

# Semantic Web In Use: Applications and Vocabularies

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# Overview

- Social Networking
- Bibliographic Information
- Cultural Heritage
- Business Intelligence
- Public Sector Information
- Research Information
- e-Science

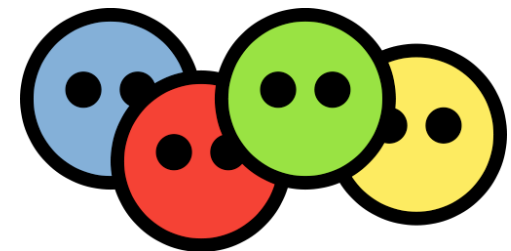


# Social Networking

<http://www.flickr.com/photos/bigblackbox/4269397346/>

# Friend of a Friend (FOAF)

- Semantic Web realisation of “six degrees of separation”
- Fully distributed system
  - Each user writes an RDF file describing themselves and who they know (using the FOAF schema)
  - Files are harvested and aggregated
  - Data is presented in a variety of interfaces
- Avoids siloing of existing social networking systems
- Data from many providers (LiveJournal, etc)



# Multiple Interfaces


Daniel "eikeon" Krech: FOAF: Web View - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://eikeon.com/foaf/?mbox=nmg%40ecs.soton.ac.uk

[ eikeon.com | foaf ]

## FOAF: Web View

Nick Gibbins | Nick Gibbin | Nicholas 

Show depictions



Nickname  
nmg

Homepage  
<http://purl.org/net/ngibbins/>

workplaceHomepage  
<http://www.soton.ac.uk>  
<http://www.iam.ecs.soton.ac.uk>  
<http://www.ecs.soton.ac.uk>

A current project this person works on.  
\_:VZaWRjew4126  
\_:VrHOMgya2612

Knows  
**Brian Kelly**  
**Dan Brickley**  
**Ian Hickson**  
**Isobel Stark**  
**Libby Miller | libby | Libby Miller**  
**Max Froumentin**

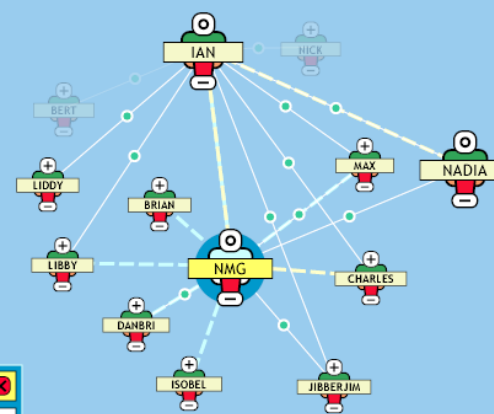
This site is running on  Redfoot 1.8.0 / RDFLib 1.3.0 and is 

foafnaut - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://jibbering.com/foaf/foafnaut.svg

## foafnaut



NMG

NMG

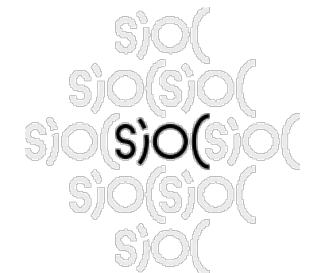
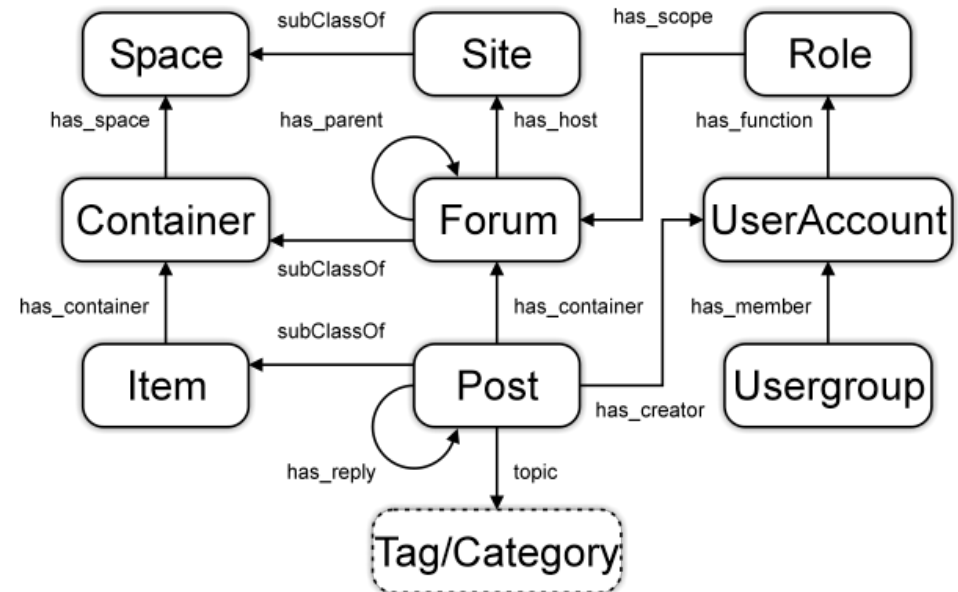
NICK GIBBINS  
nmg@ecs.soton.ac.uk  
nick@totl.net  
nick@gark.net

Knows: 6  
Codepictions: 4  
Known by: 1  
[homepage](#)

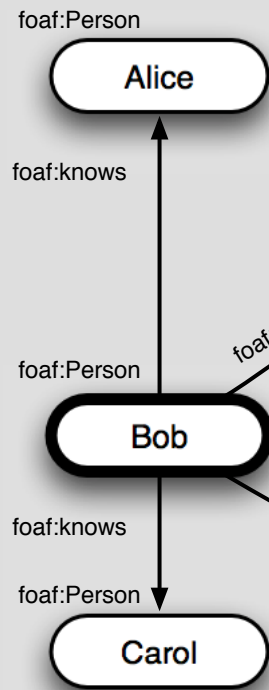
Internet

# Semantically-Interlinked Online Communities (SIOC)

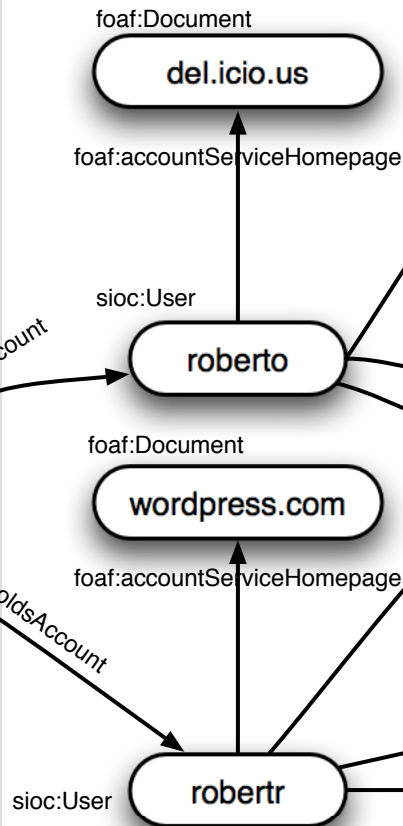
- Ontology for describing wikis, bulletin boards, blogs, etc
- Designed to interoperate with FOAF



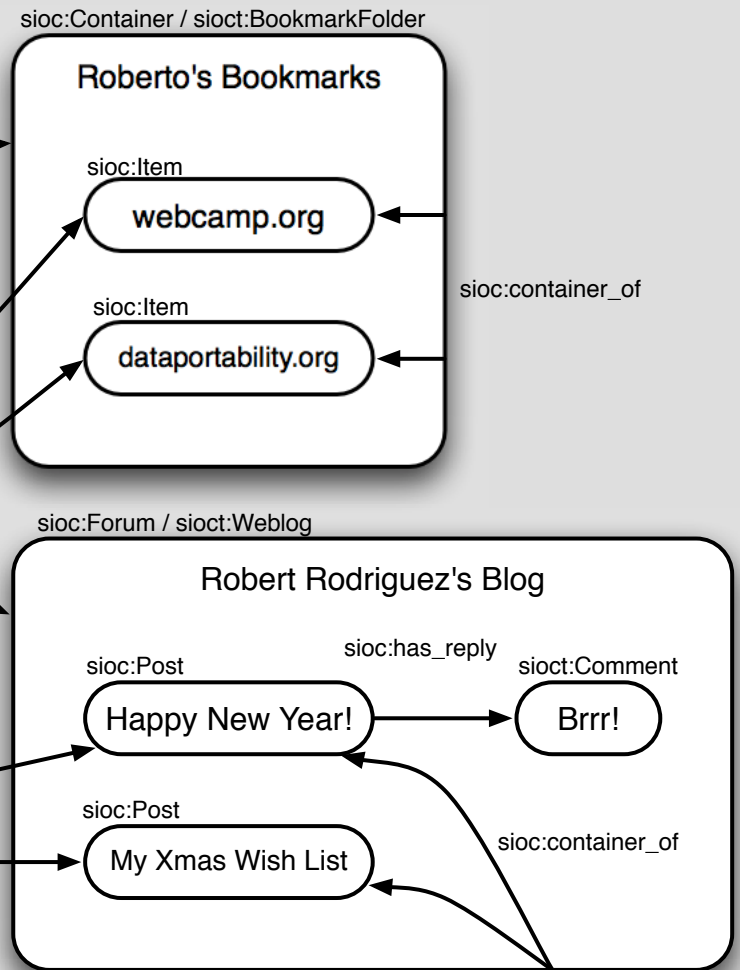
## People



## Services and User Accounts



## Containers and Content Items





568 GAL. DE VST

eiusdem sunt generis, maxime  
guerint musculis: quidam  
que sinum magnum adhibent  
tys rariora sunt  
gumentum, quod omnia  
libris offa sunt laxata

# Bibliographic Metadata



# Dublin Core

- A standard set of 15 metadata elements for cross-domain information resource description
- Formally endorsed by ISO, NISO and CEN
- Representation language-neutral
  - Plain XML serialisations in addition to RDF/XML
  - Predates RDF (started in 1995)
- Possibly the most widely used Semantic Web vocabulary
  - Libraries (electronic and physical)
  - Museums
  - Web archives
    - Open Directory Project
    - UK Mirror Service
    - MusicBrainz
  - ...



# Bibliographic Ontology

- More detailed bibliographic ontology
- Describes types of publication
  - Conference paper
  - Journal article
  - ...
- Builds on Dublin Core
- Used as export format for Eprints 3.2 (more on this later)

<http://bibliontology.com/>



# MusicBrainz

- An open replacement for the CDDB Internet CD database
- Complementary to freedb.org
- Community-maintained service
  - Submissions and moderations
- Vocabularies used:
  - Dublin Core
  - Custom ontology for metadata specifically relating to audio recordings



<http://www.musicbrainz.org/>

# Publishing Standards for Industry Standard Metadata

- Set of metadata vocabularies for automating publishing production processes and content exchange
- Simplified profile of RDF/XML
  - Lower hurdle to adoption
- Commercial users include
  - Time, Inc
  - Lexis-Nexis
  - McGraw-Hill
- Vocabularies used:
  - Dublin Core
  - Custom ontologies for
    - Controlled vocabularies
    - Relational information
    - Resource types
    - Rights management

# BBC Programmes

- Simple ontology for describing programmes
  - Brands
  - Series (seasons)
  - Episodes
  - Broadcast events
  - Broadcast services
- Data describing all BBC programmes

<http://purl.org/ontology/po/>

<http://www.bbc.co.uk/programmes/developers>



<http://www.flickr.com/photos/nicecupoftea/4104234460/>

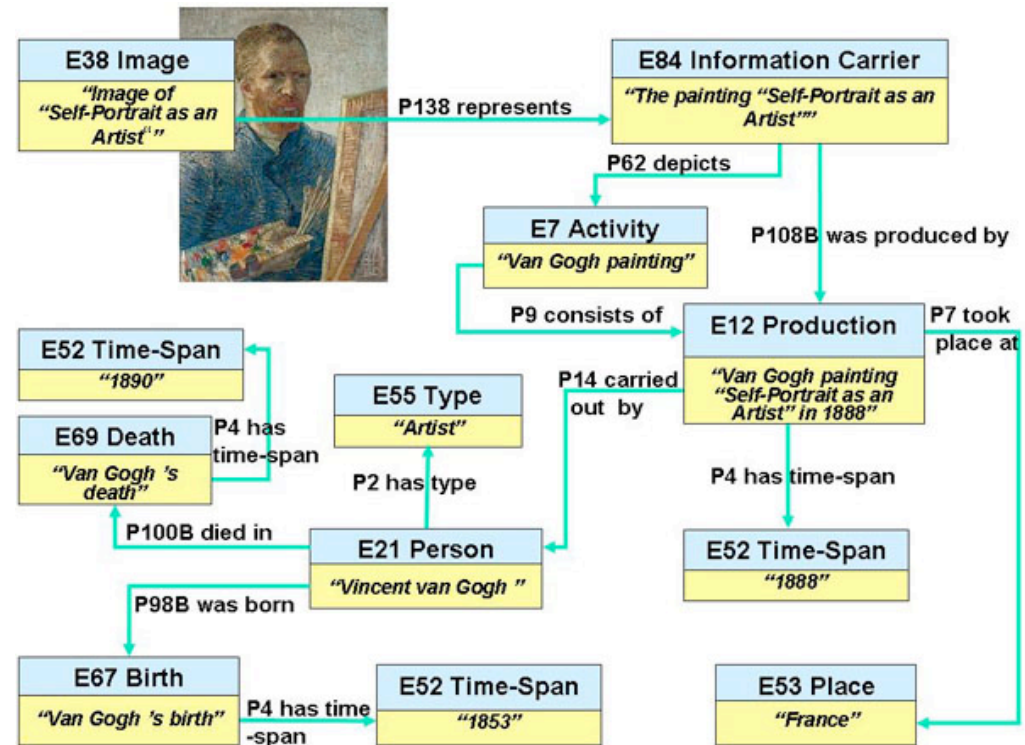


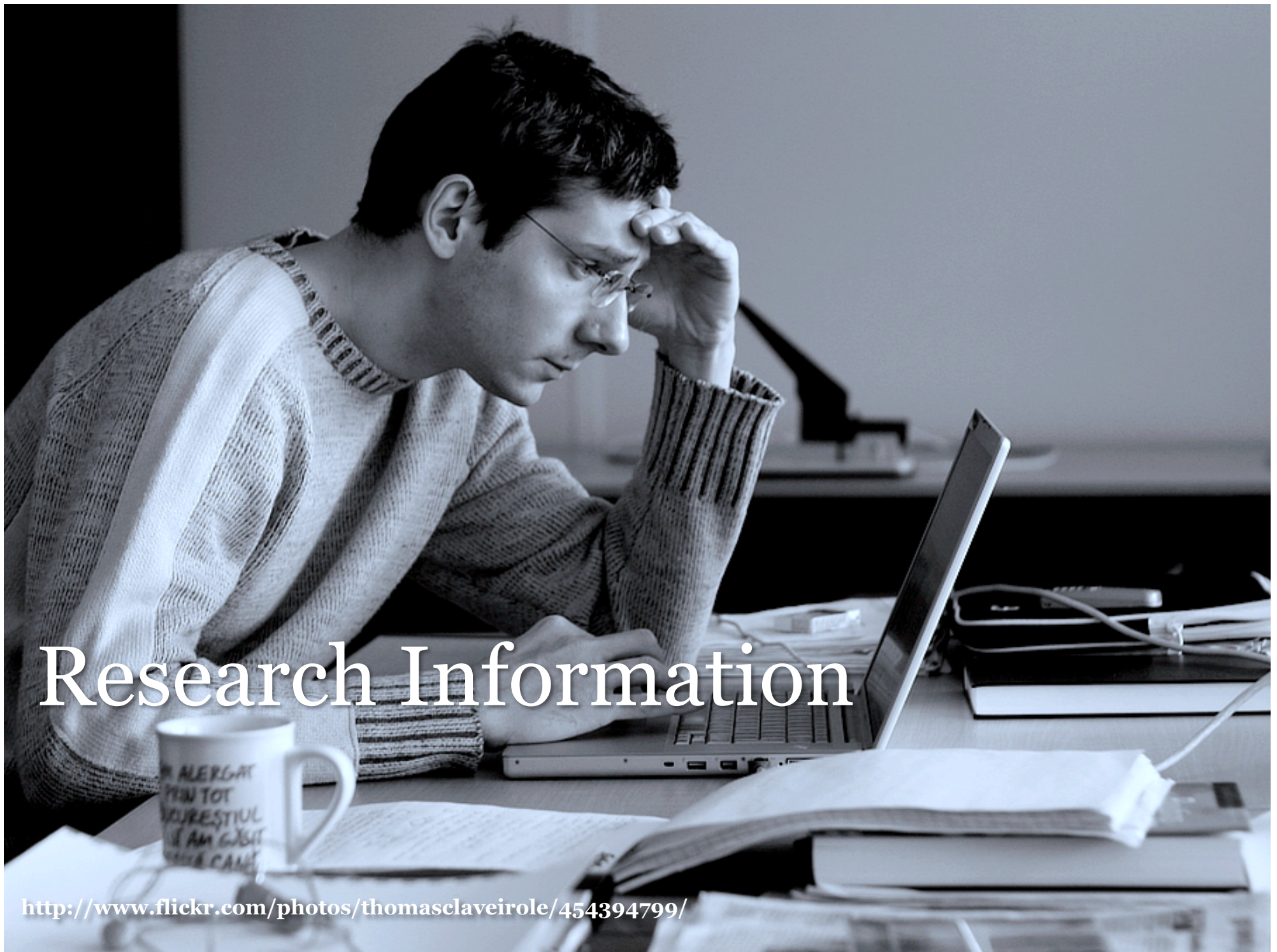
# Cultural Heritage

<http://www.flickr.com/photos/juanilloo/476627356/>

# CIDOC CRM

- Ontology for heterogeneous cultural heritage information
- Represents more than just bibliographic information
- Event-based model (compare with DC's attribute-based approach)





# Research Information

<http://www.flickr.com/photos/thomaslaveirole/454394799/>



# CS AKTive Space (2003)

- Repurpose information gathered about CS researchers to help them understand and explore their community
- Data sources:
  - 2001 Research Assessment Exercise submissions
  - Research Council project data
  - Detailed data on personnel, projects and publications harvested for leading CS departments in the UK



# AKT CS Aktive Space

[About this page](#)  research area/region  region/research area

## Research area

probability and statistics  
 discrete mathematics  
 numerical analysis  
 general

**Information Systems**  
 information interfaces and presentation  
 information systems applications  
 information storage and retrieval  
 database management  
 general

**Computing Methodologies**  
 document and text processing  
 simulation and modeling  
 pattern recognition  
 image processing and computer vision  
 computer graphics  
 artificial intelligence  
 symbolic and algebraic manipulation  
 general

**Computer Applications**

## Radial:

200 miles

## Map:

uk-political



## Researcher

NR Shadbolt  
 PC Treleaven  
 L Moreau  
 H Hu  
 LA Carr

## Detail: NR Shadbolt

[browse](#)

**Name** Professor NR Shadbolt

**Institution** Department of Electronics and Computer Science, University of Southampton

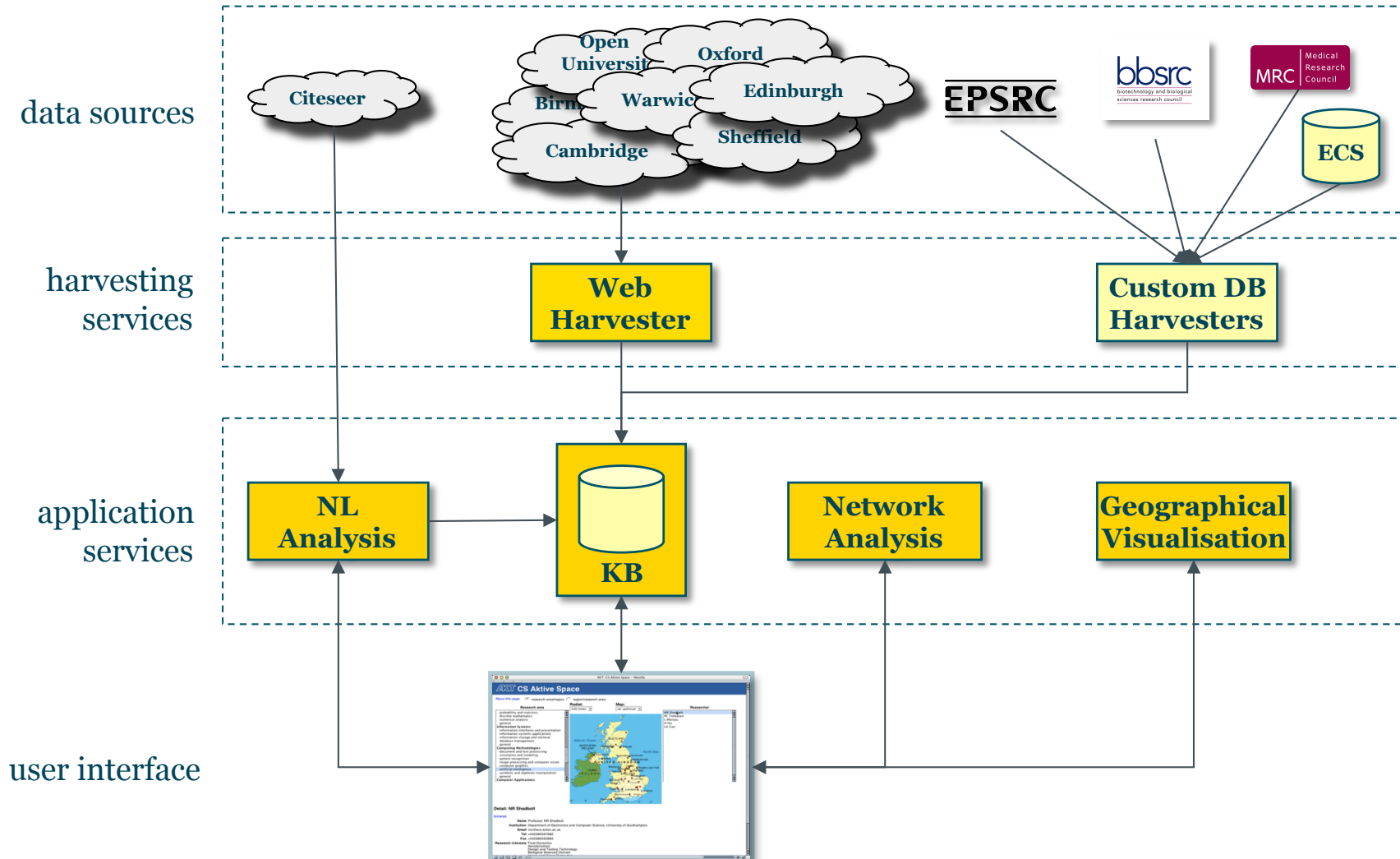
**Email** nrs@ecs.soton.ac.uk

**Tel** +442380597682

**Fax** +442380592865

**Research interests** Fluid Dynamics  
 Aerodynamics  
 Design and Testing Technology  
 Biological Sciences Domain  
 Image and Vision Computing

# System Architecture



# dotAC (2009)

- CS AKTive Space revisited
  - All UK Higher Education
  - Integrated data from institutional research repositories
  - Sustainable live data from research councils
  - Mapping from CERIF
- Extra services
  - Network analysis for related resources (communities of practice)
  - Coreference management – identify duplicates in data

<http://dotac.info/>

The screenshot displays the dotAC web application interface. The top section features a map titled "Location of Project Members" with a callout for "Andrew McGregor" in Glasgow. To the right, a "Details" panel lists project information: Title: Readiness for REF, F/R, Begins: 01/04/2009, Ends: 01/03/2011, Web Address: http://www.kcl.ac.uk/es/researchref/, and Programme, etc.: Information Environment Programme. Below the map is a "Participating Organisations" list including King's College London and University of Southampton. A "Project Members" list includes Andrew McGregor, Dr. Leslie Carr, and Mary Davies. A "Related JISC Projects" list includes Repositories for Sharing Learning Resources in Distributed Social Spaces, Collaborative Orthopaedic Research Environment, Content Lifecycle Integration Framework, DISC-UK DataShare, From Entry to Ethos, and Institutional Repositories and Research.

The bottom section shows a network diagram with five nodes (1-5) and a table of coreference management results. The table has two columns: one for node (1) Les Carr and one for node (5) Hugh Glaser. Node (1) has one entry: "1 Full Name (http://full-name) Les Carr". Node (5) has five entries: "3 Label (http://label) Thomas Martinez", "2 Label (http://label) Thomas Martinez", "4 Full Name (http://full-name) David De Roure", and "5 Full Name (http://full-name) Hugh Glaser". Each entry has a red "X" icon to its right.



# Business Intelligence

<http://www.flickr.com/photos/tetsu-k/393957103/>

# AKTive Futures (2004)

- How do we produce a portal for end users within the “strategic decision making” process of an organisation?
- Inform strategic planning and market intelligence
  - Identify relevant drivers
  - Visualise trends in heterogeneous data
  - Present information contextually

## Climate and environment

- Storms ahead: weather extremes
- Bio-diversity
- Global transport and industrialisation
- Abrupt climate change
- Sea level rises
- Water shortages
- Kyoto to 'Contraction and Convergence'

## Geo-political economy

- US-dominated agenda
- International institutions
- North vs South
- China, India and Asia
- European social agenda
- Scramble for oil in Africa
- US interventionist
- Middle East
- US 'technological sublime'

## Terrorism, total surveillance and security

- Global terror
- Future of 'remote wars'
- Everyone is watching
- Human rights
- Privacy and trust

## Energy

- Post oil?
- Large to small scale networks
- Hydrogen fuel cells: mobility
- 'Hydrogen highway'
- Costs and pricing
- Demand cuts
- Wind, tidal, solar

## Sustainability agenda

- Anti-science: the values debate
- Socio-political conflict over economics and business
- EU/regulatory drivers
- Public engage vs indifferent
- Corporate social responsibility

## Bio-everything

- Bio-tech
- Bio-remediation
- Bio-terror
- Bio-error
- Bio-agriculture
- Bio-medical
- Bio-informatics
- Genomics
- Proteomics
- Bio-systems

## Nano-science to nanotech

- Nanobots or goo?
- Materials science
- Nano-machines
- Sensors:RFIDS – MEMS
- Drug delivery
- Nano-filtration

## Demographics, migration and ageing

- Cures for everything?
- Longer and better?
- Ageing West, pensions crisis, inter-generational tension
- Acceleration of migration

## Augmented reality, pervasive and mobile computing

- 'Ambient' computing
- The Grid
- Broadband Mobile
- Wireless
- Bio-inspired computing
- Hybrid iDTV/web
- Remote sensing

## Knowledge, Innovation

- The Semantic Web
- Private research
- Public knowledge
- Artificial intelligence
- Intellectual property vs open source
- E-science

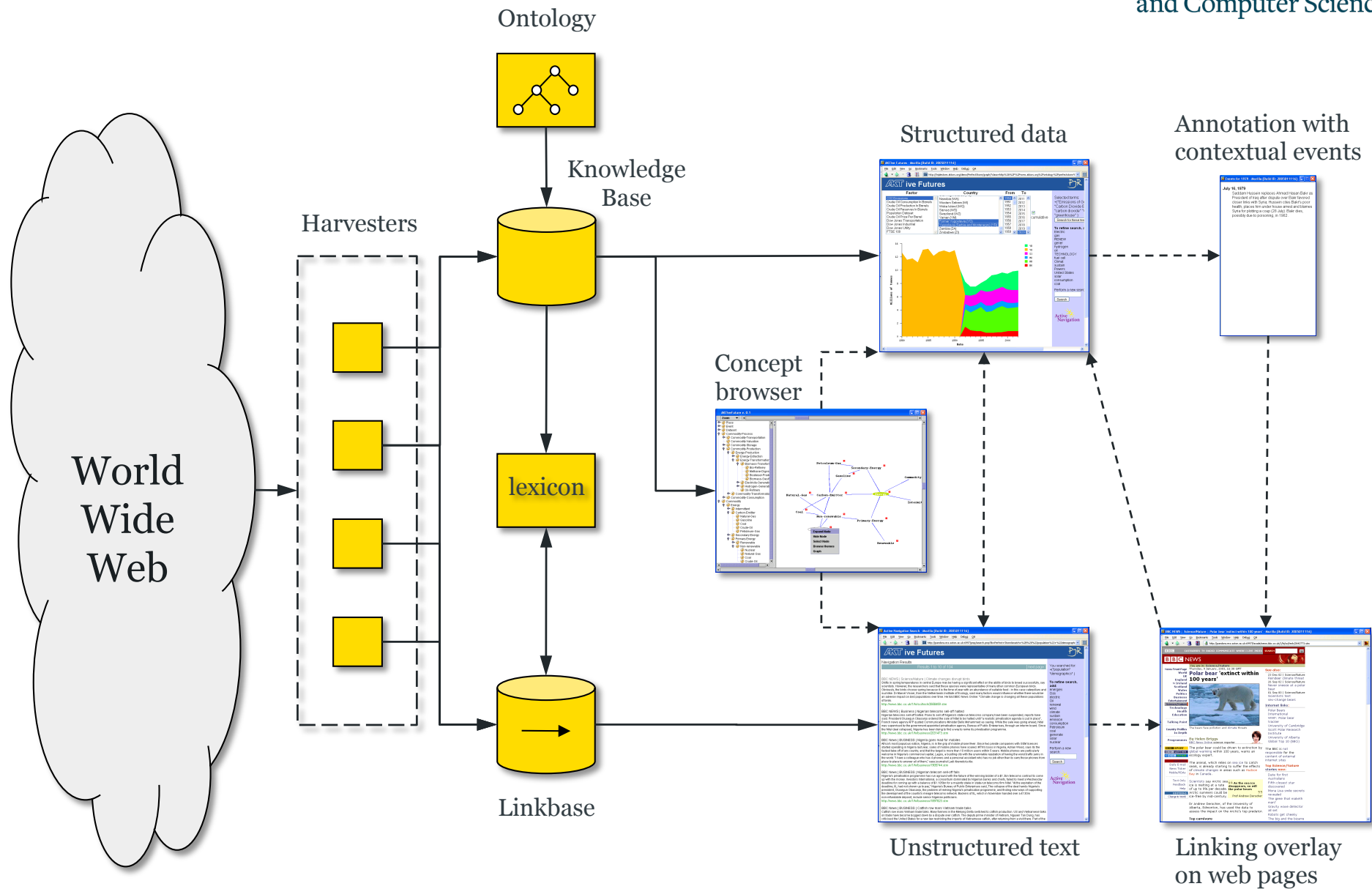
## Socio-cultural

- Values, attitudes and lifestyles: fast trends
- Anti-corporate
- 'Open source' values
- New trust matrix: NGOs
- Ethical consumers
- Family life
- Young vs old
- Boomers age
- Hypermobility, transport and urban/rural futures
- Health 'economy'
- 'Care world'
- Culture of fear and anxiety

## Media

- Conflicts over 'simple/certain' vs 'complex/uncertain'
- Plural
- Fragmented public media and discourse
- Single issue moral panics
- Smart mobs
- Mobile opinion formers

# System Architecture





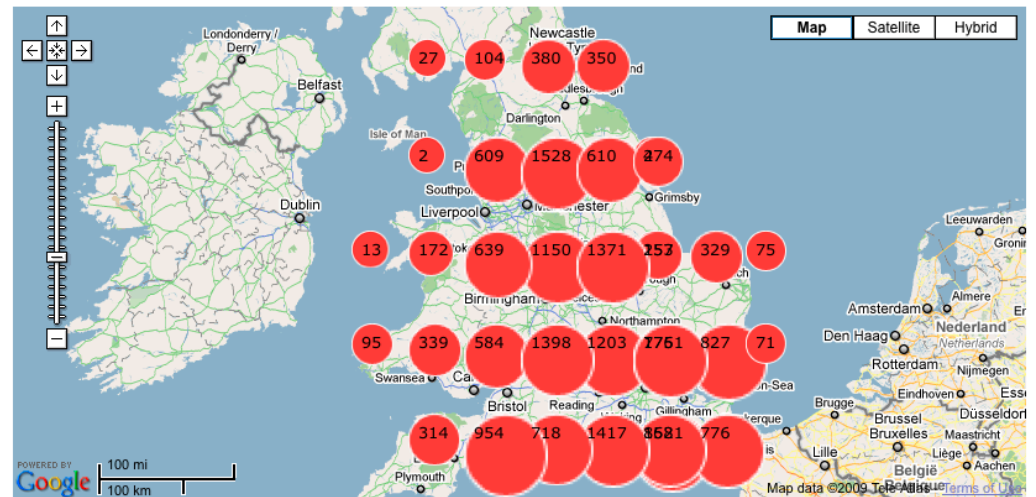
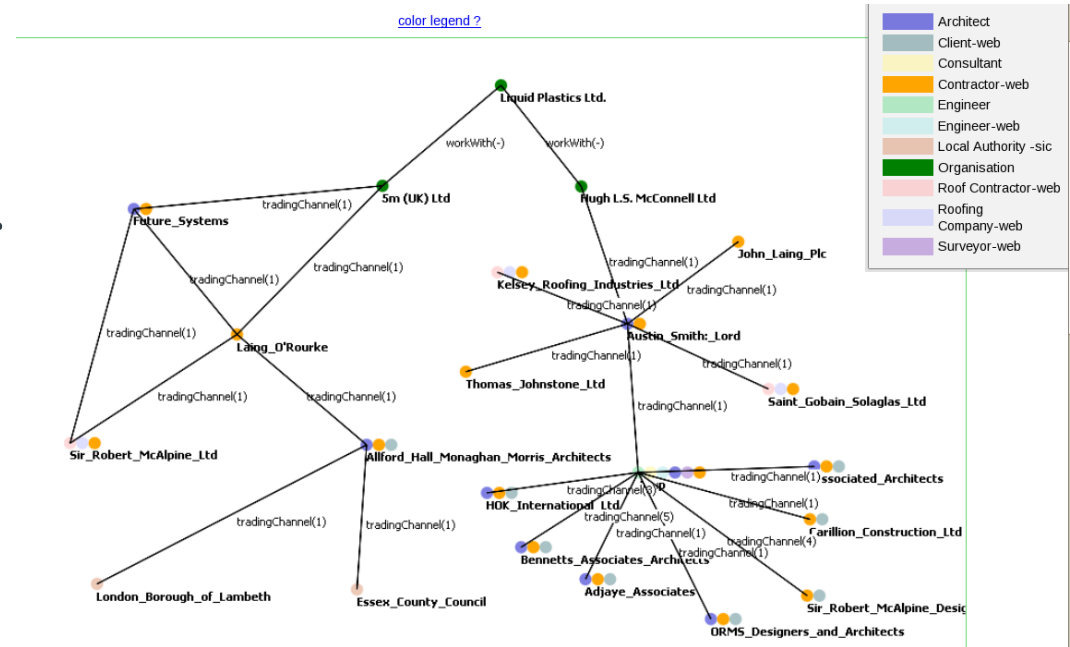
# Market Blended Insight (2006-2010)

- Application of Semantic Web technologies to marketing strategies for the B2B sector
- Real data, real B2B processes to ensure real scenarios for the undertaken research
- Workflow:
  - Identify market segments
  - Identify value chains and key relationships
  - Identify opportunities and channels of communication
  - Refine and iterate



# Data Sources and Visualisations

- UK business backbone:  
~4M companies
- Ordnance Survey Address Layer
- UK SIC(92) industrial classifications
- Other sources:
  - Local publications
  - Trade publications
  - Contact data for ~300K companies, extracted from company web sites
  - London Gazette (all UK insolvencies)



# Good Relations

- Standardised vocabulary for product, price, and company data
- Represents:
  - Prices
  - Accepted payment methods
  - Opening times
  - Delivery methods and charges
  - Warranty promises and scope
- Integrates with:
  - UNSPSC vocabulary for offerings
  - SIC codes for company type

<http://purl.org/goodrelations/>





# Public Sector Information

<http://www.flickr.com/photos/emsef/1398072554/>

# AKTive PSI (2005)

- Use advanced knowledge management technology to improve the delivery of policy and public services across Government
- Build up a detailed picture of life in two London Boroughs, using as broad a collection of Public Sector Information as possible



Office of  
PUBLIC SECTOR INFORMATION



Land Registry  
Cymraeg



national **STATISTICS**

**LONDON**

**CabinetOffice**



# Visualisations and Mashups

AKTive PSI - Mozilla Firefox

http://sasoki/AKTivePSI/scrape/ch/?companyname=Abington+Autos

**AKTive PSI**  
 Companies House Web Scraper

Company Name:  
 Abington Autos

Get Company Information

Suggested Searches:  
 Abington Autos  
 Abington Autocentre

Company Information

The closest company that matched your search was

ABINGTON AUTO'S LIMITED	MAYFIELDS INSOLVENT WEST MIDLANDS
Company No. 03869315	
Status	Dissolved 29/12/20
Date of Incorporation	01/11/1999
Country of Origin	United Kingdom
Company Type	Private Limited Company
Nature of Business (SIC(03))	5010 - Sale of motor vehicles
Accounting Reference Date	31/03
Last Accounts Made Up To	31/03/2001 (TOTAL)
Next Accounts Due	31/01/2003
Last Return Made Up To	01/11/2001
Next Return Due	29/11/2002
Last Members List	01/11/2001
Insolvency History	

AKTive PSI on Google Maps - Mozilla Firefox

http://sasoki.ecs.soton.ac.uk/AKTivePSI/lr/maps/

**AKTive PSI**  
 Land Registry Camden Sample Set

Show Markers

land and buildings on the south side of Platt Street at the Junction with Goodway

Title Number: NGL185462  
 Owned by: CLARK KENT 1 Smith Street, London, E14 9NZ  
 Tenure: Absolute Freehold  
 Other Register Data:

**Daisies Day Nursery**

Risk Category  
 B

Camden Food Premises  
<http://www.camden.gov.uk/foodPremiseOntology/#premise5083310>

PointX Points of Interest  
<http://www.ordnancesurvey.co.uk/PoIOntology/#business26453632>

# Integrated Public Sector Vocabulary

- Taxonomy for classifying public sector information resources
- Developed with the backing of the ODPM and the Cabinet Office e-Government Unit
- Available in a variety of formats, but RDF/XML is the definitive format
- Uses Dublin Core and SKOS

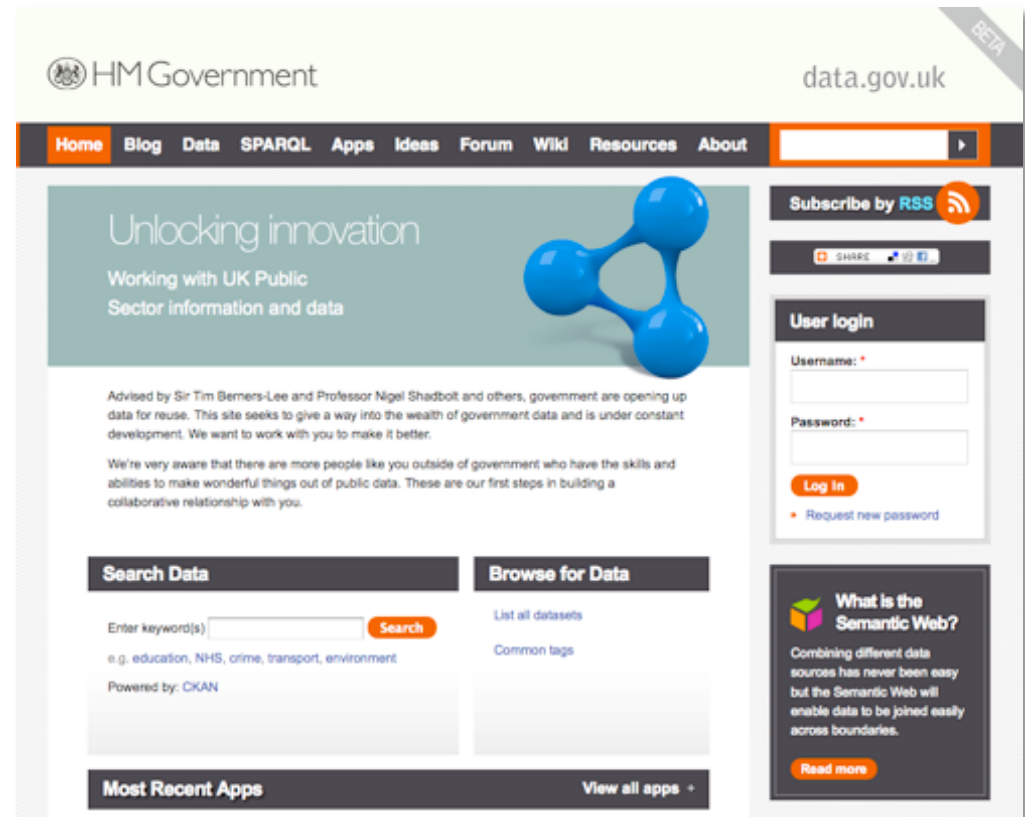
# IPSV Top Level Headings

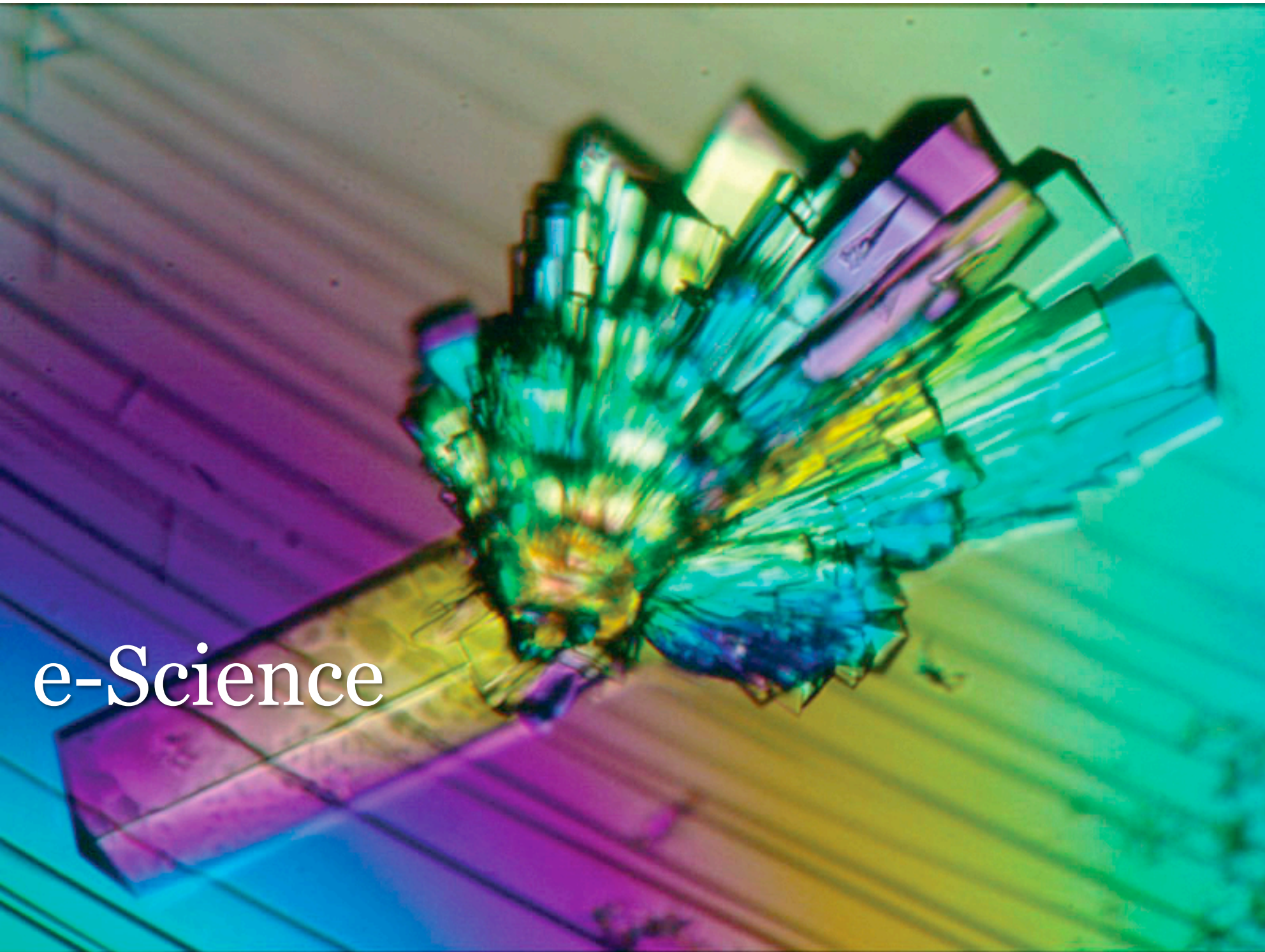
- Business and industry
- Economics and finance
- Education and skills
- Employment, jobs and careers
- Environment
- Government, politics and public administration
- Health, well-being and care
- Housing
- Information and communication
- International affairs and defence
- Leisure and culture
- Life in the community
- People and organisations
- Public order, justice and rights
- Science, technology and innovation
- Transport and infrastructure



# data.gov.uk (2010)

- In 2009, Tim Berners-Lee and Nigel Shadbolt appointed as advisors to HMG on opening up public data
- data.gov.uk website went public on 21 Jan 2010
  - 2890 datasets from central and local government
  - Uses SW technologies to represent data



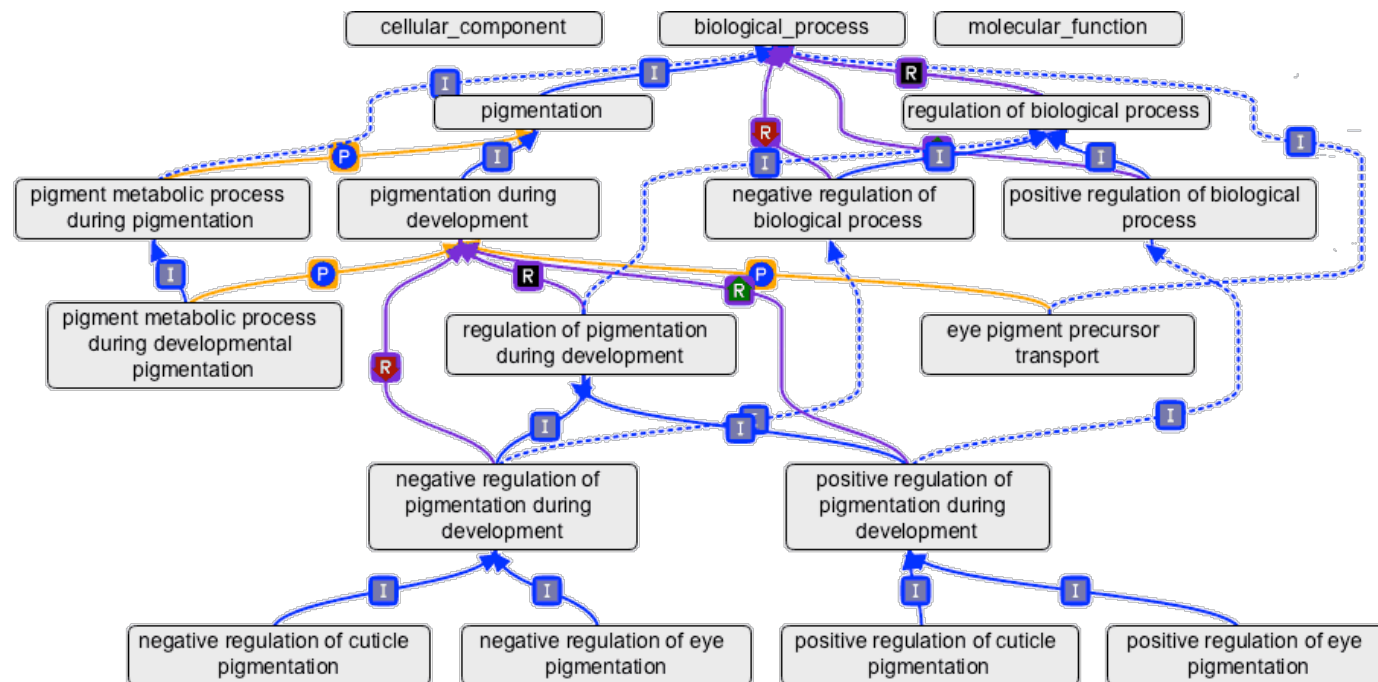


e-Science

# e-Science

- e-Science characterised as:
  - Large-scale science
  - Distributed global collaborations
  - Very large data collections
  - Very large scale computing resources
- Data integration will be a major issue
  - Capture, publish, reuse data
  - Agreed vocabularies for data exchange

- Controlled vocabularies for the consistent description of gene products
- Simplified profile of RDF/XML
- Multi-view ontology
  - Molecular function
  - Biological process
  - Cellular component



## Search GO

 Exact Match

 Terms

 Gene Symbol/Name

[Advanced Query](#)
[Query By Sequence](#)

## Gene Product Filters

### Species

All  
A. japonica  
A. niger  
A. platyrhynchos

### Datasource

All  
FlyBase  
SGD  
MGI

### Evidence Code

All Curator Approved  
IC  
IMP  
IGI

[XML](#)
[Flat File](#)
[Permalink](#)

Last updated: 2006-01-05

all : all ( 166170 )

GO:0008150 : biological\_process ( 118045 )

GO:0000004 : biological process unknown ( 33123 )

GO:0009987 : cellular process ( 70992 )

GO:0007275 : development ( 12234 )

GO:0040007 : growth ( 3010 )

GO:0051704 : interaction between organisms ( 1392 )

GO:0051705 : behavioral interaction between organisms ( 196 )

GO:0042710 : biofilm formation ( 17 )

GO:0000746 : conjugation ( 204 )

GO:0000128 : flocculation ( 10 )

GO:0009292 : genetic transfer ( 70 )

GO:0044419 : interspecies interaction between organisms ( 820 )

GO:0044402 : competition with another organism ( 0 )

GO:0044403 : symbiosis, encompassing mutualism through parasitism ( 818 )

GO:0051703 : intraspecies interaction between organisms ( 8 )

GO:0051706 : physiological interaction between organisms ( 135 )

GO:0007582 : physiological process ( 72983 )

GO:0043473 : pigmentation ( 86 )

GO:0050789 : regulation of biological process ( 13235 )

GO:0000003 : reproduction ( 3883 )

GO:0050896 : response to stimulus ( 13945 )

GO:0016032 : viral life cycle ( 289 )

GO:0005575 : cellular\_component ( 103652 )

GO:0003674 : molecular\_function ( 114778 )

obsolete\_biological\_process : obsolete\_biological\_process ( 0 )

obsolete\_cellular\_component : obsolete\_cellular\_component ( 0 )

obsolete\_molecular\_function : obsolete\_molecular\_function ( 0 )

Graphical View

[Term]

id: [CL:0000540](#)

name: [neuron](#)

def: "The basic cellular unit of nervous tissue. Each neuron consists of a body\, an axon\, and dendrites. Their purpose is to receive\, conduct\, and transmit impulses in the nervous system." [MESH:A.08.663]

xref\_analog: [FBbt:00005106](#)

xref\_analog: [FBbt:00005146](#)

is\_a: [CL:0000393](#) ! electrically responsive cell

is\_a: [CL:0000404](#) ! electrically signaling cell

relationship: develops\_from [CL:0000031](#) ! neuroblast

# The Smart Tea Project

UNIVERSITY OF  
**Southampton**  
School of Electronics  
and Computer Science



- Improving the information environment for chemists – both within and beyond the lab
- Supporting chemists in the preparation, execution, analysis and dissemination of their work



<http://www.smarttea.org/>

2-21-39

Prep. of Benzene azo compound

179 g aniline

1750 cc dil.  $H_2SO_4$  (168 cc conc.  $H_2SO_4$ )

} cool to zero  
with rapid stirring

137 g  $NaNO_2$  in 1050 cc of water

244 g ... in 7000 cc aq. containing 100 g  $NaOH$ .

3000 cc aq. containing 240 g  $NaOH$ .

179 g of aniline (1.93 moles) was dissolved in 1750 cc of dil.  $H_2SO_4$  contg. 2.98 moles  $H_2SO_4$  (168 cc conc.  $H_2SO_4$ ). Cooled to zero with rapid stirring. The with end of dropping funnel below surface, 137 g (1.98) moles of  $NaNO_2$  in 1050 cc of water were added very slowly, rate being so, that no large excess of nitrous acid at any time. Allowed to stir for two hours at  $0^\circ$ , at which time a slight starch iodide paper test.



# Weigh-Station #1

11-Feb-2004 16:04:40

**dj** **djbj3403**

## Experiment Details

Name	Planned	Actual
Fluorinated biphenyl	0.9000 g	0.9031 g
Br11OCB	1.5900 g	1.5918 g
Potassium Carbonate	2.0700 g	2.0719 g
	40.0 ml	40.0 ml

# Bench-Station #1

11-Feb-2004 16:05:38

**dj** **djbj3403**

## Experiment Details

Stage	Instructions	Done
3	Heat at reflux for 1.5 hours	<input checked="" type="checkbox"/>
4	Cool and add Br11OCB	<input checked="" type="checkbox"/>
5	Heat at reflux until completion	<input checked="" type="checkbox"/>

All tasks completed.

**Escape**  
 Quit Weigh Liquid-Measure Bench Store

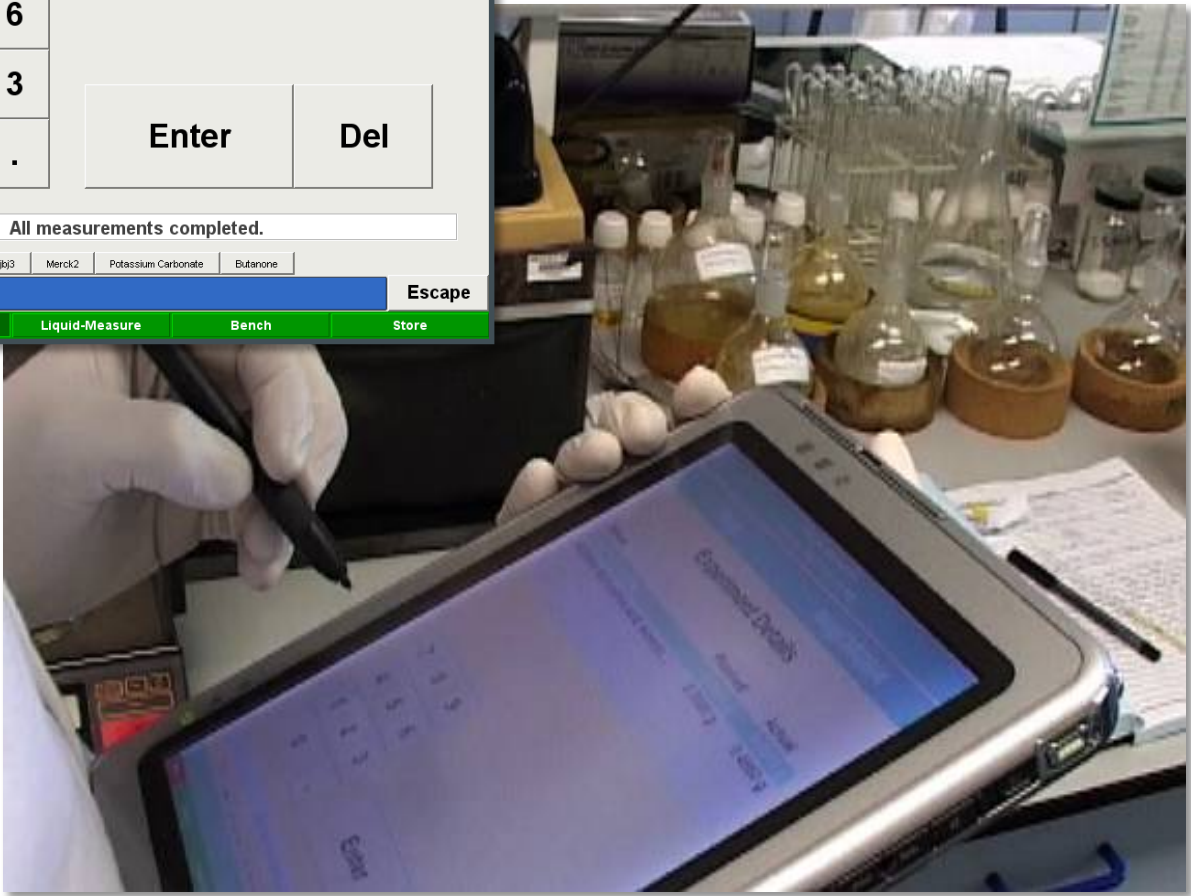
9  
6  
3  
.

Enter Del

All measurements completed.

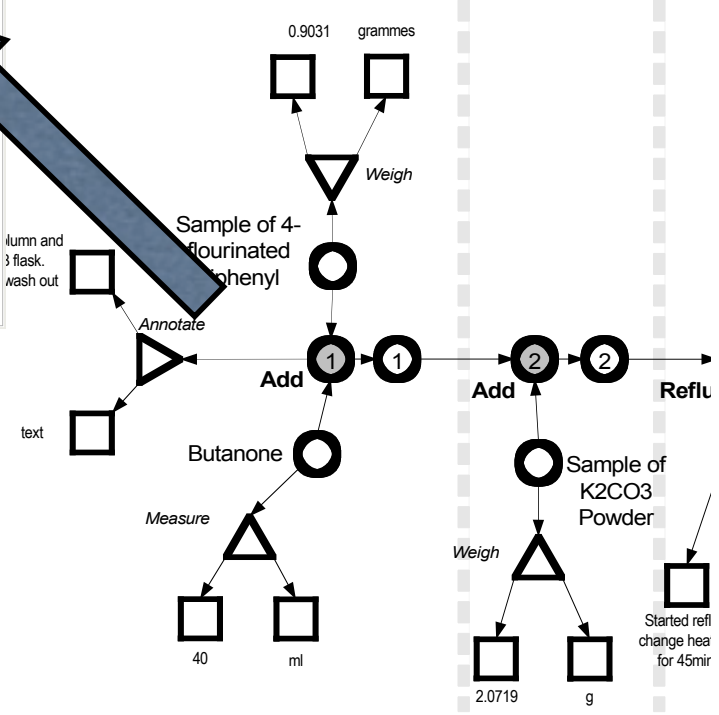
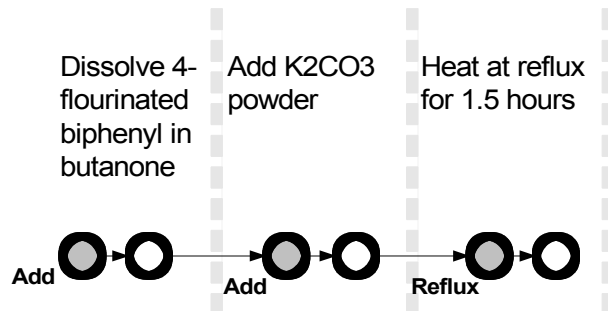
djbj3 Merck2 Potassium Carbonate Butanone

**Escape**  
 Liquid-Measure Bench Store



Ingredient List	
Fluorinated biphenyl	0.9 g
Br11OCB	1.59 g
Potassium Carbonate	2.07 g
Butanone	40 ml

Butanone dried via silica column and measured into 100ml RB flask  
 Used 1ml extra solvent to wash out container



# Publish and Reuse

**University of Southampton** Crystal Structure Report Archive

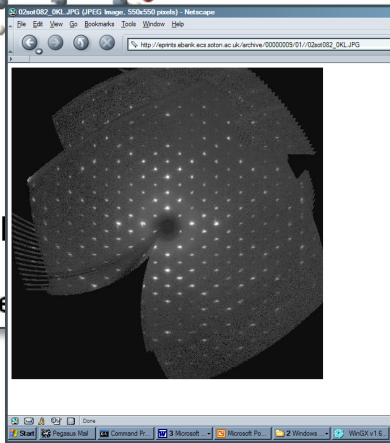
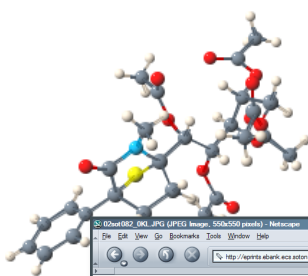
**5- Cyano- 2- methyl- 4- phenyl- 1- (5,6,7- tris(acetoxy)- 2,10- dioxo- 3,9- dioxo- undeca- 4- yl)- 2- aza- 7- thiabicyclo[2.2.1]heptane- 3- one**

M. J. Arevalo, M. Avalos, R. Babiano, P. Cintas, M. B. Hursthouse, J. L. Jimenez, M. E. Light and J. C. Palacios.

University of Southampton  
C28H32N2O11S

**InChI Code:** C28H32N2O11S,1H3-15(31)37-14H2- 23H(38-16(2H3)32)24H(39- 17(3H3)33)25H(40-18(4H3)34)26H(41- 19(5H3)35)27- 13H2-22H(7- 29)28(42-27,21(36)30(27)6H3)20- 11H- 9H- 8H- 10H- 12H- 20 ([google for ichi](#))

**Compound Class:** Organic  
**Keywords:** Controlled Keywords  
UNSPECIFIED  
**Creation Date:** 26 September 2001  
**Deposited By:** [Susanne L. Huth](#)  
**Deposited On:** 03 August 2004



Available

Final Re

## Data collection parameters

Chemical formula	C28 H32 N2 O11 S
Crystallisation Solvent	
Crystal morphology	
Crystal system	Orthorhombic
Space group symbol	P2(1)2(1)2(1)
Cell length a	10.9877(7)
Cell length b	11.9703(8)
Cell length c	22.4663(18)
Cell angle alpha	90.00
Cell angle beta	90.00
Cell angle gamma	90.00
Data collection	120(2)

01esp301_data/01esp301.CIF	17k
01esp301_data/01esp301.cml	11k
01esp301_data/01esp301_inchi.cml	1k

## Validation

01esp301_data/01esp301_cif.html	15k
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## Refinement

01esp301_data/01esp301.res	10k
01esp301_data/01esp301_xl.lst	48k

## Solution

01esp301_data/01esp301.PRP	6k
01esp301_data/01esp301_xs.lst	47k

## Processing

01esp301_data/01esp301.HKL	468k
01esp301_data/01esp301.HTM	6k

## Other Files

01.DOC	290k
01.mol	6k

is record



# Exchange Vocabularies

- BioPax Ontology (biological pathways)
  - Metabolic and signalling pathways, molecular interactions
- Gene Ontology (genes and gene products)
  - Molecular function, cellular component, biological process
- NCI Cancer Ontology
  - Diseases, drugs, anatomy, genes

(and many others from other disciplines)

# Advanced Visualisations

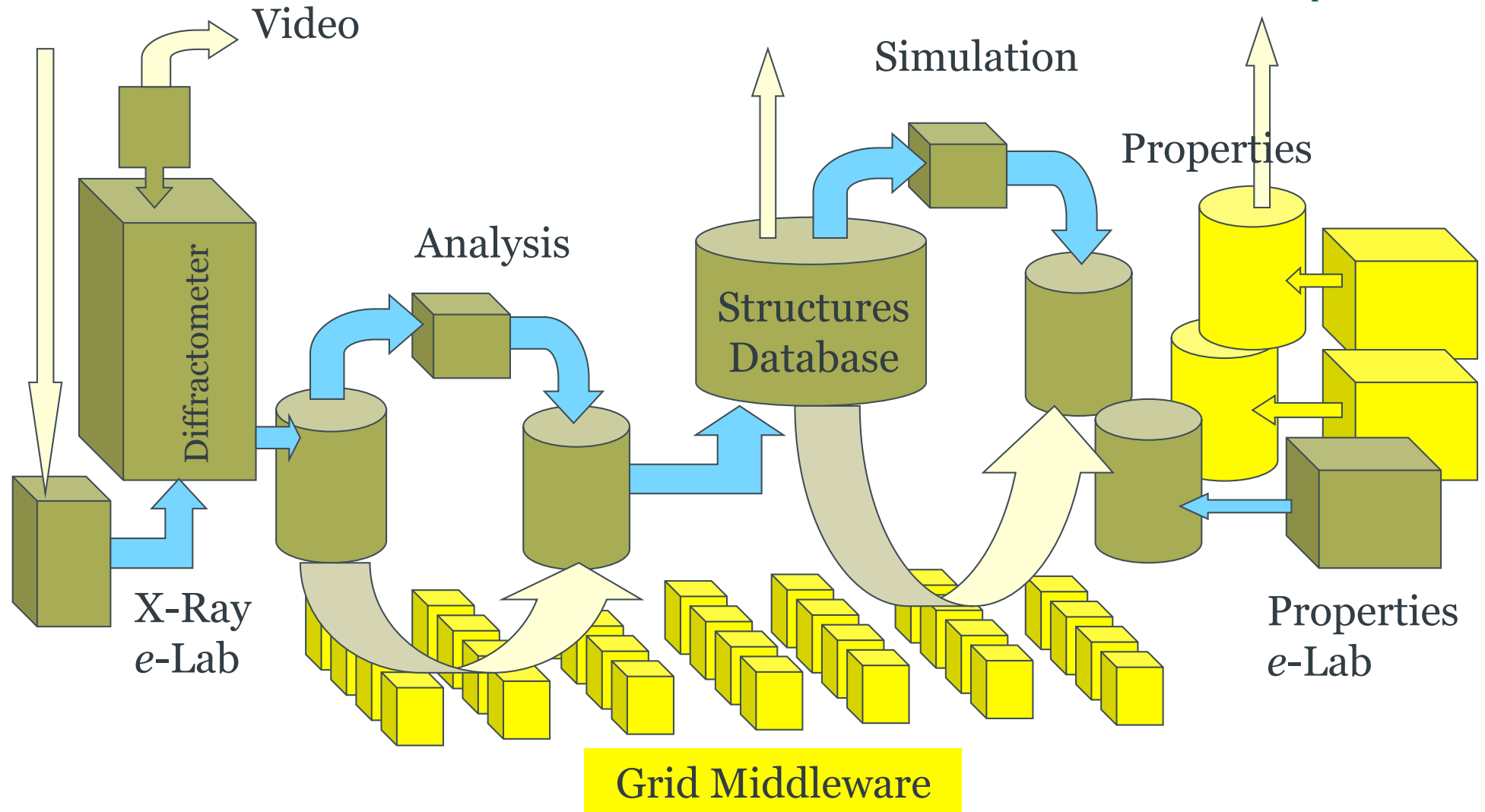
The screenshot displays the DOPE Browser interface. The main window is titled "DOPE Browser" and contains several panels:

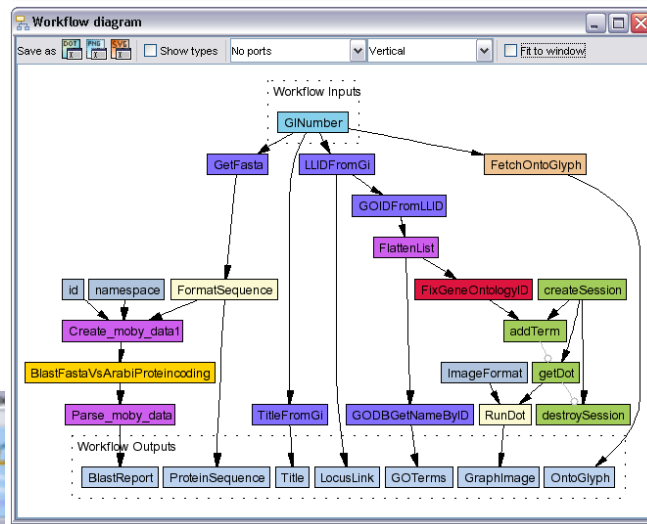
- File Panel:** Shows the "Focus Term" as "acetylsalicylic acid". A search box contains "aspirin" and a "Go!" button. A "Navigate Thesaurus..." button is also present.
- Co-occurring Terms Panel:** A list of terms with associated counts and checkboxes. The "practice guideline" term is selected with a checkmark.
- Term Overlap Display Panel:** A central visualization showing overlapping clusters of terms. The clusters are labeled with terms and their counts: "mortality (8/37)", "practice guideline (4/12)", "warfarin (3/25)", and "blood clot lysis (23/23)". Each cluster is represented by a group of colored spheres (yellow, white, green, blue, red) connected by lines.
- Document List Panel:** A list of documents related to the selected term. The first document is titled "1. Antithrombotic Therapy for Acute Myocardial Infarction." and includes the authors O'Donnell, C.J.; Ridker, P.M.; Hebert, P.R.; Hennekens, C.H. (1995). The second document is "2. Can the MADIT Results Be Applied to Myocardial Infarction Patients at Hospital Discharge?".

At the bottom of the window, there are buttons for "Collapse all" and "Clear all", and the status bar shows "Ready".

# Grid Computing

- e-Science applications typically have very high computational requirements
- Grid Computing provides an infrastructure for
  - Flexible, secure, coordinated resource sharing
  - Dynamic collections of individuals, institutions and resources
  - Virtual organisations
  - Workflow management
- Social computing, in effect





**Workflow information**

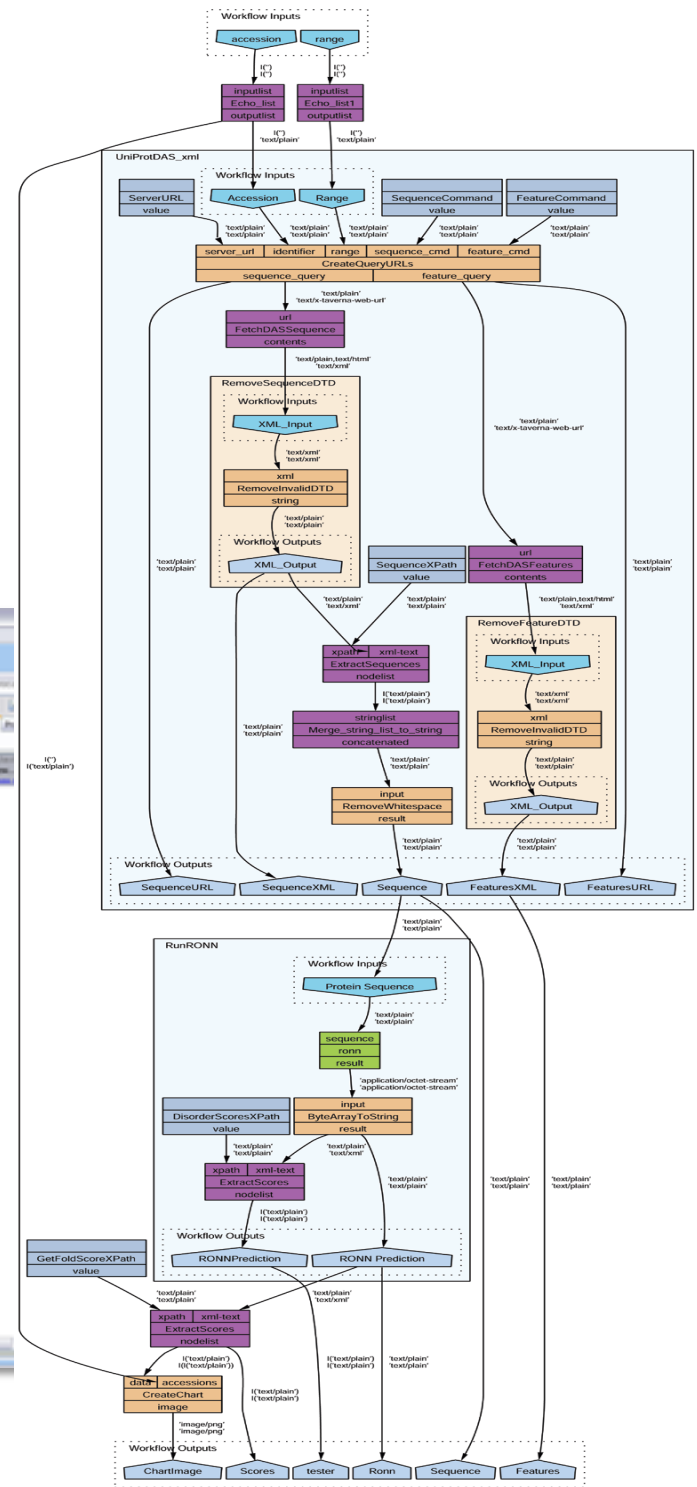
This report applies to the workflow titled **Custom functions of genes on human Y chromosome to those on X** authored by **Tara Clew** and web-LLID **http://www.mygrid.org.uk/operation/1152259.RL4/**. The textual description, if any is shown below:

1. Terms shown in purple are those explicitly mapped to genes on the Y chromosome and neither explicitly nor implicitly mapped to any on X
2. Terms not are those implied by those in purple and not explicitly or implicitly mapped to any genes on X
3. Yellow terms are those explicitly mapped in X
4. Green terms are those implied by terms mapped in both X and Y

**Resource usage report**

This display shows the various internal resources used by the current workflow. It does not show resources such as local operations or string constants which are not within the execution engine. Services are categorized by resource host and type, and the name of the instance of each service shown to the right.

Resource on <b>essex0108.essex.ac.uk</b> 10 instances	Operation name	Processor
Storage	DataSetName	Processor
	namespace_name_accessid	GetChoiceFunctions
Storage	DataSetName	Processor
	namespace_name_accessid	GetChoiceFunctions





# The Semantic Grid

- Grid Computing + Semantic Web
- Information and services are given a well-defined meaning
  - Uses SW technologies – OWL, RDF, etc
  - Ontologies for describing services
- Better enables computers and people to work together
  - Requires coordination and planning capabilities found in agent technologies