Linked Data Infrastructures and HE Challenges

The Outcomes of the SemTech Project

Thanassis Tiropanis

tt2@ecs.soton.ac.uk

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

the talk

- semantic technologies, semantic Web and linked data
- the case for linked data in HE (SemTech project)
  - the survey
  - the value of linked data
  - the roadmap
- progress so far

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

semantic technologies
semantic Web
linked data

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Ontologies and Knowledge Modelling

- Concepts
  - Student
  - Class
- Relationships
  - *attends*
  - *is_a_classmate_of*
- Instances
  - Student: Alice, Bob, John
  - Class: French

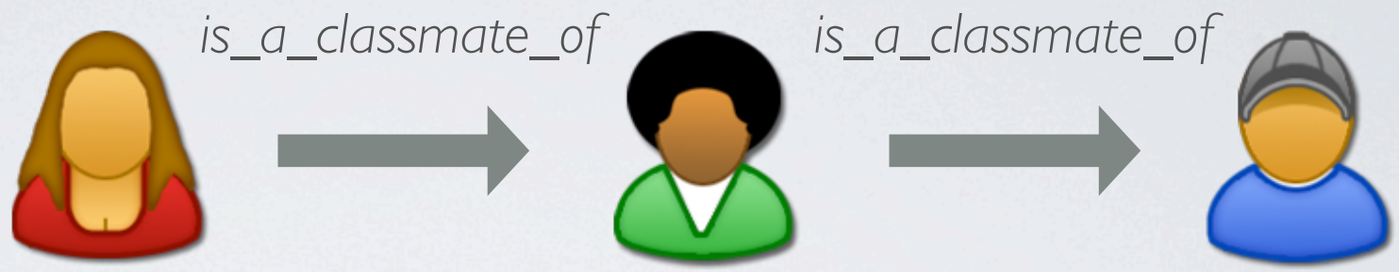
SemTech

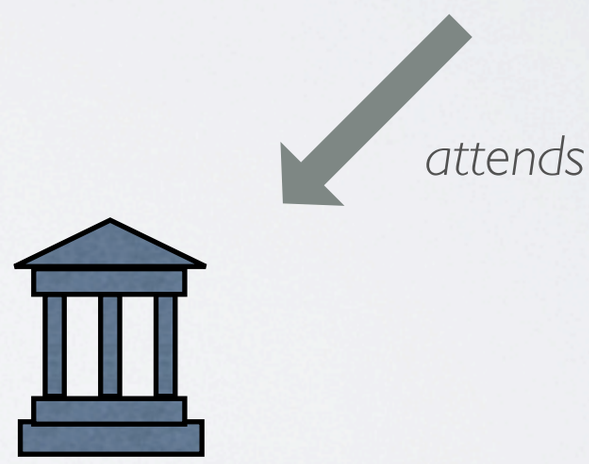
JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Ontologies and Knowledge Modelling

- Concepts
  - Student
  - Class
- Relationships
  - *attends*
  - *is_a_classmate_of*
- Instances
  - Student: Alice, Bob, John
  - Class: French





SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

RDF and SPARQL

http://id.ecs.soton.ac.uk/interest/linked_data

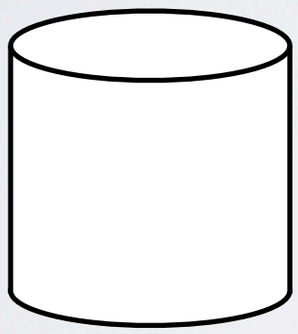
http://id.ecs.soton.ac.uk/person/11208

http://rdf.ecs.soton.ac.uk/ontology/ecs#hasInterest

linked data

Thanassis

SPARQL Query



SPARQL Endpoint

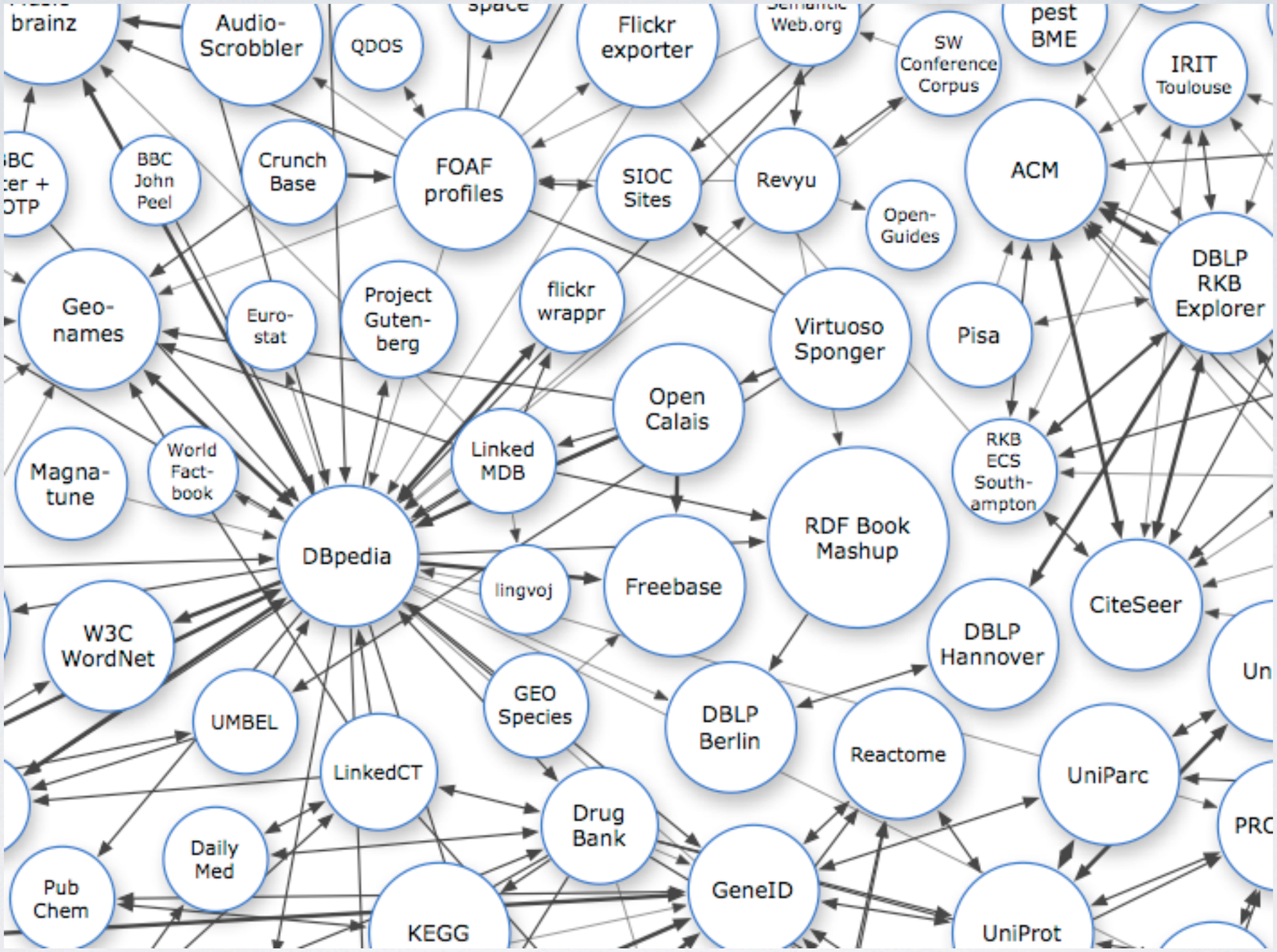
SemTech

JISC cetis

UNIVERSITY OF Southampton

School of Electronics and Computer Science

Linked Data Cloud



SOURCE: http://linkeddata.org/

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

the case for linked data in HE

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

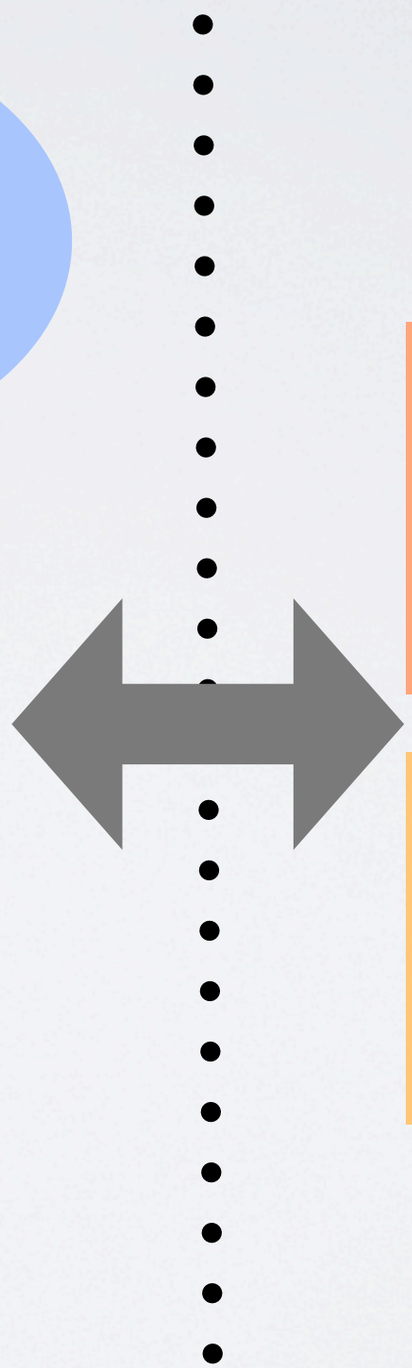
UNIVERSITY OF Southampton
School of Electronics and Computer Science

semantic tech in edu scenario?

Agreed Ontologies

Metadata

Learning Content



learning content discovery

personalisation & adaptation

SemTech

it was time to re-think the value of semantic technologies in HE?

- Web 2.0 promise for content generation annotation
- Value of lightweight knowledge modelling and reasoning
- The HE institutional challenges
- The learning and teaching challenges
- Linked data movement and the Web of data

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

HE institutional perspective

- Visibility of degree programmes and research output of HE institutions
- Curriculum design
- Recruitment and retention of students
- Efficiency of accreditation
- Collaboration across departments and institutions through workflows
- Integration of knowledge capital, cross-curricular initiatives
- Transparency of data held by educational institutions

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

learning and teaching perspective

- Course creation and delivery workflows
- Group formation for learning and teaching activities
- Critical thinking and argumentation support
- Personal and group knowledge space construction
- Assessment, certification and addressing of plagiarism

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

semantic tech in a web 2.0 world

- *Soft semantics*
  - Meaning in formats that humans can process
  - Lightweight knowledge modelling in Web 2.0 applications
- *Hard semantics*
  - Meaning in formats that machines can process
  - Processing is independent of domain specific schemas

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

the survey

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

surveyed semantic technologies

semtech-survey.ecs.soton.ac.uk

Collaborative Authoring and Annotation

Searching and Matching

Repositories, VLEs and Authoring tools

Infrastructural Technologies for Linked Data and Semantic Enrichment

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Collaborative Authoring and Annotation Tools

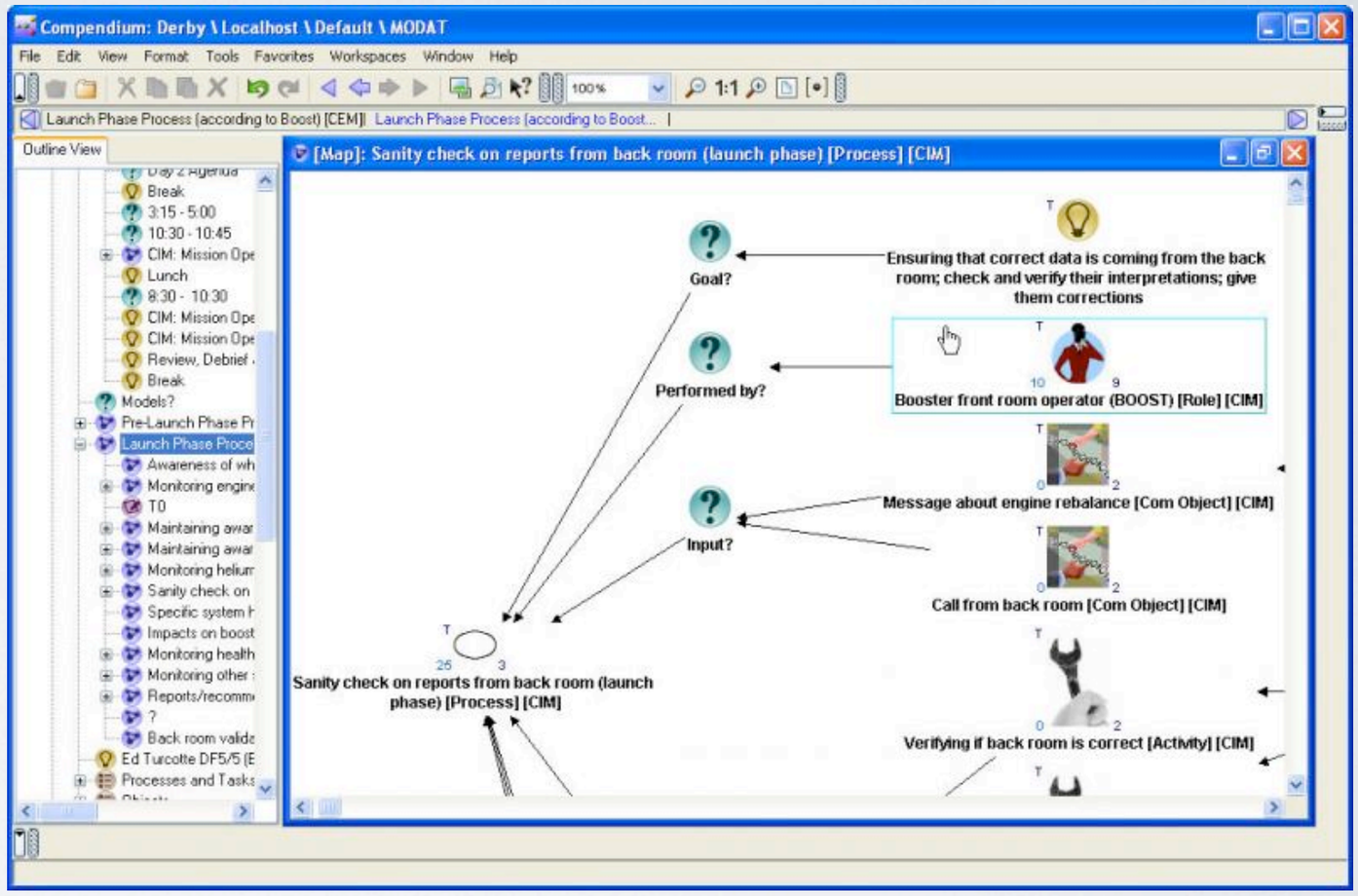
UNIVERSITY OF Southampton
School of Electronics and Computer Science

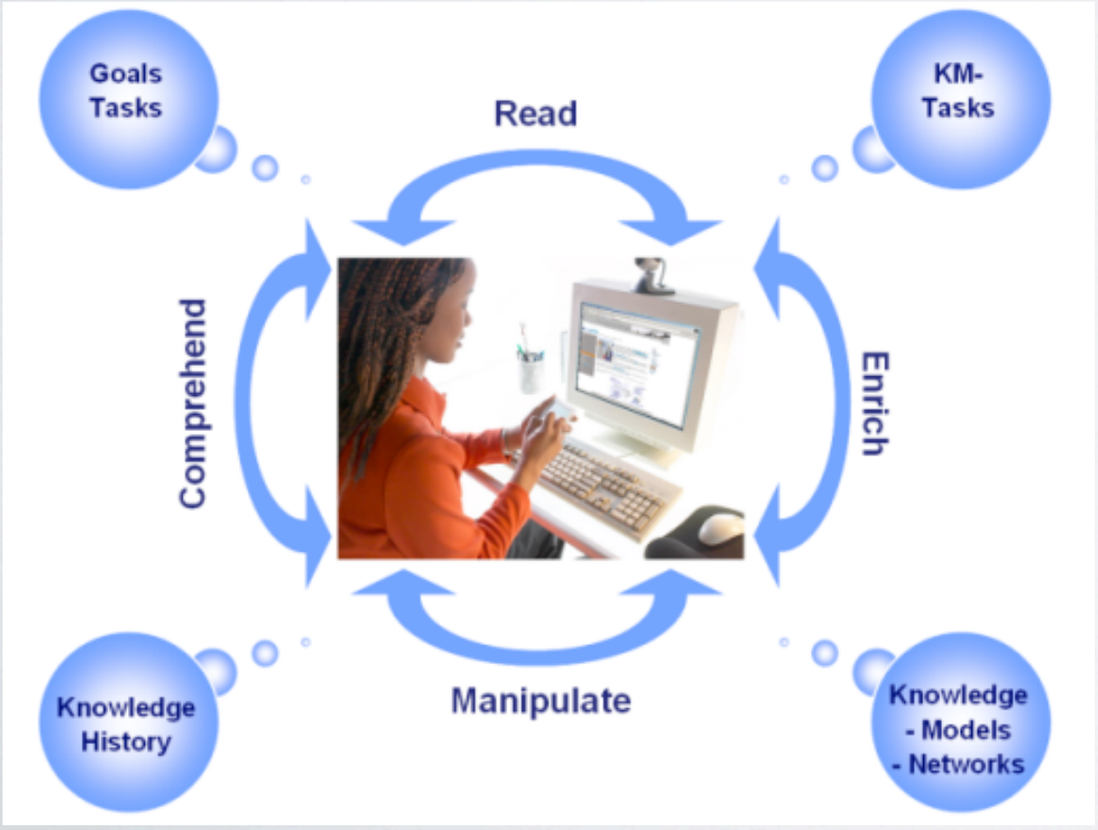
Mymory

Unobtrusive user observation

Meaning co-ordination

Annotation of resource sections





Compendium

Visualisation of arguments

Collaborative domain modelling

Real time meeting capture

SemTech

Searching and Matching tools

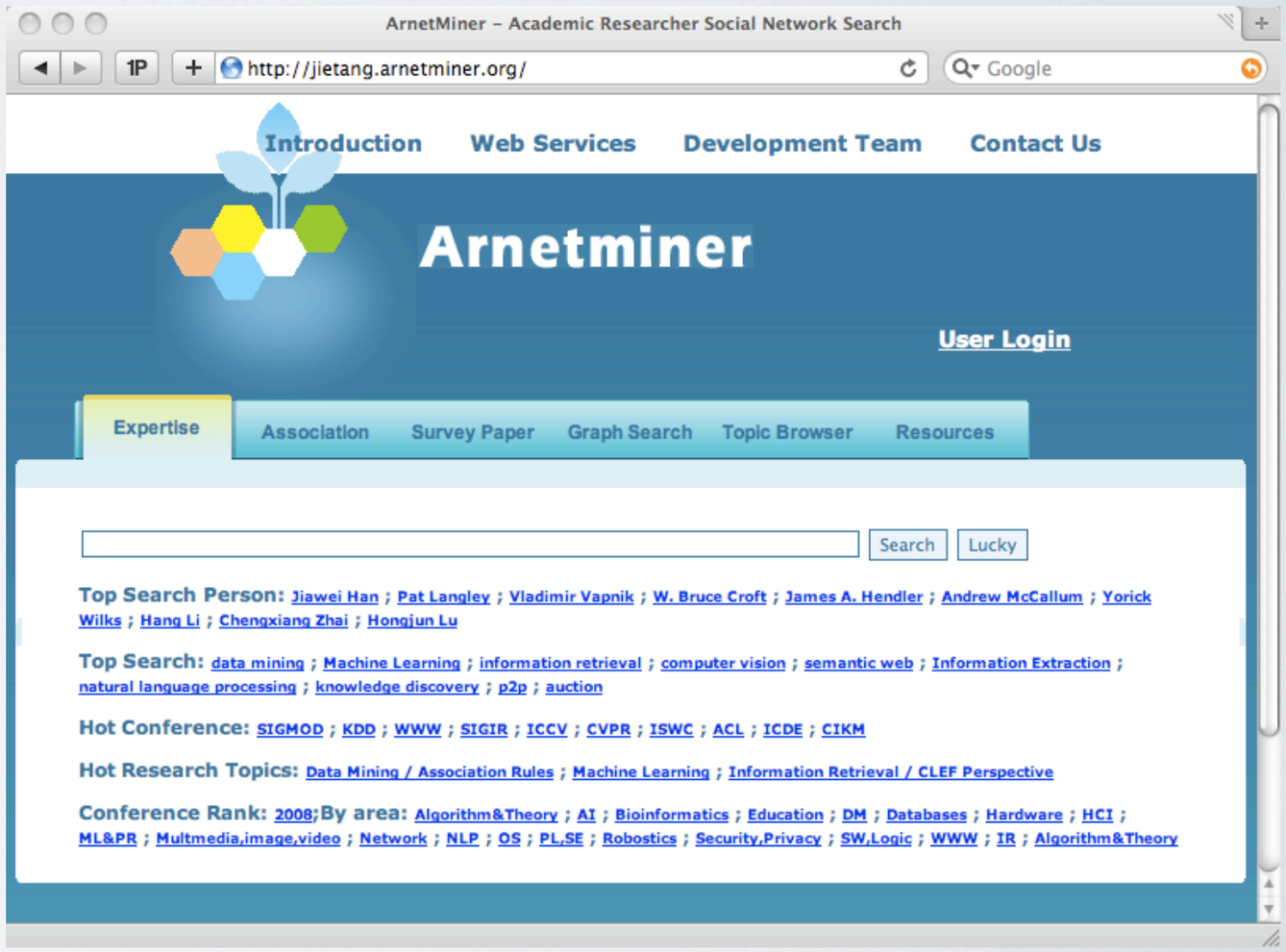
UNIVERSITY OF Southampton
School of Electronics and Computer Science

LUISA

Discovery, selection, negotiation and composition of LOs
Annotation techniques
Use of Semantic Web Services

Arnetminer

Find experts
Associations between experts
Mining RDF from existing repositories



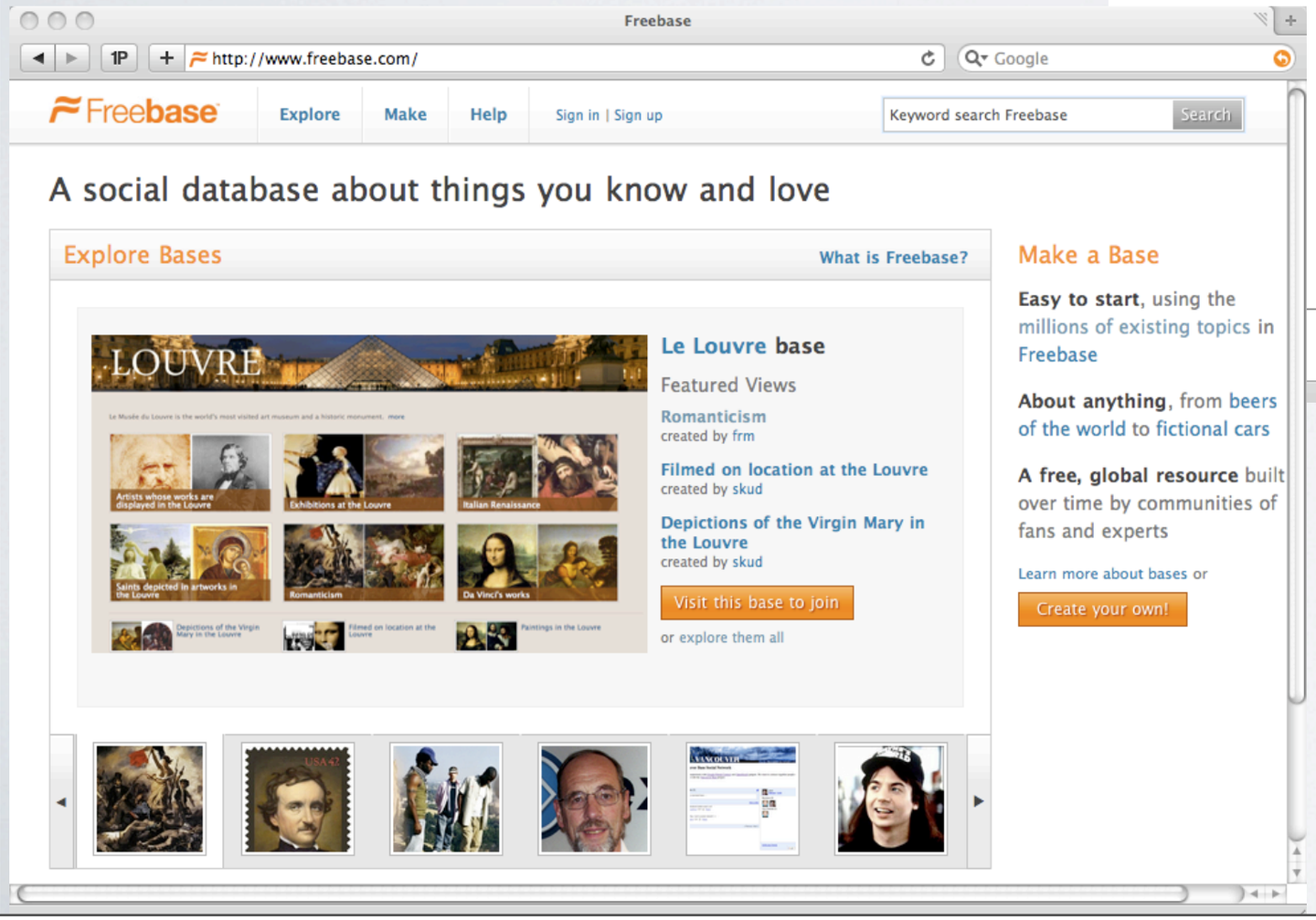
SemTech

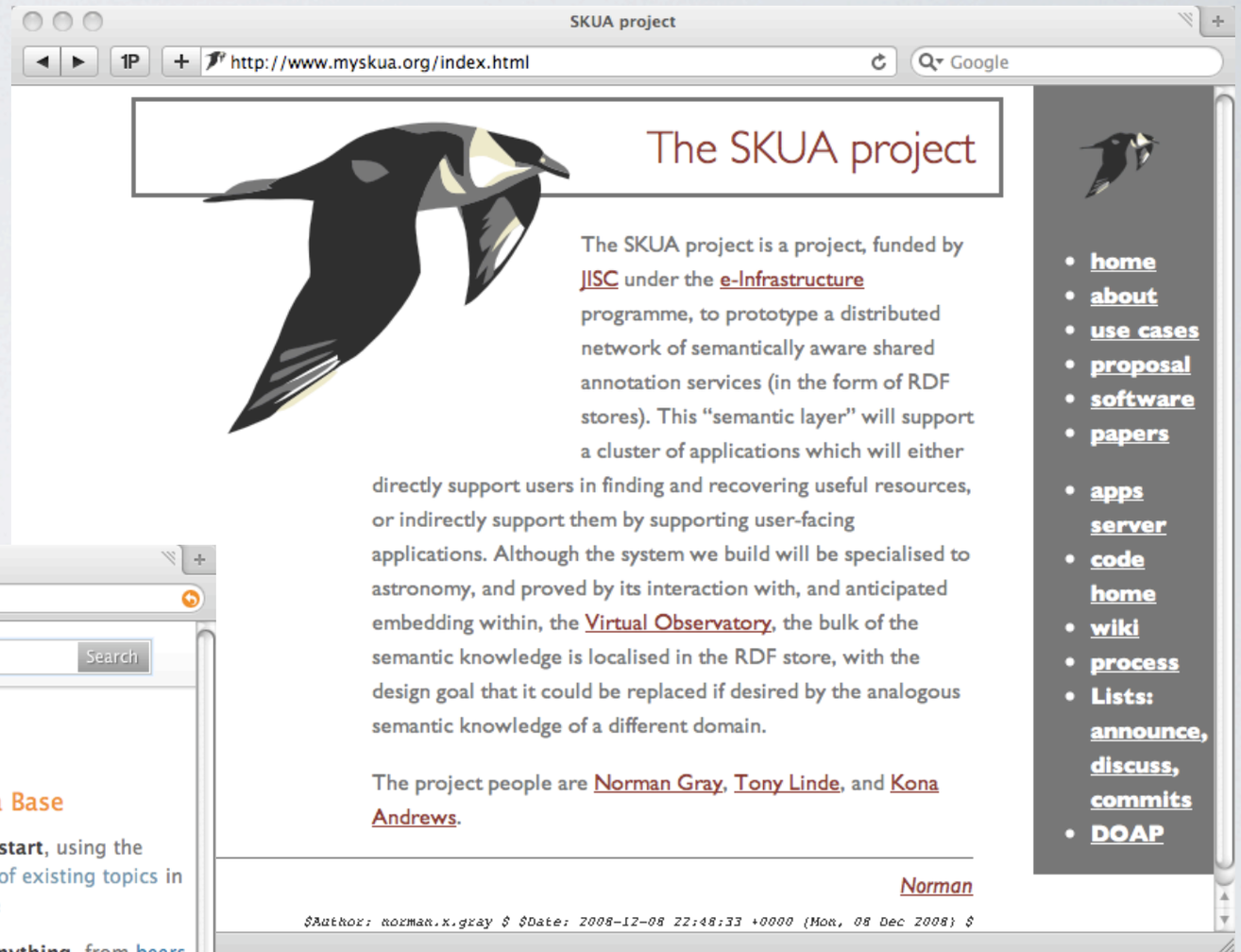
Repositories, VLEs, Annotation tools

University of Southampton
School of Electronics and Computer Science

Freebase

Collaboratively authored, open repository of structured topics
Topics mined from other repositories
Accessible via open APIs





SKUA

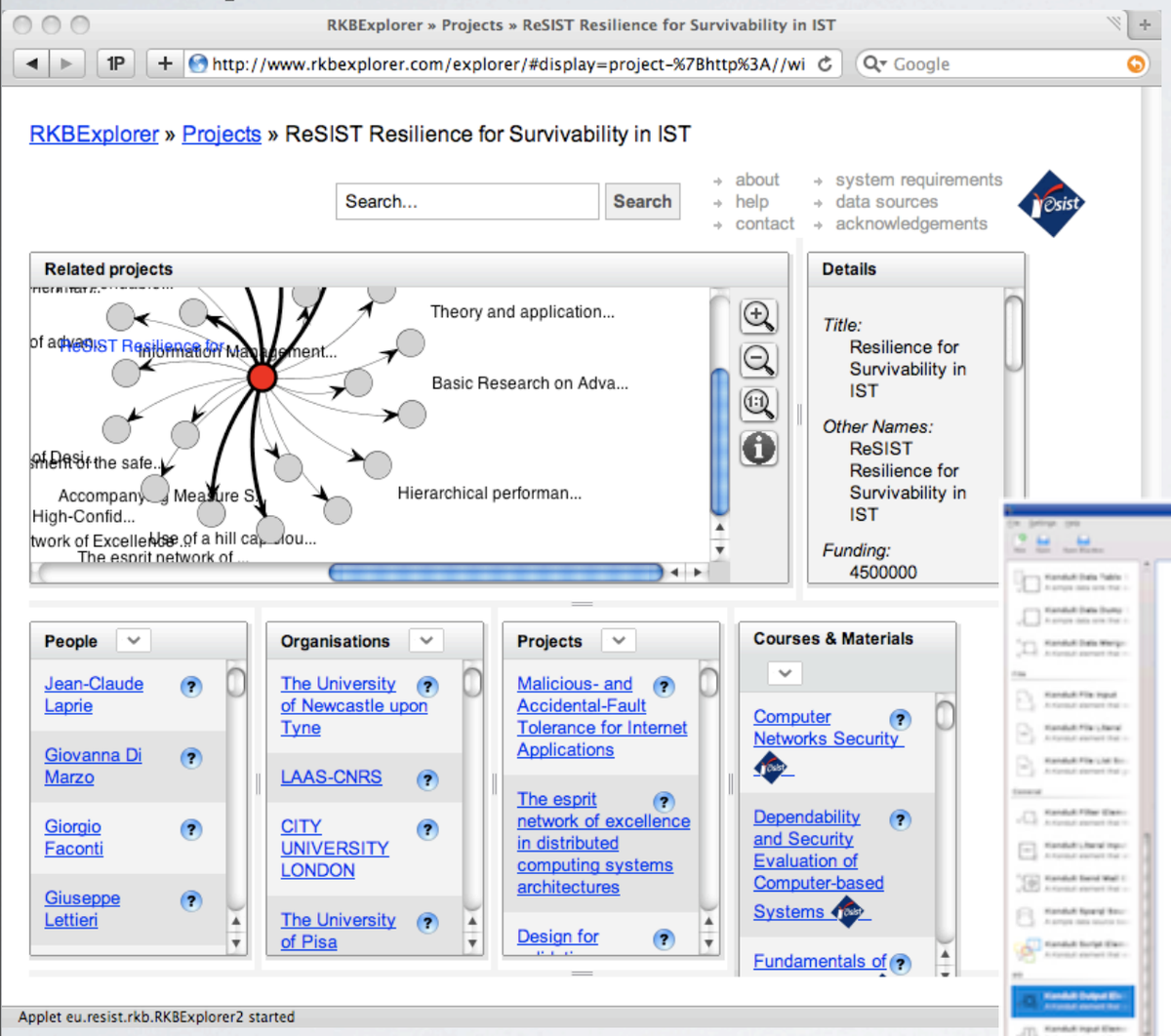
Distributed network of semantically aware shared annotation services in the form of RDF stores
Support for user-facing applications

SemTech

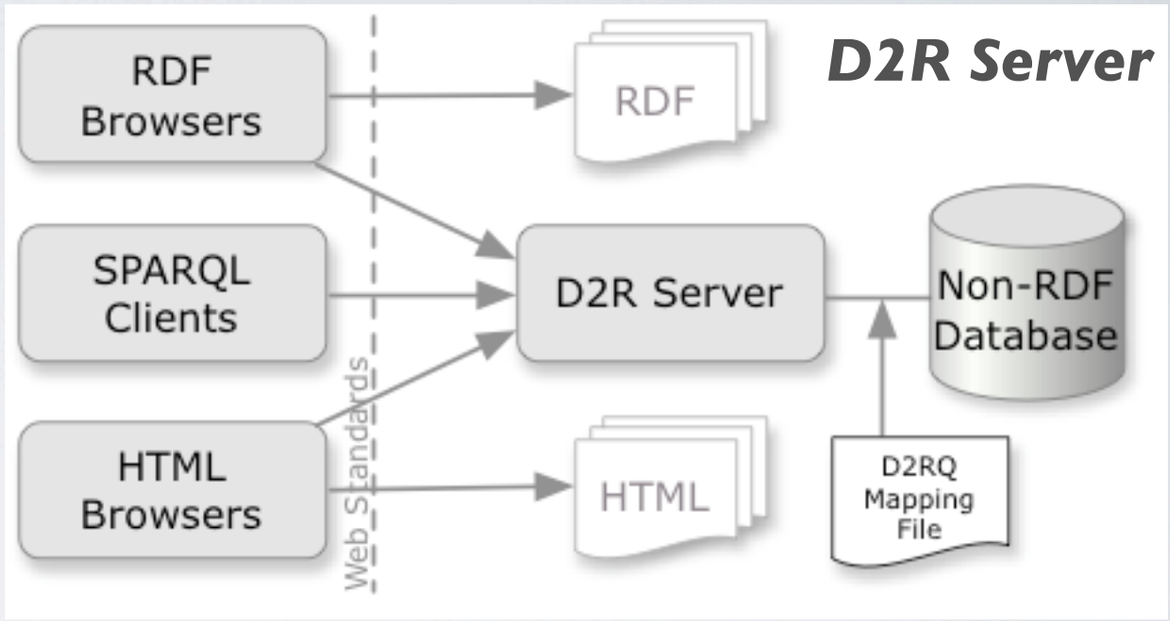
Infrastructural Technologies

UNIVERSITY OF Southampton
School of Electronics and Computer Science

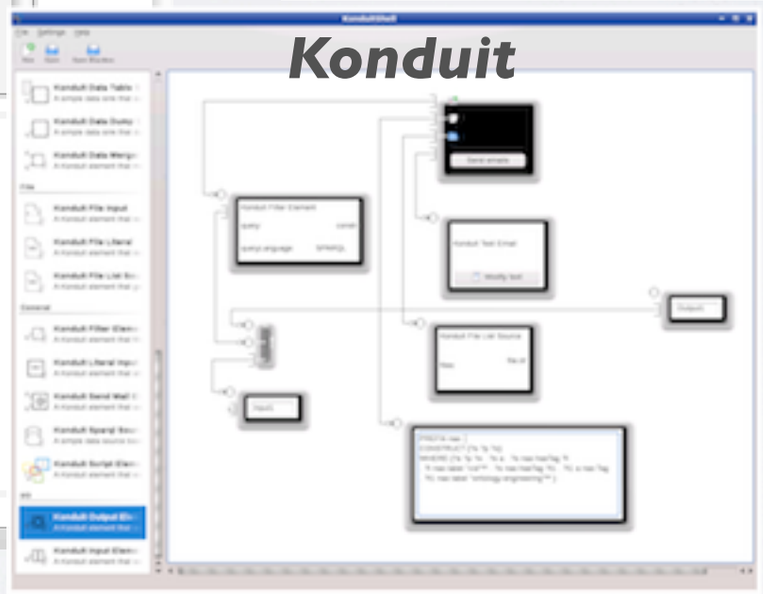
RKBExplorer



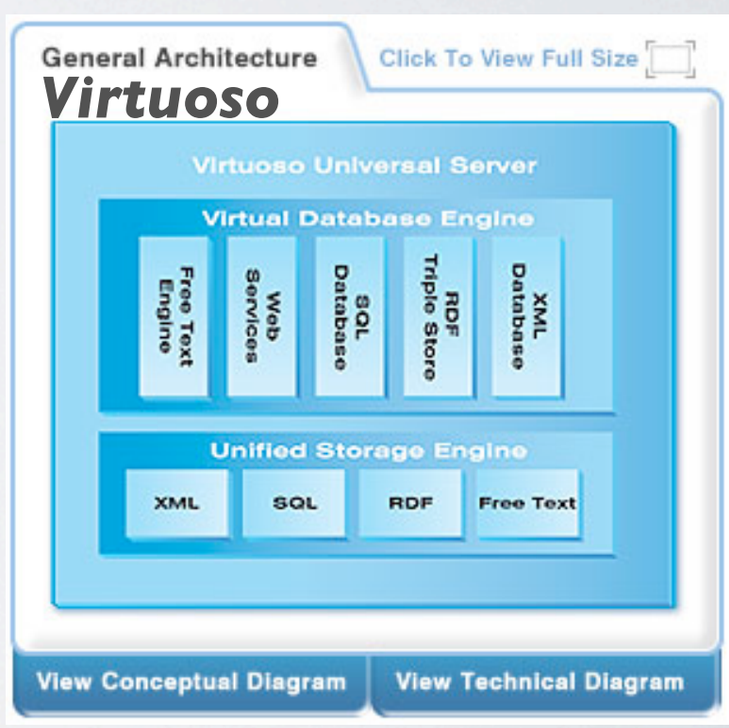
D2R Server



Konduit

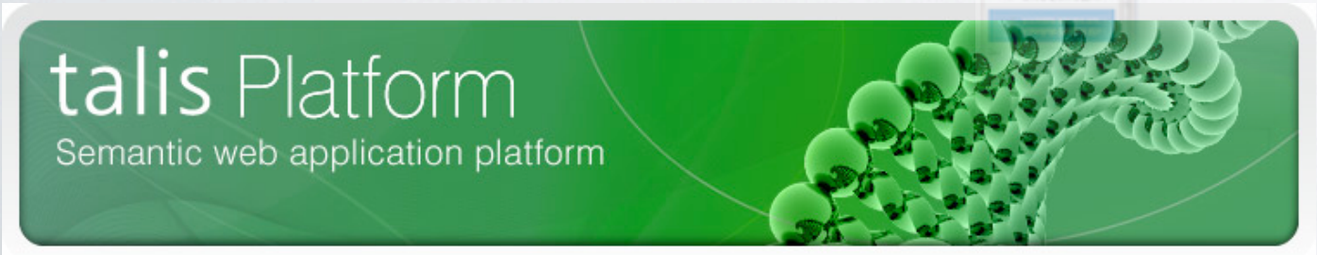


Virtuoso



talis Platform

Semantic web application platform



SemTech

the value

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

surveyed semantic technology value

- Technologies:

Wiki

Tagging

Blog/Electronic Journal

Shared Bookmarking

RDF

OWL

FOAF

SKOS

Triple Store

Ontology/Taxonomy

Archive/Repository

- **Value**:

Well-formed Metadata

Interoperability/Data Integration

Improved Data Analysis/Reasoning

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

insights

- Most of the identified HE challenges can be addressed by querying across institutional repositories (databases, web pages, VLEs)
- Significant learning and teaching challenges can be addressed by accessing resources across departments, schools, institutions
- Argumentation and critical thinking could benefit from advanced reasoning over a large scale of resources
- Could we adopt a bottom-up approach starting from linked data which can be related to (layers of) ontologies later in the context of specific applications?

➡ *VALUE IN A LINKED DATA FIELD ACROSS HE*

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

the roadmap

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

breadth vs. depth

- The value of semantic technologies on a large *scale* needs to be investigated

  - In addition to the value of *reasoning* using ontologies

- Mapping a critical volume of linked data to expressive ontologies can be promising

- Encouragement for community-agreed ontologies can be more effective and flexible

- Expressive semantics to enable pedagogy-aware applications over a large volume of linked data can be meaningful in a Web 2.0+ world

SemTech

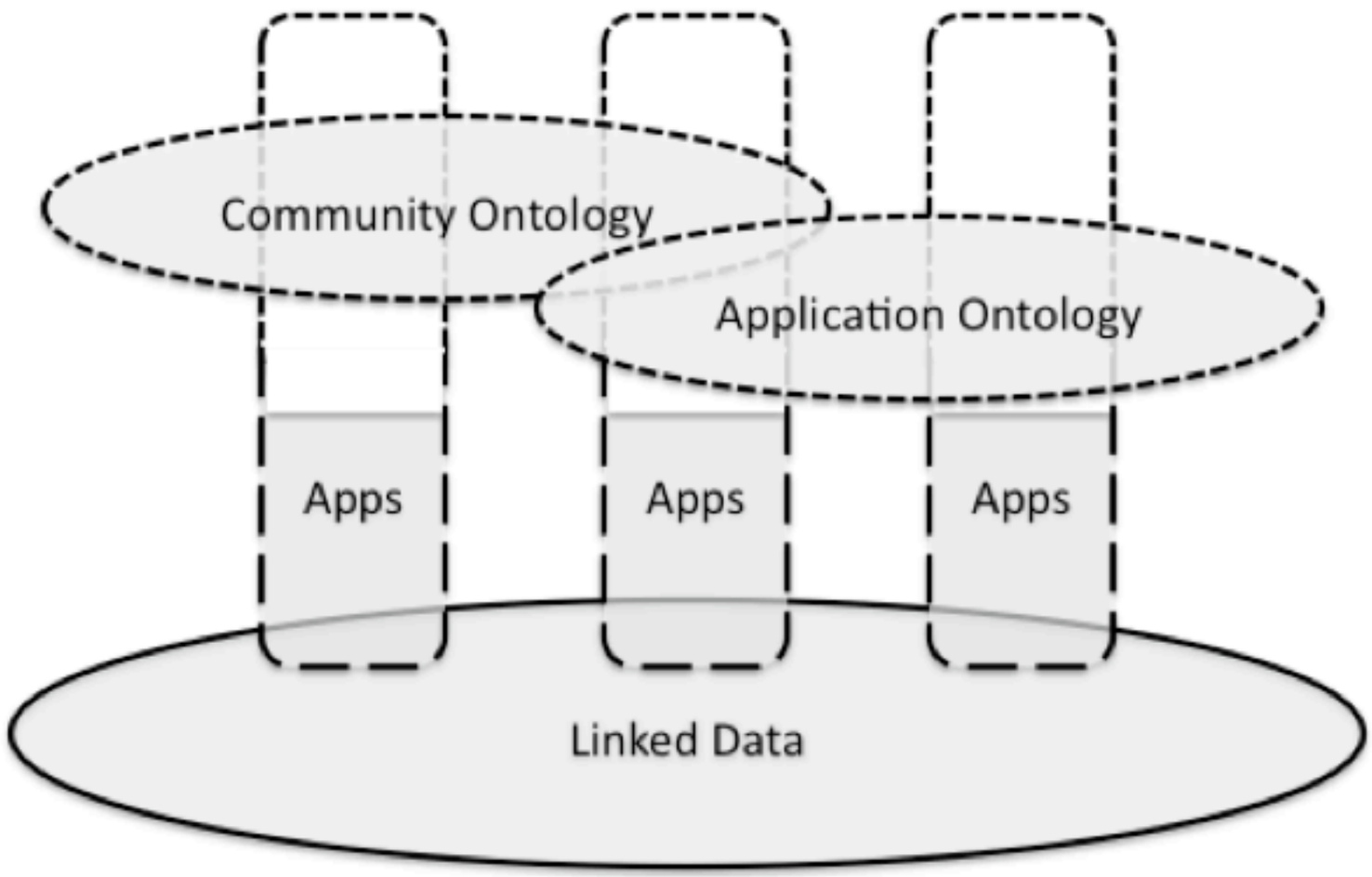
JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

a roadmap of sem tech adoption

STAGE 2: Ontology-based applications
(Ontology building, mapping linked data, applications)
ArnetMiner

STAGE 3: Pedagogy-aware reasoning
(Collaborative ontology building, pedagogy in reasoning)
Compendium, Debategraph



STAGE 1: Linked Data Field
(Triple stores, SPARQL endpoints, RDF)
RDFisers, TALIS, Virtuoso, Collibra, dbpedia.org, freebase.com

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

a roadmap of sem tech adoption

- Stage 1
  - Exposing internal repositories as linked data, performance optimised triple stores
  - Searching across repositories, matching students, teachers, curricula, research interests
- Stage 2
  - Advanced searching and matching, argumentation and critical thinking applications
  - Mapping linked data to application-wide or community-wide agreed ontologies
- Stage 3
  - Collaborative semantic enrichment of linked data by communities
  - Pedagogy-aware applications and services with reasoning

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

the network effect

- HE institutions exposing relational databases, VLE material, Web pages as linked data
  - Relevant technologies: RDF, RDFa, VLE plugins
  - Starting from information already available in (X)HTML!
- Applications that use exposed linked data across institutions
  - Curriculum design or alignment
  - Inline recommendation of resources or people
  - Addressing HE challenges such as curriculum alignment, student retention and others using linked data across institutions

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

progress so far

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Where are we now?

- It seems that the first step of the roadmap is well under way
- Now is the time to discuss issues related to:
  - Exposure of linked data
  - Use of linked data across HE repositories
  - Privacy and confidentiality
  - Searching and matching applications to address HE challenges

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Challenges

- Are we ready for the next steps in terms of:
  - Standards
  - Tools
  - Practices

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Related PhD Research

- Farhana Sarker

  Linked Data Technologies to Support Higher Education Challenges: Student Retention, Progression and Completion

- Xin Wang

  Query optimisation over Linked Data Repositories in Specific Domains

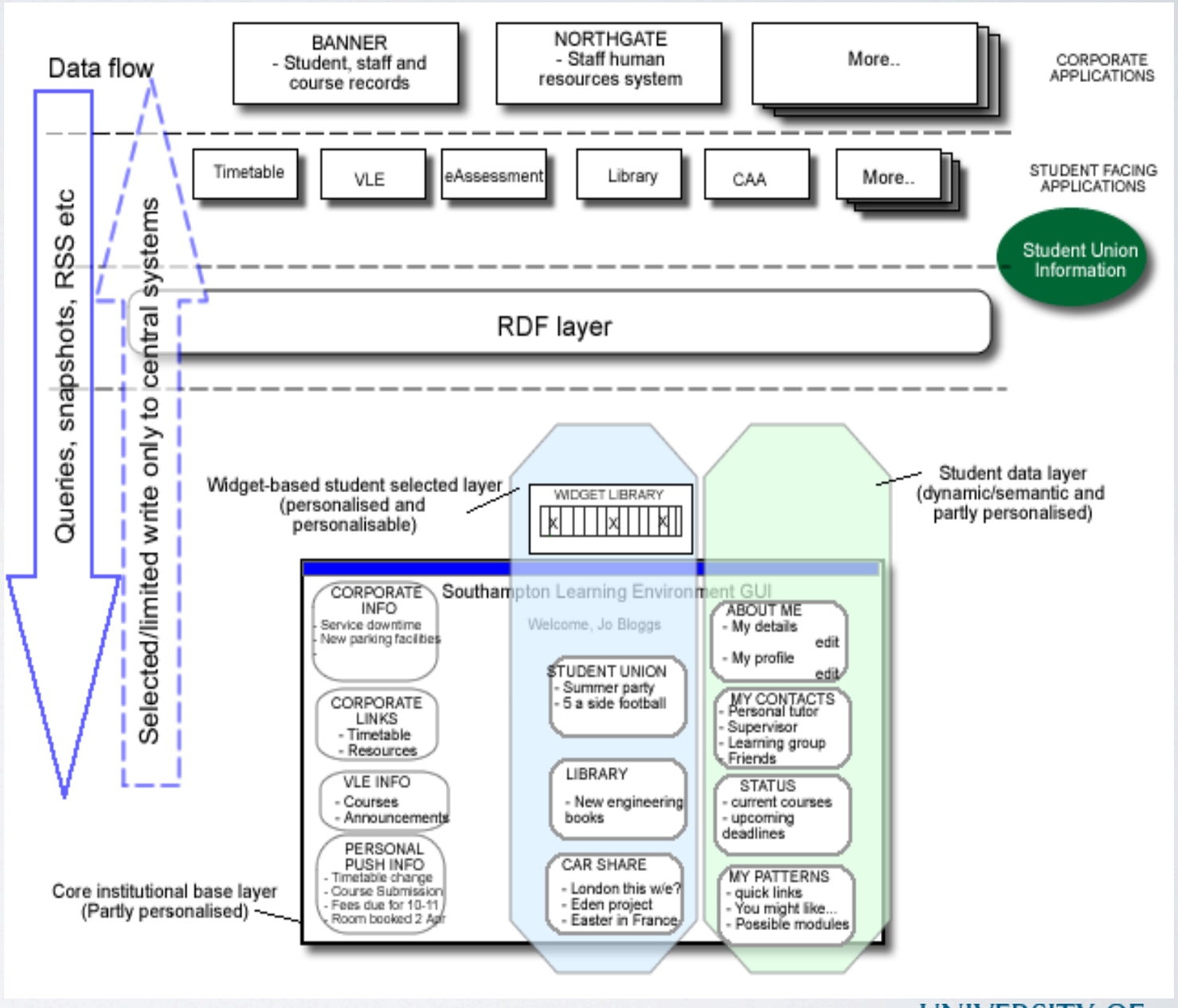
SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Related Projects

- *SLE (Southampton Learning Environment)*
  - looking to enhance the student and staff experience around learning and living at UoS
  - Closely aligned with the Southampton Research Environment (SRE) and the Southampton Business Environment (SBE)



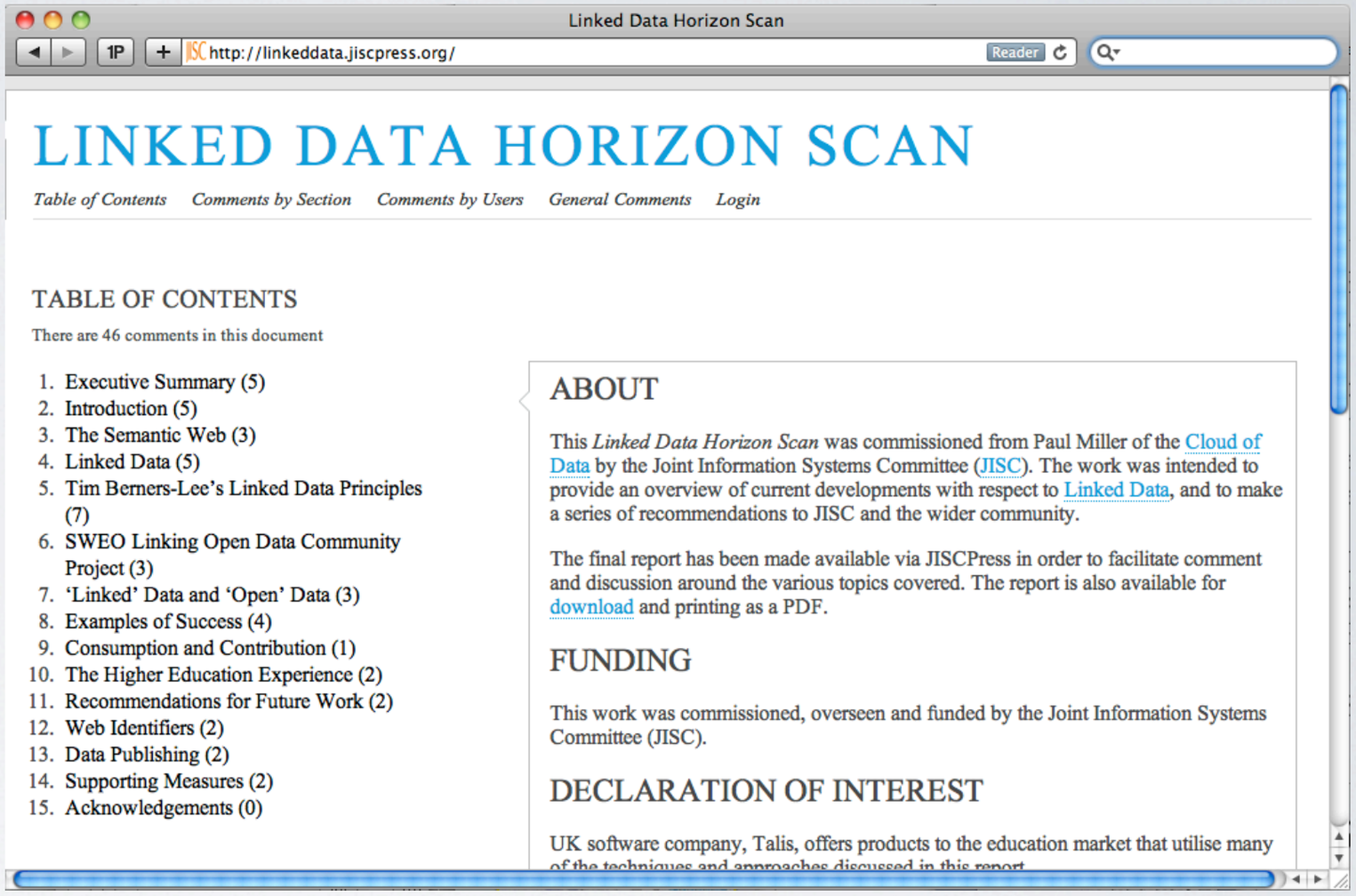
SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Related Reports

- *Paul Miller, Linked Data Horizon Scan http://linkeddata.jiscpress.org/ JISC, 2010*



- *Jason Ohler. The semantic web in education. http://net.educause.edu/ir/library/pdf/EQM0840.pdf Educause Q (2008) vol. 31 (4)*

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

SemTech

- JISC-funded project working with CETIS
- Objectives:

Survey of semantic tools and services

Current adoption of semantic technologies in the UK higher education

Roadmap of semantic technology adoption in the next 5 years

- www.semtech.ecs.soton.ac.uk

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Acknowledgements

The SemTech team:
Hugh Davis
Faith Lawrens
David Millard
Asma Ounnas
Heather S. Packer
Marcus Ramsden
Daniel A. Smith
Thanassis Tiropanis
Mark Weal
Su White
Gary Wills
Learning Societies Lab

(ECS-University of Southampton)

The JISC CETIS Semantic Technology Working Group:
Sheila MacNeill (CETIS)
Lorna Campbell (CETIS)
Phil Barker (CETIS)
Helen Beetham
Simon Buckingham-Shum (Open University, UK)
David Davies (University of Warwick)
Michael Gardner (University Essex)
Tony Linde (University of Leicester)
Wilbert Kraan (CETIS)
Sue Manuel (University of Loughborough)
Lou McGill
Graham Wilson (LT Scotland)
Robin Wylie (LT Scotland)
David Kernohan (JISC)

The SemTech workshop participants:
Colin Allison (University of St. Andrews)
Chris Bailey (University of Bristol)
Liliana Cabral (Knowledge Media Institute, Open University)
Patrick Carmichael (University of Cambridge)
Tom Franklin (Franklin Consulting)
David Kay (Sero Consulting)
George Magoulas (London Knowledge Lab, Birkbeck College)
Uma Patel (City University)
Alex Poulovassilis (London Knowledge Lab, Birkbeck College)
John Scott (University of Essex)

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

SemTech activities

- *1st SemTech workshop*: organised at JISC premises, London, 19 January 2009
- *1st International SemTech workshop*: "A roadmap for semantic technology adoption in UK higher education" accepted to the ALT-C conference, Manchester, 8-10 September 2009.
- *1st International SemHE Workshop*: "SemHE-09: Semantic Web applications for learning and teaching support in higher education" ECTEL 2009 conference, Nice, 28-29 September 2009 http://www.semhe.org/semhe09 - with ESRC/EPSRC project ENSEMBLE
- *2nd International SemHE Workshop*: "SemHE-10: Semantic Web applications in Higher Education" Southampton, 3 November 2010 http://www.semhe.org/
- Publications

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Publications

- Tiropanis, T., Davis, H., Millard, D., Weal, M. and White, S. (2009) Linked Data as a Foundation for the Deployment of Semantic Applications in Higher Education. In: SWEL'09: Ontologies and Social Semantic Web for Intelligent Educational Systems, 7 July 2009, AIED'09 Conference, Brighton, UK.

- Tiropanis, T., Davis, H. and Carmichael, P., eds. (2009) Proceedings of the 1st International Workshop on Semantic Web Applications for Learning and Teaching Support in Higher Education (SemHE'09). www.semhe.org.

- Tiropanis, T., Davis, H., Millard, D., Weal, M. and White, S. (2009) A roadmap for semantic technology adoption in UK higher education. In: Association for Learning Technology (ALT-C 2009), 16th International Conference, 8-10 September 2009, Manchester, UK, 6-8 Septem,ber 2005, University of Manchester. p. 26.

- Tiropanis, T., Davis, H., Millard, D. and Weal, M. (2009) Semantic Technologies for Learning and Teaching in the Web 2.0 era - A survey. In: WebSci'09: Society On-Line, 18-20 March 2009, Athens, Greece.

- Tiropanis, T., Davis, H., Millard, D., Weal, M., White, S. and Wills, G. (2009) Semantic Technologies in Learning and Teaching (SemTech) - JISC Report.

- Tiropanis, T., Davis, H., Millard, D. and Weal, M. (2009) Semantic Technologies for Learning and Teaching in the Web 2.0 Era. Intelligent Systems, IEEE, 24 (6). pp. 49-53.

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Thank you!

Thanassis Tiropanis - tt2@ecs.soton.ac.uk

The special issue (IEEE TLT): **http://www.computer.org/**

The project: **www.semtech.ecs.soton.ac.uk**

The survey: **semtech-survey.ecs.soton.ac.uk**

The workshop: **www.semhe.org**

SemTech

JISC cetis

UNIVERSITY OF Southampton
School of Electronics and Computer Science