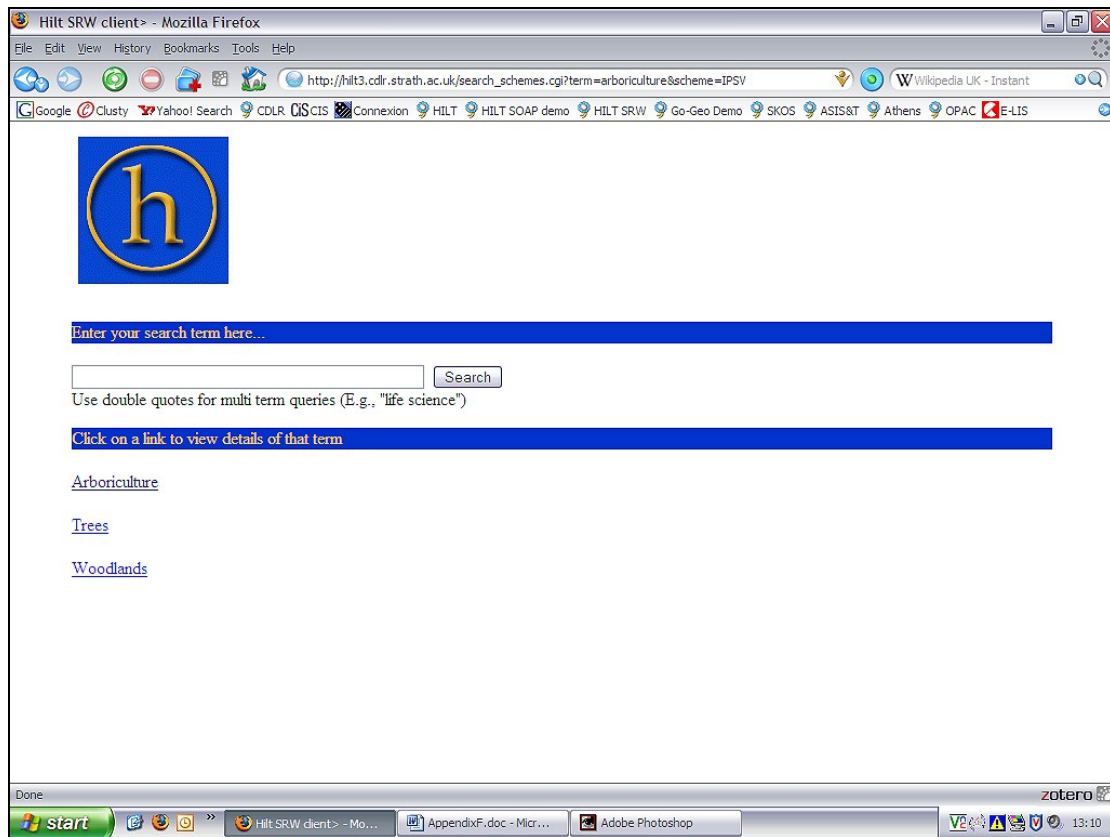
Figure 2: Screenshot of resultant browse screen in response to 'arboriculture'.

Figure 2 (above) illustrates the resultant browse screen presented to the user in response to a query for 'arboriculture' using IPSV as the selected terminology. This resultant browse screen presents the top of the hierarchy for the term 'arboriculture', but also the top of the hierarchies for terms related to 'arboriculture' (IE 'Trees' and 'Woodlands').
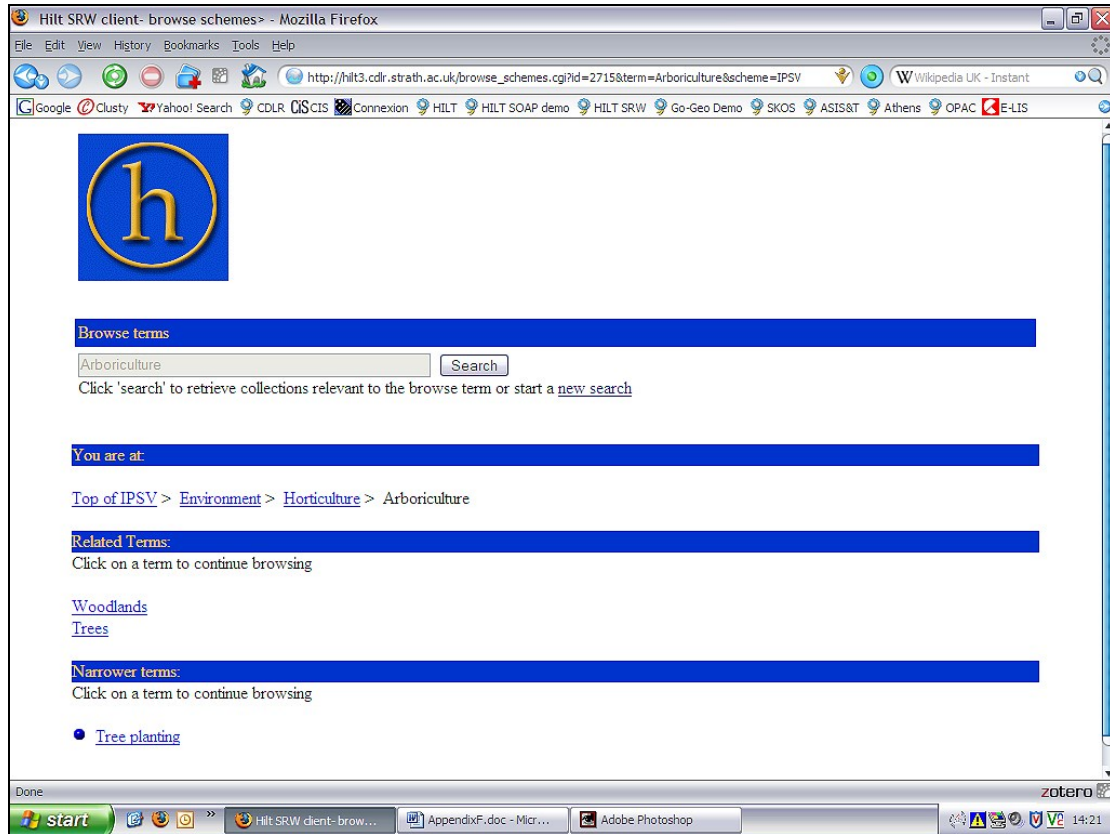
Figure 3: Screenshot of drilling down the hierarchy of the IPSV term, 'Arboriculture'.

Figure 3 (above) provides a screenshot of selecting 'Arboriculture' from Figure 2 and drilling down the hierarchy to provide details of the

a) hierarchical tree, with broader terms
b) related terms, and
c) narrower terms.

Where returned from the HILT SRW server, non-preferred terms are also provided since these may prove useful to the user in query reformulation and the interrogation of alternative repositories.

It is also worth noting that the user can select any term they encounter while browsing scheme hierarchies in order to initiate a search of collections or services.
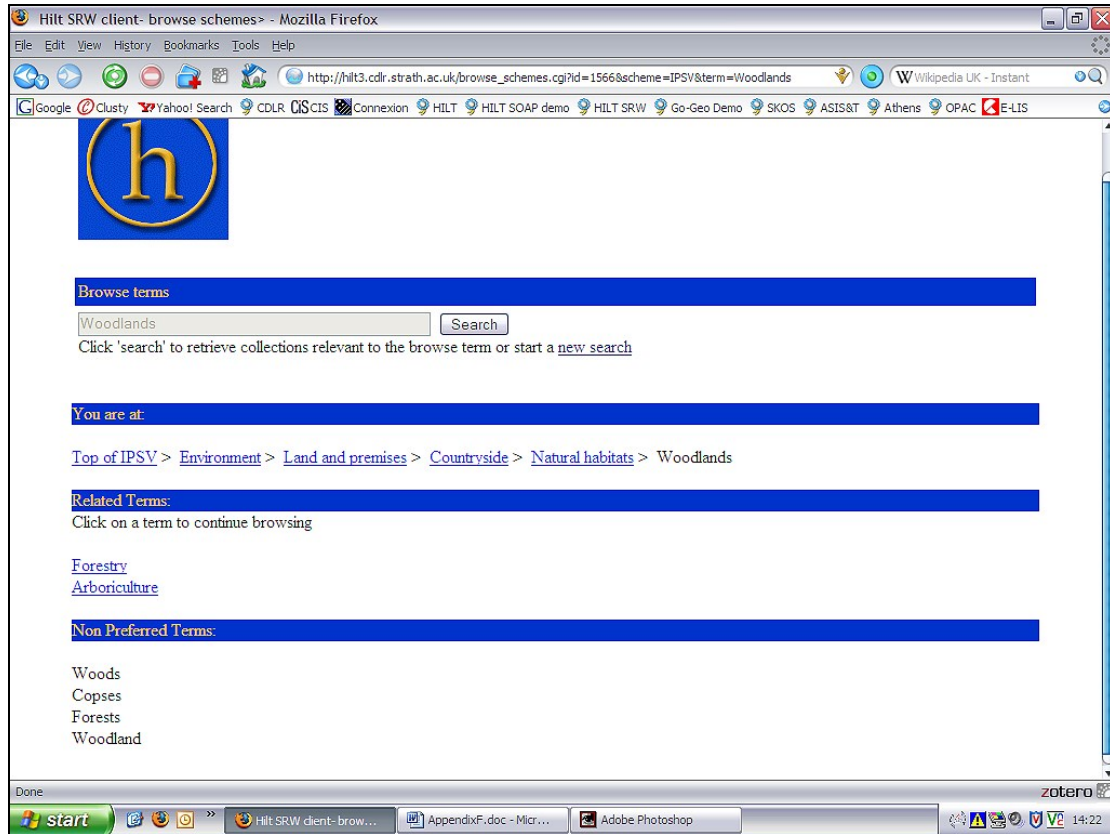
Figure 4: Screenshot of selecting 'Woodlands' from the 'Arboriculture' screen in Figure 3.

Figure 4 (above) demonstrates how a user can qualify an information query by browsing scheme hierarchies and reviewing broader and narrower terms, and related terms. In Figure 3 the user has perused 'Arboriculture' but has decided that 'Woodlands' is more relevant. 'Woodlands' has therefore been selected by the user and has created the above resultant screen (Figure 4).

Once again, it is worth noting that the user can select any term they encounter while browsing scheme hierarchies in order to initiate a search of collections or services.

The following screenshots demonstrate the way in which scheme specific browsing can be invoked by services in response to a 'no hits' search by users, thus allowing them to browse scheme headings and refine search queries using correct terminology.
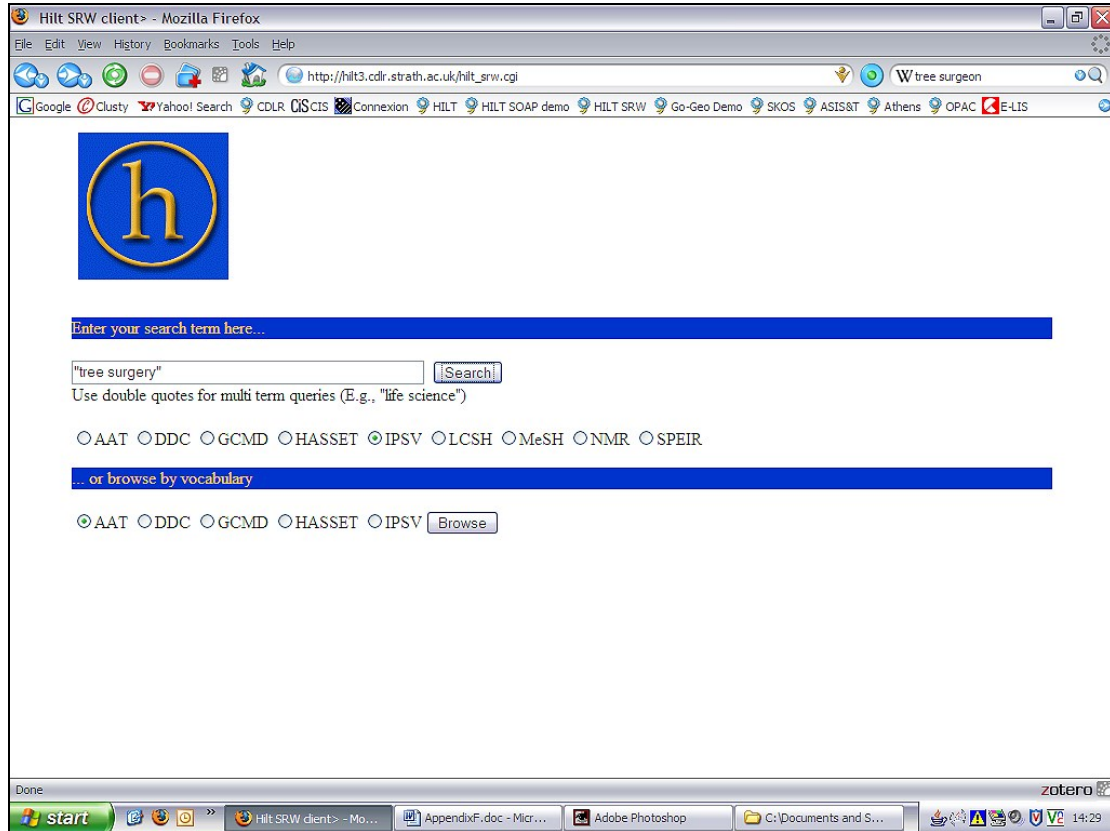
Figure 1: Screenshot of scheme specific browse custom client demonstrator home page.

Figure 1 (above) is a screenshot of the home page of the HILT Phase III scheme specific browse custom client demonstrator. The term 'tree surgery' has been entered into the search form as a potential user query and the Integrated Public Sector Vocabulary (IPSV) has once again been selected as the scheme. As in our previous example for the term 'Woodlands', such a scheme selection is rather artificial since in practice client services would have a particular scheme selected as their default terminology. Our selection process has been incorporated in our custom client to allow and demonstrate the browsing of a variety of schemes.
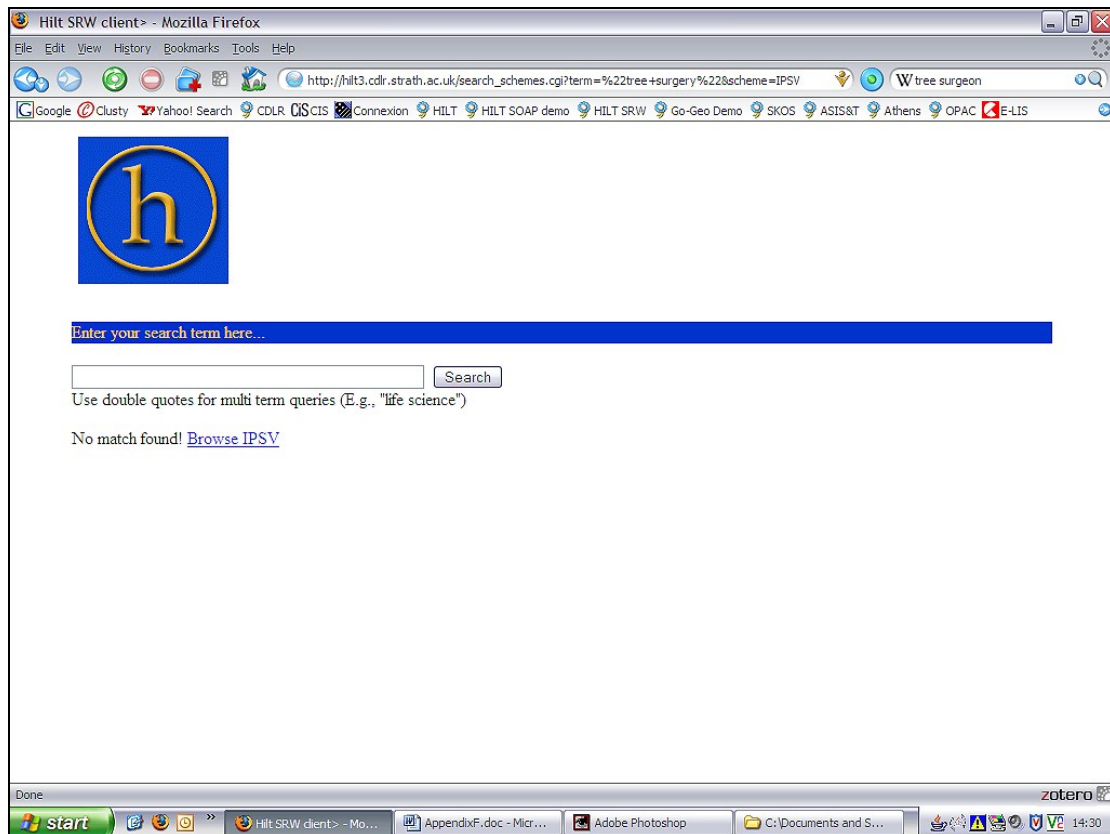
Figure 2: Screenshot of illustrating a 'no hit' result for a user search.

Figure 2 (above) demonstrates a 'no hit' search result by the user. Since no match has been found for their query, the user is presented with the opportunity to browse the IPSV hierarchy in order to qualify their information need and to use the correct terminology to satisfy this need.
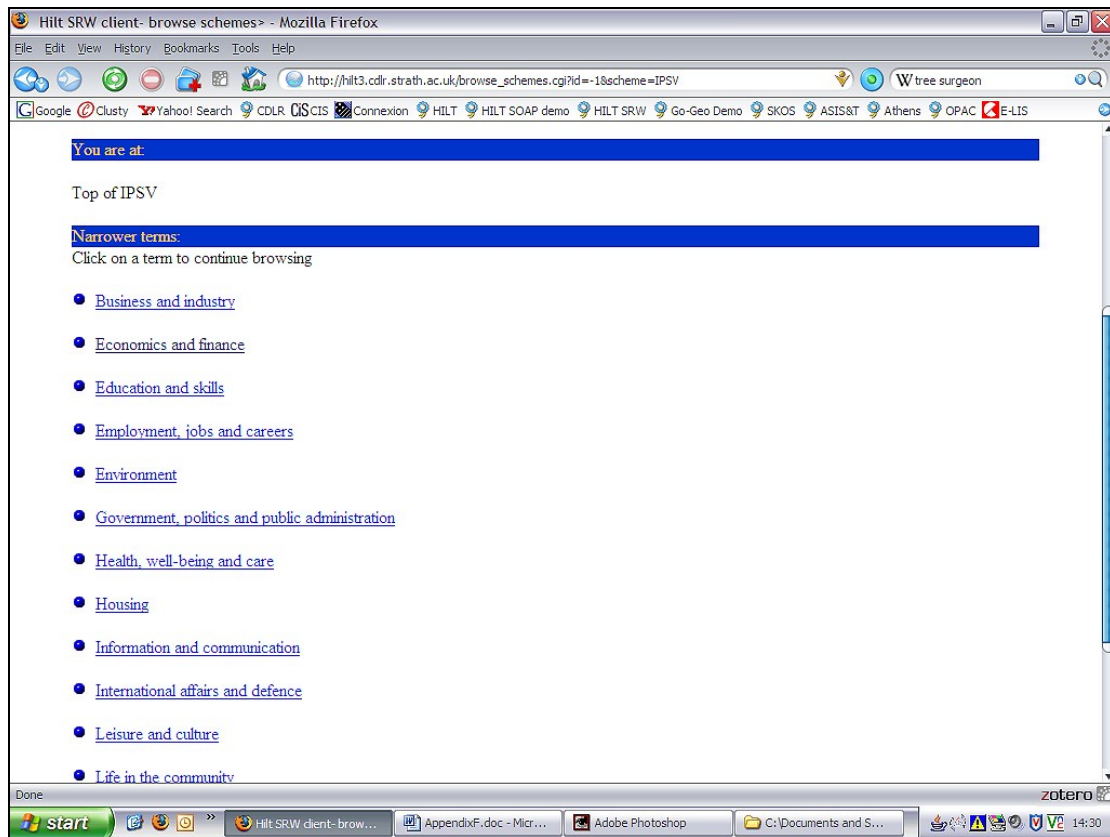
Figure 3: Screenshot of IPSV hierarchical browsing.

Figure 3 (above) illustrates the hierarchical browsing of IPSV, initiated via Figure 2. In the above screenshot shows the top level of IPSV. 'Environment' has been selected by the user.
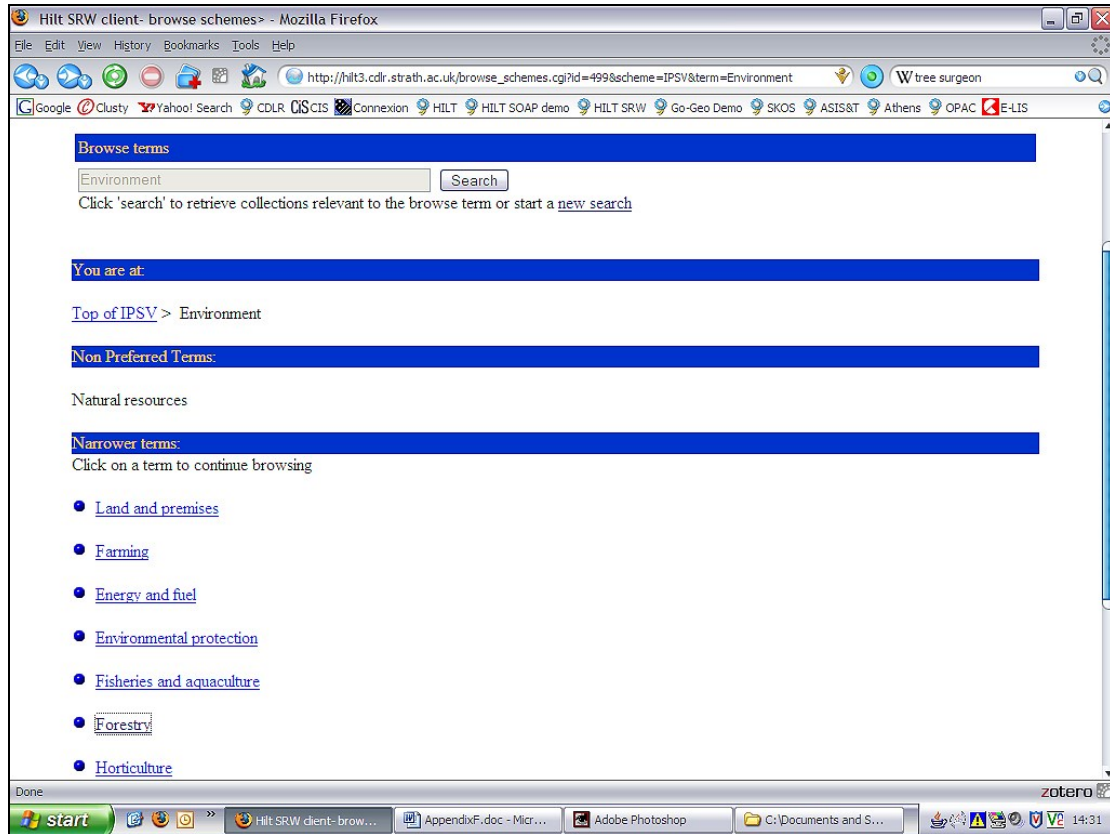
Figure 4: Screenshot of drilling down the IPSV hierarchical via hierarchical browsing.

Figure 4 (above) illustrates 'drilling down' the IPSV hierarchical tree. In Figure 3 the term 'Environment' was selected. This takes the user to a higher degree of specificity and allows the user to browse details of the

a) the hierarchy, and broader terms,
b) narrower terms, and
c) non-preferred terms.

Related terms are also provided, where they are available.

In the above example, there are numerous narrower terms. Since the original user query pertained to 'tree surgery', the user peruses the narrower terms and selects 'Forestry' as the most relevant.

Note that the user can select any term they encounter while browsing scheme hierarchies in order to initiate a search of collections or services.
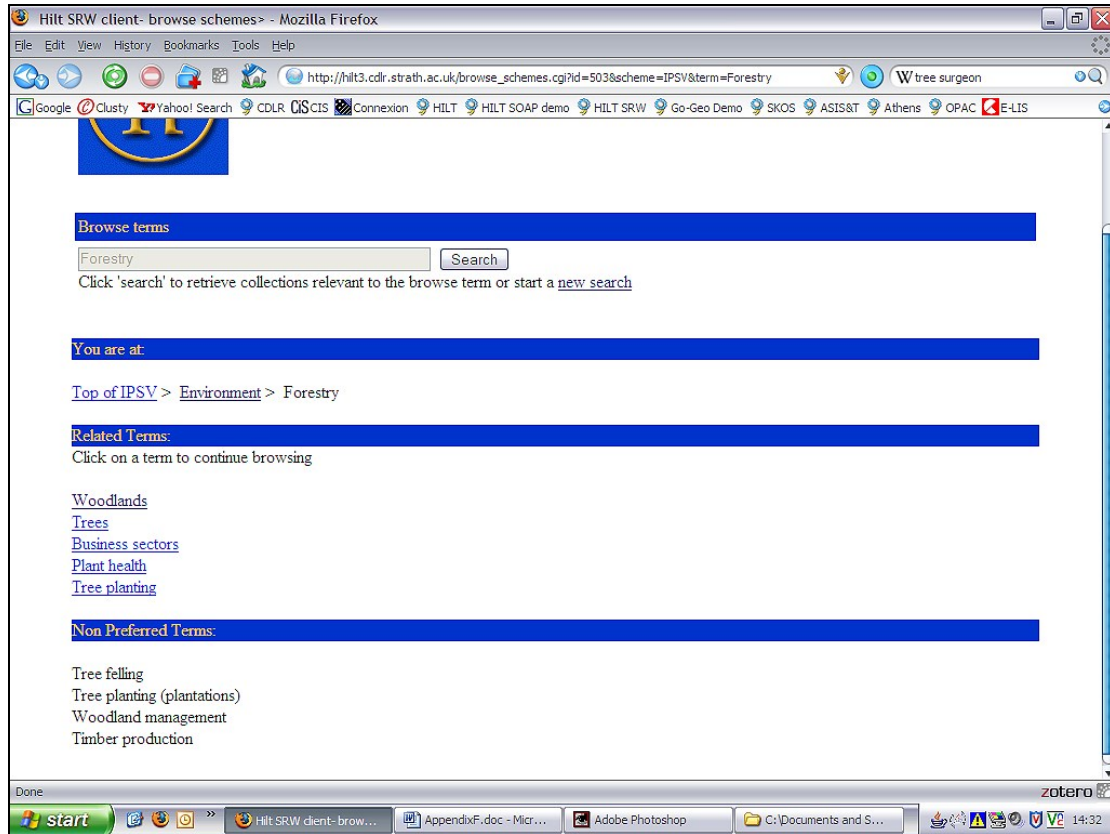
Figure 5: Screenshot of drilling down the IPSV hierarchical via hierarchical browsing, after selecting 'Forestry'.

Figure 5 (above) illustrates further 'drilling down' the IPSV hierarchical tree. In Figure 4 the user could not find terms characterising their search query. To continue the search for appropriate search terms, the user selected 'Forestry' to continue the hierarchical browsing. The greater specificity allows the user to browse details of the

a) the hierarchy, and broader terms,
b) narrower terms,
c) related terms, and
d) non-preferred terms.

Note that the user can select any term they encounter while browsing scheme hierarchies in order to initiate a search of collections or services.

In our fictional example illustrated above, the user satisfies his/her information need by clicking the term 'Tree planting', thus providing the user with a relevant search term (IE 'Tree management') as illustrated below in Figure 6. The user can then use this term to dynamically search local or distributed collections/services for relevant items meeting the specified search criteria.

Figure 6: Screenshot snippet of user clicking on 'Tree planting' in Figure 5 to reveal the relevant search term, 'Tree management'.

Appendix G: Proposal for HILT Phase IV

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[37]. Phase III built an M2M pilot interoperability service that:

5. Offers web services access via the (SOAP-based[38]) SRW protocol[39], but is designed so that a possible extension offering other protocols (Z39.50[40], or SRU[41], for example) at a later date could be an option.
6. Uses SKOS Core[42] 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[43] and Zthes[44] would be an option at a later date.
7. Provides the pilot datasets, mappings, and functionality capable of servicing the 5 use cases agreed in the HILT M2M Feasibility Study.
8. 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[45], it is now proposed to move HILT to a transition to service phase which would:

6. Utilise SRW, SOAP, and SKOS to build a baseline or entry-level[46] 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.
7. Evaluate[47] 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.
8. 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

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[37] HILT Machine to Machine (M2M) Feasibility Study: http://hilt.cdlr.strath.ac.uk/hiltm2mfs/
[38] SOAP: http://www.w3.org/TR/soap/
[39] Search/Retrieve Web Service (SRW): http://www.loc.gov/standards/sru/
[40] Z39.50: http://www.loc.gov/z3950/agency/
[41] Search/Retrieve via URL (SRU): http://www.loc.gov/standards/sru/
[42] Simple Knowledge Organization System (SKOS) Core: http://www.w3.org/2004/02/skos/
[43] MARC Concise Format for Authority Data: http://www.loc.gov/marc/authority/
[44] Zthes: http://zthes.z3950.org/
[45] 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.
[46] 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.
[47] 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.

dissemination programme spelling out the advantages 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.

9. 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 preferred spines for specific query types where options exist; many to many mappings; guidelines for others wishing to produce HILT-compatible mappings themselves[48]; 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.

10. 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[49] and EDINA[50], and of the HILT terminology advisors, together with some ongoing liaison with UKOLN[51], who are the project's advisors on the MIMAS[52] IESR[53] project and on intute[54].

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[55] have again agreed to provide free access to the electronic files of DDC[56] and of LCSH mappings to DDC[57]. 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

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[48] 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.

[49] Centre for Digital Library Research (CDLR): http://cdlr.strath.ac.uk/

[50] EDINA: http://edina.ac.uk/

[51] UKOLN: http://www.ukoln.ac.uk/

[52] Manchester Information & Associated Services (MIMAS): http://www.mimas.ac.uk/

[53] Information Environment Services Registry (IESR): http://iesr.ac.uk/

[54] intute: http://www.intute.ac.uk/

[55] OCLC Online Computer Library Center: http://www.oclc.org/

[56] Dewey Decimal Classification (DDC): http://www.oclc.org/dewey/

[57] LCSH to DDC mappings: http://www.oclc.org/asiapacific/zhcn/dewey/updates/numbers/default.htm
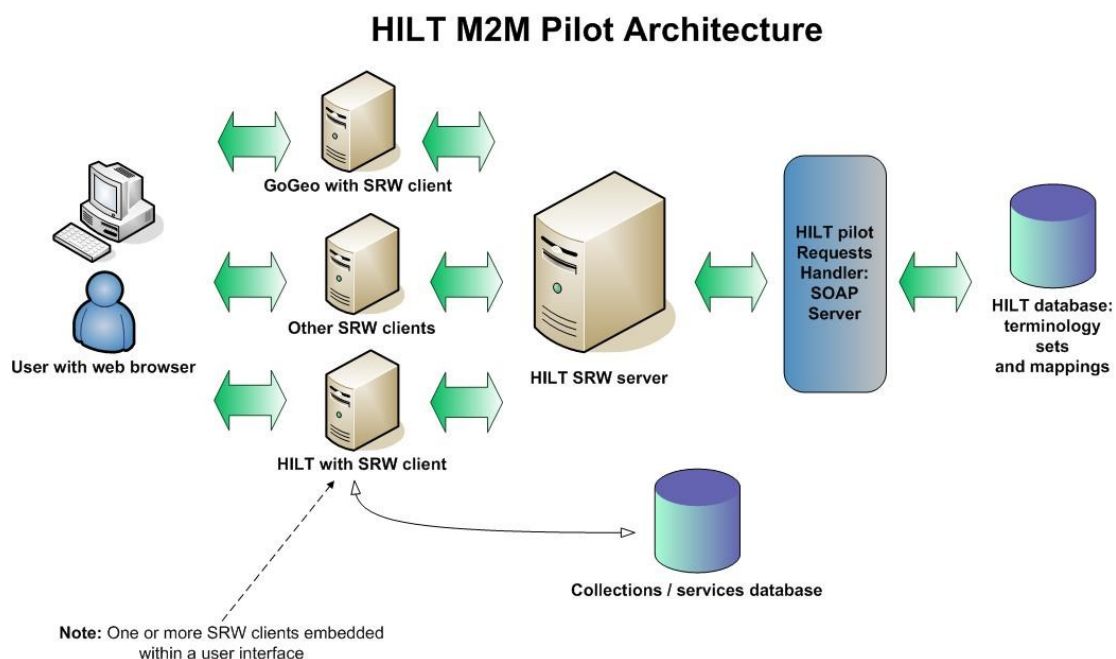
Ensuring that FE and HE users of the JISC IE can find appropriate learning, research and information resources by subject search and browse in an environment where most service providers use different subject schemes to describe their resources is a major challenge facing the JISC domain (and, indeed, other domains beyond JISC). To date, HILT has:

3. 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[58]).
4. 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).
5. 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).
6. 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.

HILT M2M Pilot Architecture

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

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 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[59], IPSV[60], AAT[61], GCMD[62], HASSET[63], MeSH[64], NMR[65], JACS[66], UNESCO[67].
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-

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

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 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[68] a minimum of two representative stand-alone JISC information services and/or aggregator facilities[69], 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[70], 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[71]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

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[68] The client would be embedded in service interfaces to offer HILT- based terminology and interoperability services transparent to local service users

[69] e.g. a Z39.50 clump like CAIRNS or M25 or a repositories service like IRI-Scotland or a union catalogue like Suncat

[70] Or the 1000 (or thereabouts) considered most useful by in-project experts.

[71] 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.

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 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[72], the NLS[73] and NLW[74]) via the project Steering Group.

Deliverables

The HILT Phase IV deliverables will be:

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[72] British Library (BL): http://www.bl.uk/
[73] National Library of Scotland (NLS): http://www.nls.uk/
[74] National Library of Wales (NLW): http://www.llgc.org.uk/

- 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.
- 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[75] that might be discovered via IESR

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

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.
- 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	CDLR with advice from EDINA

performance levels.	
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 interoperability services that might be discovered via IESR or similar services, either now or in future.	CDLR
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[76] 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[77]. It is also aware of current developments with respect to the Z39.19 'thesaurus standard'[78]. 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. Costs

Year 1: 19/3/07 – 31/7/07	Costs
CDLR Project Director (1 day per week for 4.5 months)	Donated
CDLR Project/Terminologies Manager (0.6FTE for 4.5 months)	£ 7,793
CDLR Programming Costs (0.5 FTE for 4.5 months)	£ 6,695
EDINA staff Costs (0.33FTE for 4.5 months)	£ 7,204
EDINA other Costs (50% of FTE related) (4.5 months)	£ 2,841

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

Specialist terminologies advice and mapping work	£ 2,143
Evaluation Planning and Execution Consultancy	£ 1,071
Travel and Subsistence Costs	£ 643
Hardware Costs	£ 1,000
Year 1 Total	**£ 29,390**

Year 2: 1/8/07 – 31/7/08	**Costs**
CDLR Project Director (1 day per week for 12 months)	Donated
CDLR Project/Terminologies Manager (0.6FTE for 12 months)	£ 22,333
CDLR Programming Costs (0.5FTE for 12 months)	£ 19,421
EDINA staff Costs (0.33 FTE for 12 months)	£ 19,210
EDINA other Costs (50% of FTE related) (12 months)	£ 7,576
Specialist terminologies advice and mapping work	£ 5,714
Evaluation Planning and Execution Consultancy	£ 2,857
Travel and Subsistence Costs	£ 1,714
Year 2 Total	**£ 78,825**

Year 3: 1/8/08 – 19/12/08	**Costs**
CDLR Project Director (1 day per week for 4.5 months)	Donated
CDLR Project/Terminologies Manager (0.6FTE for 4.5 months)	£ 9,366
CDLR Programming Costs (0.5FTE for 4.5 months)	£ 7,834
EDINA staff Costs (0.33FTE for 4.5 months)	£ 7,204
EDINA other Costs (50% of FTE related) (4.5 months)	£ 2,841
Specialist terminologies advice and mapping work	£ 2,143
Evaluation Planning and Execution Consultancy	£ 1,071
Travel and Subsistence Costs	£ 643
Year 3 Total	**£ 31,102**

Total Direct Costs (as broken down into 3 years above)	**£139,317**

Additional Costs (for 21 month project)	**Costs**
Estates Costs (Strathclyde University)	£ 15,228
Indirect Costs (Strathclyde University)	£ 78,034
General Technical Support (Strathclyde University)	£ 6,144

Total Additional Costs (for 21 month project)	**£ 99,406**

JISC agreed to pay 50% of Additional Costs	**£ 49,703**

OVERALL TOTAL (Total Direct Costs + 50% Additional Costs)	**£189,020**

11. 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.

12. 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.

13. 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.

14. 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

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																				▪	▪	▪

Appendix H: Use Case submitted to the W3C Semantic Web Deployment Working Group

Simple Knowledge Organization Systems (SKOS): Call for use cases

High-level Thesaurus (HILT) projects

Questions marked with an asterix (*) are more important.

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Section 0. Contact and confidentiality
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Contact e-mail:

George Macgregor: george.macgregor@strath.ac.uk
Emma McCulloch: e.mcculloch@strath.ac.uk
Dennis Nicholson: d.m.nicholson@strath.ac.uk

Do you mind your use case being made public on the working group website and documents?

No.

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Section 1. Application
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In this section we ask you to provide some information about the application for which the vocabulary(ies) and or vocabulary mappings are being used.

Please note:
 -- If your use case does not involve any specific application, but consists rather in the description of a specific vocabulary, skip straight to Section 2.
 -- If your application makes use of links between different vocabularies, do not forget to fill in Section 3!

1.1. What is the title of the application?

High-level Thesaurus (HILT) (http://hilt.cdlr.strath.ac.uk/)

1.2. What is the general purpose of the application?
What services does it provide to the end-user?

Problems relating to the use of terminologies use have been an impediment to information retrieval for many years, but the growth of Web, associated heterogeneous digital repositories, and the need for distributed cross-searching within multi-scheme information environments has recently drawn the issue into sharp focus. The HILT project, which is now in phase III, aims to research, investigate and develop solutions for problems pertaining to cross-searching multi-subject scheme information environments, as well as providing a variety of other terminological searching aids. The project is currently at a pilot stage.

The current phase of HILT (phase III) is researching and developing the creation of an M2M demonstrator that will offer web services access via the (SOAP-based) SRW protocol and use SKOS Core as the 'mark-up' for sending terminology sets and maintaining the structural nature of the terminological data requested and/or found in the database.

The expectation is that services will employ Search/Retrieve Web service (SRW) clients to interact transparently with the SRW compliant terminology mapping server during normal service operation. Client requests made to the server will be sent to a database of terminology sets and associated mappings to DDC (the Dewey Decimal Classification system is used as the basis of vocabulary switching). Hits identified are then sent back to the server for onward communication to the SRW clients. Although one of the primary purposes of HILT is to provide mappings, it also offers a variety of other terminological functions (e.g. data for interactive query expansion, hierarchical browsing of specific scheme hierarchies, etc.).

Experimentation with bona fide services has been conducted as part of HILT phase III (e.g. GoGeo!: http://www.gogeo.ac.uk/). To date, only a pilot implementation is available.

1.3. Provide some examples of the functionality of the application. Try to illustrate all of the functionalities in which the vocabulary(ies) and/or vocabulary mappings are involved.

In brief, HILT provides a series of functions that can be invoked by client services for a variety of purposes. It is therefore difficult to anticipate how such data might be used by third parties or how they might enhance the functionality of local services. However, the current functions are described and summarised in Table 1 and hints at anticipated use are also provided. Only those functions requesting terminological data (and ergo SKOS Core) are described below.

Function name	Description	Notes and anticipated use
get_all_records	Get records that include – or are directly or indirectly mapped to records that include – specified term or term phrase.	User enters term via the embedded SRW client service (and request is sent to SRW server and SOAP requests handler). The client service processes the results to offer DDC and non-DDC records (e.g. LCSH, IPSV, AAT, etc.) to the user.
get_ddc_records	Get any DDC record that either includes the term specified, or that is mapped to by a record that includes the term specified.	User enters term via the embedded SRW client service (and request is sent to SRW server and SOAP requests handler). The client service processes the results to offer the user captions possibly relevant to their query from DDC with corresponding DDC numbers.
get_non_ddc_records	Get any non-DDC record that includes a mapping to the DDC number sent.	Following identification of a DDC number by the user (either via a disambiguation process or by some other means), get_non_DDC_records allows the client to request details of any non-DDC record that includes a mapping to the DDC number sent. This process enables the identification of a variety of terms from disparate terminologies associated with a particular DDC number to be used to search relevant repositories or information services using the correct terminology to match local indexes.

get_filtered_set	Get record and fields terminology set that meets the specified parameters.	Filters would be by things such as subject scheme (e.g. UNESCO and LCSH only, say), or specified fields (e.g. mappings only, say, or broader terms and narrower terms only, say) and so on. The primary anticipated purpose of get_filtered_set is to facilitate the enrichment of users' search vocabulary, provide user feedback and allow limited interactive query expansion. The filtered search can provide (where they exist) related terms (RT), broader terms (BT), narrower terms (NT), preferred terms (PT), and non-preferred terms (NPT). Scope notes may also be provided, depending on the characteristics of the terminology. As a requirement of earlier project work, get_filtered_set can also be invoked to provide the data necessary to create browsable hierarchical concept trees.

Table 1: HILT (phase III) SOAP functions

1.4. What is the architecture of the application?
What are the main components?
Are the components and/or the data distributed across a network, or across the Web?

The application is invoked via an appropriately configured SRW client. The application comprises an SRW server, SOAP server (requests handler, wrapping responses in SKOS Core) and terminology database (complete with mappings to the DDC spine). Our testing architecture also includes collections databases (e.g. the UK Information Environment Services Registry (IESR), Scottish Collections Network (SCONE, etc.); however, this does not return terminological data[79] and can be ignored for the purposes of this document. Figure 1 illustrates how the various nodes interact.

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[79] The HILT get_collections function initiates interaction with collection databases and although not providing terminological data does provide details of the terminologies in use at particular collections or services. Data returned in response to the get_collections function is wrapped in the Dublin Core Collection Description Schema.
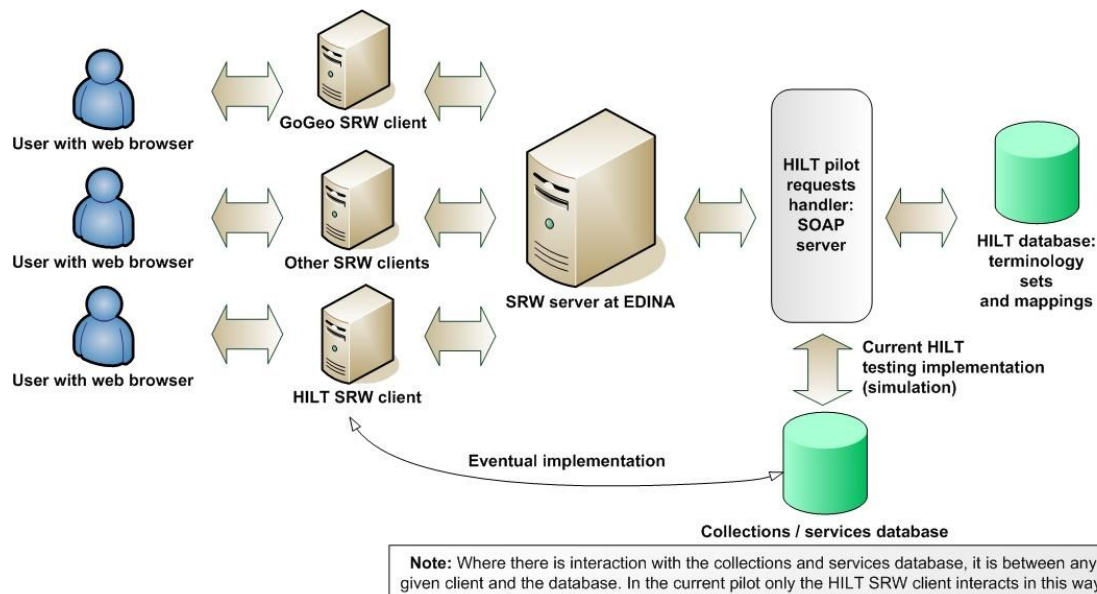
Note: Where there is interaction with the collections and services database, it is between any given client and the database. In the current pilot only the HILT SRW client interacts in this way.

Figure 1: HILT (Phase III) architecture

1.5. Briefly describe any special strategy involved in the processing of user actions, e.g. query expansion using the vocabulary structure.

Not applicable in our instance. See 1.6 below.

1.6. Are the functionalities associated with the controlled vocabulary(ies) integrated in any way with functionalities provided by other means? (For example, search and browse using a structured vocabulary might be integrated with free-text searching and/or some sort of social bookmarking or recommender system.)

HILT is a web-service and it would up to client service administrator whether they wished to incorporate the types of functionalities mentioned in 1.6. In addition, HILT is a third party service and therefore has little knowledge of the documents held (or their indexes) by services. HILT does currently use the Google spellchecker (via the Google API) on the server side. This is expected to be removed in future as the 'Did you mean' suggestions offered by Google does not meet the functionality required by HILT. The Google spellchecker is expected to be replaced with a spellchecking/suggestions tool more suitable for the application in the near future.

1.7. Any additional information, references and/or hyperlinks.

HILT website: http://hilt.cdlr.strath.ac.uk/
HILT III pilots & demonstrators: http://hilt.cdlr.strath.ac.uk/hilt3web/pilots.html
HILT III requirements document (Version 6.0):
http://hilt.cdlr.strath.ac.uk/hilt3web/reports/h3requirementsv6.pdf

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

Nicholson, D. & McCulloch, E. HILT Phase III: Design requirements of an SRW-compliant Terminologies Mapping Pilot, *5th European Networked Knowledge Organization Systems (NKOS) Workshop, 10th ECDL Conference*, 21 September 2006, Alicante, Spain, 2006. Available: http://hilt.cdlr.strath.ac.uk/hilt3web/Dissemination/HILTECDLwithnotes.pdf

Nicholson D. & McCulloch E. Interoperable Subject Retrieval in a Distributed Multi-Scheme Environment: New Developments in the HILT Project, *Ibersid, 2-4 November 2005*, Zaragoza, Spain, 2005. Available: http://cdlr.strath.ac.uk/pubs/nicholsond/ZaragosaPaperFinal.pdf

Macgregor, G., Joseph, A. & Nicholson, D. A SKOS Core approach to implementing an M2M terminology mapping server, International Conference on Semantic Web and Digital Libraries (ICSD-2007), 21-23 February 2007, Documentation Research & Training Centre (DRTC), Indian Statistical Institute (ISI), R.V. College, Bangalore, India, 2007. (An online version should be available by late Feb 2007)

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Section 2. Vocabulary(ies)
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In this section we ask you to provide some information about the vocabulary or vocabularies you would like to be able to represent using SKOS.

Please note:
 -- If you have multiple vocabularies to describe, you may repeat this section for each one individually or you may provide a single description that encompasses all of your vocabularies.
 -- If your use case describes a generic application of one or more vocabularies and/or vocabulary mappings, you may skip this section.
 -- If your vocabulary case contains cross-vocabulary links (between the vocabularies you presented or to external vocabularies), please fill in section 3!

For HILT to solve issues pertaining to interoperability, it is possible that any terminology may need to be modelled using SKOS Core. Currently however, HILT is experimenting with the following terminologies:

- Art and Architecture Thesaurus (AAT), The J. Paul Getty Trust. See: http://www.getty.edu/research/conducting_research/vocabularies/aat/
- Dewey Decimal Classification (DDC), OCLC. See: http://www.oclc.org/dewey/default.htm
- Global Change Master Directory (GCMD) (Science Keywords), NASA. See: http://gcmd.nasa.gov/Resources/valids/keyword_list.html
- HASSET Thesaurus, UK Data Archive at the University of Essex. See: http://www.data-archive.ac.uk/search/hassetSearch.asp
- Integrated Public Sector Vocabulary (IPSV), e-Government Unit (UK). See: http://www.esd.org.uk/standards/ipsv/2.00/viewer/
- Joint Academic Coding System (JACS), Universities and Colleges Admission Service (UK). See: http://www.ucas.ac.uk/figures/ucasdata/subject/
- JITA Classification Schema, E-Prints in Library and Information Science (E-LIS). See: http://eprints.rclis.org/jita.html
- Library of Congress Subject Headings (LCSH), Library of Congress (USA). See: http://www.loc.gov/cds/lcsh.html
- Medical Subject Headings (MeSH), National Library of Medicine (USA). See: http://www.nlm.nih.gov/mesh/
- National Monuments Record Thesaurus (NMR), English Heritage. See: http://thesaurus.english-heritage.org.uk/
- UNESCO Thesaurus, UNESCO and the University of London Computer Centre. See: http://www2.ulcc.ac.uk/unesco/

Because HILT has to serve data on each terminology dynamically, it is not possible to model the particular nuances of every terminology exactly; rather, a generic approach is taken since most of the terminologies represent some form of relational vocabulary (e.g. thesauri, subject heading lists, etc.). The exception to this is DDC. Terminological data pertaining to DDC is modelled in SKOS according to basic guidance discussed on the SKOS email list http://lists.w3.org/Archives/Public/public-esw-thes/ and http://esw.w3.org/topic/SkosDev/ClassificationPubGuide.

2.1. What is the title of the vocabulary? If you're describing multiple vocabularies, please provide as many titles as you can.

See answer to question 2.

2.2. Briefly describe the general characteristics of the vocabulary, e.g. scope, size...

- AAT: 34,000 concepts, comprising 131,000 terms. Focussed on describing art, architecture, decorative arts, material culture, and archival materials.
- DDC: 40,000 numbers and associated captions. A universal classification scheme aiming to accommodate most areas of knowledge at varying levels of specificity. Note that DDC contains many more numbers for representing concepts; however, the version in use by HILT is a truncated version supplied by OCLC based on their People, Places and Things handbook (See Mitchell, 2001).
- GCMD: 1,500 terms. Focussed on concepts pertaining to earth science (e.g. geology, marine science, oceanography, etc.).
- HASSET: 10,000 terms.
- IPSV: 8,000 terms. A scheme primarily optimised for resource discovery in UK public sector organisations.
- JACS: A simple term list pertaining to the UK Higher Education sector, with only 100 terms.
- JITA: A simple term list as used by E-LIS. Focussed on library and information science and comprises 150 terms.
- LCSH: 62,000 terms. A universal subject heading scheme aiming to accommodate most areas of knowledge.
- MeSH: 25,000 terms, focussed on medicine and allied sciences.
- NMR: 10,000 terms. A scheme primarily focussed on representing common assets found in the area of national heritage, such as buildings, monuments, cultural sites, and so forth.
- UNESCO: 5,000 terms. The UNESCO Thesaurus includes subject terms for the areas of education, science, culture, social and human sciences, information and communication, and politics, law and economics. It also includes countries and groupings of countries: political, economic, geographic, ethnic and religious, and linguistic groupings.

2.3. In which language(s) is the vocabulary provided?
In the case of partial translations, how complete are these?

All terminologies are currently provided in English (UK/US). Experimentation and the incorporation of multi-lingual terminologies is a future aspiration of the HILT team.

2.4. Please provide below some extracts from the vocabulary. Use the layout or presentation format that you would normally provide for the users of the vocabulary. Please ensure that the extracts you provide illustrate all of the features of the vocabulary.

This question is not necessarily applicable to HILT (see 2.6 for machine-readable representations of some of the terminologies used by HILT).

HILT is a web-service. Any terminological data HILT provides is wrapped in SKOS Core[80] and is delivered to clients in response to client service requests. It is up to client services to use the data how they wish, this includes how they may wish to parse the data and how they may wish to present the terminological data requested to the user. The data sent to clients is modelled rather generically, but is sufficiently accurate to allow clients to parse data correctly, particularly for browsing dynamically created scheme specific hierarchical trees.

The terminologies offered are widely used by digital libraries, repositories and information services within the UK and beyond. Further details on any specific characteristics of the terminologies used can be gleaned at the URLs given in the answer to question 2. Most are relational vocabularies, such as thesauri and subject heading lists (IE UNESCO, NMR, HASSET, MeSH, IPSV, LCSH, AAT). The mapping spine used for switching (IE DDC) is a taxonomic classification with analytico-synthetic attributes. There are several terms lists (IE JACS, JITA, GCMD); their simple structure reflects this.

2.5. Describe the structure of the vocabulary.

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[80] Note that because the HILT get_collections function does not provide terminological data, responses are wrapped in the Dublin Core Collection Description Schema.

What are the main building blocks?
What types of relationship are used? If you can, provide examples by referring to the extracts given in paragraph 2.4.

See 2.4 above.

2.6. Is a machine-readable representation of the vocabulary already available (e.g. as an XML document)? If so, we would be grateful if you could provide some example data or point us to a hyperlink.

We have created a mock client (IE HILT SOAP client demonstrator) to enable testing. This allows the HILT functions to be invoked and for machine-readable representations of the vocabularies (IE SKOS Core) and their mappings (where applicable) to be viewed within SOAP envelopes. Representations of the terminologies in use can be viewed in this way.

The HILT SOAP client demonstrator is available at: http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/hiltsoapclient.php. Please refer to the functions table (Table 1) provided in 1.3 to interpret HILT functions correctly. Please note that regular and ongoing modifications to the SKOS Core wrappings are made to improve the way in which terminologies are modelled.

2.7. Are any software applications used to create and/or maintain the vocabulary?
Are there any features which these software applications currently lack which are required by your use case?

Maintenance of the terminologies is not applicable in our case since all the terminologies used are maintained by external agencies; we normally receive copies of these terminologies from maintenance agencies (e.g. XML) for database importation. Where updates have taken place terminologies are re-imported.
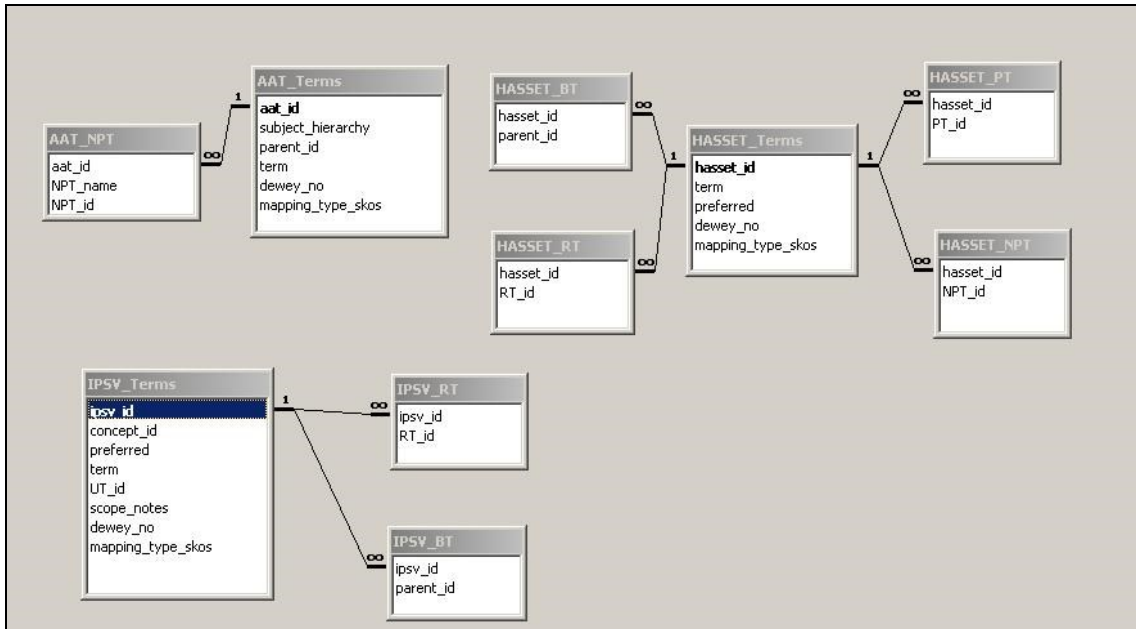
Occasional 'cleaning up' of this data is required in order to eliminate non-standard characters arising from ASCII, but this is normally undertaken by editing data directly or running routines in the database (SQL Server). Mappings (using DDC notation) and their equivalences are maintained in this way also, although it is our intention to create a suitable user interface to aid mapping management.

2.8. If a database application is used to store and/or manage the vocabulary, how is the database structured? Illustration by means of some table sample is welcome.

A relational database management system (SQL server) is used to manage the terminologies. The table structure is different for each terminology in order to maintain the structure of the terminology as received from external agencies. This aids consistency and makes maintenance simpler. Even though all the terminologies are included in a single database, they remain independent of each other.

Owing to the large number of terminologies HILT is managing - many of which are complex - we provide only a small sample below. Please feel free to get in touch to discuss this further or to receive further samples. Below is a table diagram of AAT (two tables), HASSET (five tables) and IPSV (three tables).

Please note: RT - Related Term
               BT - Broader Term
               PT - Preferred Term
               NPT - Non Preferred Term

AAT_NPT
aat_id
NPT_name
NPT_id

AAT_Terms
aat_id
subject_hierarchy
parent_id
term
dewey_no
mapping_type_skos

HASSET_BT
hasset_id
parent_id

HASSET_RT
hasset_id
RT_id

HASSET_Terms
hasset_id
term
preferred
dewey_no
mapping_type_skos

HASSET_PT
hasset_id
PT_id

HASSET_NPT
hasset_id
NPT_id

IPSV_Terms
ipsv_id
concept_id
preferred
term
UT_id
scope_notes
dewey_no
mapping_type_skos

IPSV_RT
ipsv_id
RT_id

IPSV_BT
ipsv_id
parent_id

2.9. Were any published standards, textbooks or written guidelines followed during the design and construction of the vocabulary?
Did you decide to diverge from their recommendations in any way, and if so, how and why?

Not applicable. See 2.7.

2.10. How are changes to the vocabulary managed?

Changes to the terminologies are not managed by HILT (See 2.7). As noted in 2.7, terminology mappings and their equivalences are maintained by editing the database directly.

2.11. Any additional information, references and/or hyperlinks.

Nicholson, D. & McCulloch, E. (2006). HILT Phase III: Design requirements of an SRW-compliant Terminologies Mapping Pilot, *5th European Networked Knowledge Organization Systems (NKOS) Workshop, 10th ECDL Conference, 21 September 2006*, Alicante, Spain.   Available: http://hilt.cdlr.strath.ac.uk/hilt3web/Dissemination/HILTECDLwithnotes.pdf

Mitchell, J, S. (ed). (2001). *People, places and things. A list of popular Library of Congress Subject Headings with Dewey numbers*. Forest Press, Ohio.

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Section 3. Vocabulary Mappings
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In this section we ask you to provide some information about the mappings or links between vocabularies you would like to be able to represent using SKOS.

Please note:
 -- If your use case does not involve vocabulary mappings or links, you may skip this section!

3.1. Which vocabularies are you linking/mapping from/to?

As mentioned in sections 1 and 2, HILT is using a number of terminologies. These are listed in section 2. Concepts from these terminologies are mapped to a central spine (DDC) which is used as a switching language to facilitate the following HILT functions: get_all_records, get_ddc_records and get_non_ddc_records.

3.2. Please provide below some extracts from the mappings or links between the vocabularies. Use the layout or presentation format that you would normally provide for the users of the mappings. Please ensure that the examples you provide illustrate all of the different types of mapping or link.

As in 2.4, this question is not necessarily applicable to HILT. HILT is a web-service. Any terminological data HILT provides is wrapped in SKOS Core (and the Mapping Vocabulary Specification (MVS) where applicable) and is delivered to clients in response to client service requests. Client services are responsible for how they wish to present mappings or other terminological data to users.

Some illustrative SKOS Core and MVS examples are provided below. However, since HILT uses a number of terminologies, readers are encouraged to use the mock client (IE HILT SOAP client demonstrator) to view the mappings. The HILT SOAP client demonstrator is available at: http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/hiltsoapclient.php.

Useful test terms to input when using the SOAP client demonstrator for get_all_records and get_ddc_records[81] are:

- *Environmental impacts* (GCMD)
- *Shore protection* (DDC)
- *Plant genetics* (HASSET)
- *Civil emergencies* (IPSV)
- *Land use site* (NMR)

Useful test DDC numbers to input for get_non_ddc_records are:

- 363.73 (DDC caption: Pollution)
- 627.58 (DDC caption: Shore protection)
- 631.53 (DDC caption: Plant propagation)
- 363.34 (DDC caption: Disasters)
- 333 (DDC caption: Economics of land and energy)

Brief example 1: get_all_records request for the GCMD term 'Environmental impacts'.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.73">
        <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
        <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104530"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104531"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85104532"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#2582"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#708"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#4794"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#1037"/>
        </map:exactMatch>
```

---

[81] It is worth noting that the get_ddc_records function (unlike get_all_records or get_non_ddc_records) does not return a response containing mappings using the SKOS Core Mapping Vocabulary Specification (MVS); rather, get_ddc_records uses mappings to find equivalent terms in other terminologies and then sends the results to the client service. In short, the relationship between the submitted term and the resultant term(s) is not encoded.

```
</skos:Concept>
<skos:Concept rdf:about="#sh 85104530">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104531">
        <skos:prefLabel xml:lang="en">Pollution--Economic aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104532">
        <skos:prefLabel xml:lang="en">Pollution--Environmental aspects</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2582">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#708">
        <skos:prefLabel xml:lang="en">Environmental Impacts</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4794">
        <skos:prefLabel xml:lang="en">POLLUTION</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1037">
        <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
```

Brief example 2: get_all_records request for the IPSV term 'Civil emergencies'.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.34">
        <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
        <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 85038303"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#sh 91000441"/>
        </map:exactMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#sh 85090214"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#2256"/>
        </map:narrowMatch>
        <map:narrowMatch>
                <skos:Concept rdf:about="#762"/>
        </map:narrowMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#2696"/>
        </map:exactMatch>
        <map:exactMatch>
                <skos:Concept rdf:about="#143"/>
        </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85038303">
        <skos:prefLabel xml:lang="en">Disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 91000441">
        <skos:prefLabel xml:lang="en">Emergency management</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85090214">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2256">
        <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#762">
        <skos:prefLabel xml:lang="en">Natural Hazards</skos:prefLabel>
        <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2696">
        <skos:prefLabel xml:lang="en">HAZARDS, ACCIDENTS AND DISASTERS</skos:prefLabel>
```

```
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#143">
                <skos:prefLabel xml:lang="en">Civil emergencies</skos:prefLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
```

Brief example 3: get_ddc_records request using the GCMD term 'Environmental impacts'.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#363.73">
                <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
                <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
</skos:Concept>
</rdf:RDF>
```

Brief example 4: get_ddc_records request using for the IPSV term 'Civil emergencies'.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">

<skos:ConceptScheme rdf:about="http://hiltm2m.cdlr.strath.ac.uk/schemes/DDC.xml"/>

<skos:Concept rdf:about="#363.34">
                <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
                <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
</skos:Concept>
</rdf:RDF>
```

Brief example 5: get_non_ddc_records request using the DDC number 363.73.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.73">
                <skos:prefLabel xml:lang="zxx">363.73</skos:prefLabel>
                <skos:altLabel xml:lang="en">Pollution</skos:altLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
                <map:exactMatch>
                        <skos:Concept rdf:about="#sh 85104530"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#sh 85104531"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#sh 85104532"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#2582"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#708"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#4794"/>
                </map:exactMatch>
                <map:exactMatch>
                        <skos:Concept rdf:about="#1037"/>
                </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104530">
                <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104531">
                <skos:prefLabel xml:lang="en">Pollution--Economic aspects</skos:prefLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85104532">
                <skos:prefLabel xml:lang="en">Pollution--Environmental aspects</skos:prefLabel>
                <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
```

```
<skos:Concept rdf:about="#2582">
          <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#708">
          <skos:prefLabel xml:lang="en">Environmental Impacts</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#4794">
          <skos:prefLabel xml:lang="en">POLLUTION</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#1037">
          <skos:prefLabel xml:lang="en">Pollution</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
```

Brief example 6: get_non_ddc_records request using the DDC number 363.34.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:map="http://www.w3.org/2004/02/skos/mapping#"
xml:base="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/concepts.php">
<skos:Concept rdf:about="#363.34">
          <skos:prefLabel xml:lang="zxx">363.34</skos:prefLabel>
          <skos:altLabel xml:lang="en">Disasters</skos:altLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/DDC.xml"/>
          <map:exactMatch>
                    <skos:Concept rdf:about="#sh 85038303"/>
          </map:exactMatch>
          <map:exactMatch>
                    <skos:Concept rdf:about="#sh 91000441"/>
          </map:exactMatch>
          <map:narrowMatch>
                    <skos:Concept rdf:about="#sh 85090214"/>
          </map:narrowMatch>
          <map:narrowMatch>
                    <skos:Concept rdf:about="#2256"/>
          </map:narrowMatch>
          <map:narrowMatch>
                    <skos:Concept rdf:about="#762"/>
          </map:narrowMatch>
          <map:exactMatch>
                    <skos:Concept rdf:about="#2696"/>
          </map:exactMatch>
          <map:exactMatch>
                    <skos:Concept rdf:about="#143"/>
          </map:exactMatch>
</skos:Concept>
<skos:Concept rdf:about="#sh 85038303">
          <skos:prefLabel xml:lang="en">Disasters</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 91000441">
          <skos:prefLabel xml:lang="en">Emergency management</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#sh 85090214">
          <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/LCSH.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2256">
          <skos:prefLabel xml:lang="en">Natural disasters</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/UNESCO.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#762">
          <skos:prefLabel xml:lang="en">Natural Hazards</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/GCMD.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#2696">
          <skos:prefLabel xml:lang="en">HAZARDS, ACCIDENTS AND DISASTERS</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/HASSET.xml"/>
</skos:Concept>
<skos:Concept rdf:about="#143">
          <skos:prefLabel xml:lang="en">Civil emergencies</skos:prefLabel>
          <skos:inScheme rdf:resource="http://hiltm2m.cdlr.strath.ac.uk/hiltm2m/schemes/IPSV.xml"/>
</skos:Concept>
</rdf:RDF>
```

3.3. Describe the different types of mapping used, with reference to the examples given in paragraph 3.2.

The mapping types currently used in HILT are those specified in the Mapping Vocabulary Specification: exactMatch, narrowMatch, broadMatch, minorMatch, majorMatch.

However, it is felt that in the HILT context these mapping types may be inadequate for such things as:

- The ranking of large result sets according to the degree of concordance with users' preferred terminology.

  For example, a user query, 'tooth', is submitted. A large result set is returned comprising hundreds of exactMatch resources. Among the large result set, resources pertaining to 'teeth' are found and – under SKOS MVS definitions – are considered equivalent to those on 'tooth'. However, in such a large result set it would be useful to rank results more meaningfully for the user. In the aforementioned example therefore, resources indexed 'tooth' would feature slightly higher in the result set than 'teeth' since the term is an *exact* match and is, ultimately, most relevant to the user since it exactly matches the original information query. As such, 'teeth' might be considered a *plural* match and therefore feature lower in the rankings. Match types exemplifying greater specificity would be useful to aid such ranking.

- Providing users with details of the precise nature of the relationship(s) between their entered query and their retrieved result set (which will invariably include mapped terms from other terminologies, or comprise resources retrieved using terms derived from mapped terminologies).

- The need to reconcile resources by concept is clearly necessary on the Semantic Web. However, the role of match types is of importance (in HILT and probably other potential services) when informing users (via client services) of why particular terms have been retrieved in response to a user query. For example, a user that is searching for resources on lung disease and submits the query 'lung disease' may retrieve resources indexed under 'pneumoconiosis'. These resources are indeed relevant, but for the user who is uniformed about the way in which indexes are mapped and matched may doubt that pneumoconiosis is (under the SKOS MVS) an exactMatch when they browse their results. Going to great lengths to inform users is envisaged as necessary in order to facilitate the re-formulation of subsequent queries. Providing users with such mappings could also be used to generate (potentially) improved relevance feedback.

- Imparting sufficient information during subject hierarchy browsing to enable users to make informed decisions about the relevance of mapped terms. (This is similar and related to the issues raised in the bullet point immediately above).

- Helping identify mapping regularities between specific terminologies, thus facilitating the research and development of improved automated routines to assist in large-scale terminology mapping. (This is not directly relevant to HILT, but the identification subtle patterns in mapping relationships between terminologies that could assist HILT at a later date if large scale, machine-assisted terminology mappings was being undertaken).

In addition to the above, it is also worth noting that HILT offers the ability for clients to create a 'disambiguation' stage during user searching. This process of disambiguation not only resolves the existence of homographs (as the term 'disambiguation' may suggest), but encompasses a variety of processes allowing users to qualify their search requirements.

To this end HILT has been exploring the use of a second set of match types to be used by clients instead of - or in tandem with - the SKOS MVS match types. The match types considered include some of those proposed by Chaplan (1995). Chaplan's match types are in many respects a departure from the conceptual approach taken in the SKOS MVS and the general proclivity on the Semantic Web for representing concepts. The focus of Chaplan's match types is more on differences in the way in which a *term* is represented (e.g. singular/plural match, spelling variation, word order variation, etc.) rather than reconciling concepts. However, we hypothesise that the requirement for a set of more detailed match types will be needed to assist users during the aforementioned disambiguation

stage and the other issues noted above. We also consider both approaches to be complementary, with the conceptual nature of the SKOS MVS providing a level of abstraction above - and preceding the use of - a lexically-based set of match types.

It is worth noting that this more detailed set of match types need not necessarily be lexically-based (although we currently consider such an approach useful) and could feasibly be an extension of the current MVS with the introduction of finer match types for such purposes. In particular, it is thought that the majorMatch and minorMatch types would benefit from further definition and perhaps the introduction of further gradations. For example, there is currently no indication whether a majorMatch between two concepts is 'weak' or 'strong' (IE quantification of the level of match beyond 50% as currently specified as a guideline).

Recent informal discussions between Alistair Miles and members of the HILT team indicated that we might be in a position to inform the W3C Semantic Web Deployment Working Group before the end of 2006 on our match type work in this area. However, due to work priorities this has unfortunately been undoable. We nevertheless intend to continue this line of research as soon as possible and test the utility of both the SKOS MVS and Chaplan-based match types in a controlled user study.

3.4. Any additional information, references and/or hyperlinks.

Chaplan, M. A. (1995). Mapping Laborline thesaurus terms to Library of Congress subject headings: implications for vocabulary switching, *Library Quarterly, 65*(1), 39-61.

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

Appendix I: Glossary

AAT: Art and 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

GCMD: Global Change Master Directory

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

HASSET: Humanities and Social Science Electronic Thesaurus

HE: Higher Education

HILT: HIgh Level Thesaurus

IESR: JISC Information Environment Service Registry

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

MARC: MAchine Readable Cataloging

MeSH: Medical Subject Headings

M2M: Machine to Machine

NMR: National Monuments Record

OCLC: Online Computer Library Center

PHP: Hypertext Preprocessor

Semantic Web: A collaborative initiative led by the W3C, the Semantic Web provides a common framework that facilitates data sharing and reuse across application, enterprise, and community boundaries.

SKOS: Simple Knowledge Organisation System

SKOS Core: SKOS Core supports the RDF description of language-oriented knowledge organisation systems (KOS) such as thesauri, glossaries, controlled vocabularies, taxonomies and classification schemes.

SKOS Core MVS: SKOS Core Mapping Vocabulary Specification

SOAP: Orginally the Simple Object Access Protocol, but now more commonly known simply as 'SOAP'.

SRW: Search/Retrieve Web Service (companion protocol to SRU)

SRW Client: This allows a service user interface to send requests to SRW compatible services such as HILT and IESR via an SRW Server associated with the service.

SRW Explain: XML document with an <explain> element at the top level, providing the necessary information to enable SRW clients to connect to SRW servers.

SRU: Search/Retrieve Via URL: a standard search protocol for Internet search queries, utilizing CQL (Common Query Language), a standard query syntax for representing queries.

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 Thesaurus.

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.

XML: Extensible Markup 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.