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Knowledge Capturing, Retrieval and Reuse

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Outline

- Semantic Web and Knowledge Management
  - From the Web to Corporate Applications
- Discovering Structured and Unstructured Information and Knowledge
- Structuring unstructured data
  - From Data to Information and Knowledge
  - Extracting Information from Texts
- Retrieving Knowledge and Information
  - Semantic Search
- Visualising Knowledge and Information
- Reusing Information

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Knowledge Management

- The main goal of knowledge management is to allow companies ways to reappropriate of their knowledge
  - Which is generally implicit in
    - the mind of the employees
    - the procedures
    - Millions of documents
  - but rarely formalised explicitly.
- So in short the goal of knowledge management is to enable reuse of knowledge and know-how by the appropriate people at the right time in the right form

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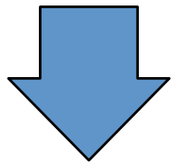
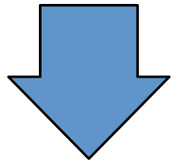
Why Manage Knowledge?

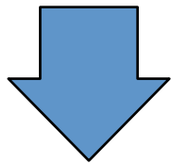
reuse



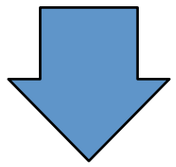
retrieval



sharing



capture



modelling

acquisition

- To enable easy timely and effective **reuse** of knowledge
  - We need to: enable **retrieval**
- To enable retrieval
  - we need to: enable **sharing**
- To enable sharing
  - we need to: **capture** knowledge
- To enable capture:
  - We need **modelling** the domain and process in an appropriate way
- To enable Modelling:
  - We need **acquisition of** domain and process knowledge

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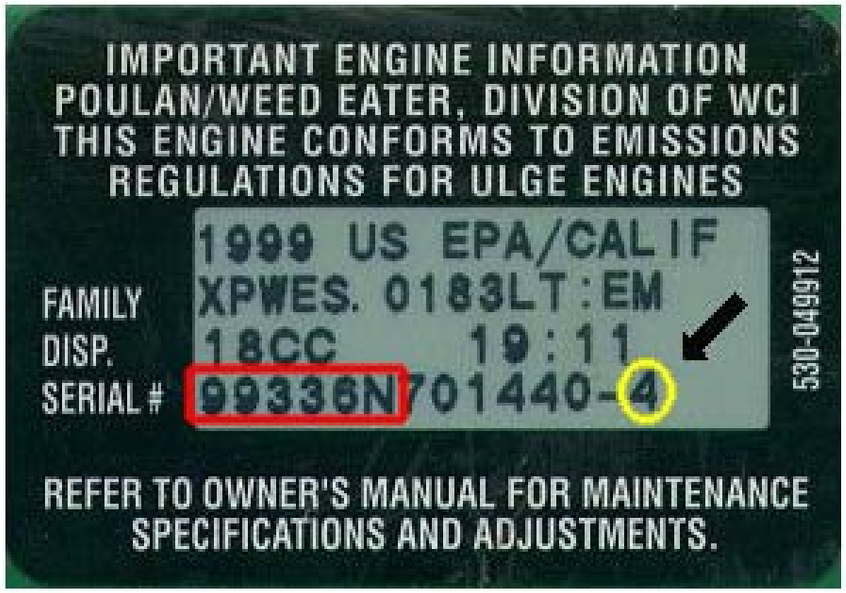
An Example of Knowledge Management

jet engines are moving towards complete serialisation
- every piece has a serial number (excepts nuts and bolts)
- the history of each part is recorded
  - e.g. part transferred between engines

© Rolls-Royce plc



99336N = Date Code
- Day of the Year
- Year of Production

4 = Product Type

Sense Making in Aerospace

- a jet engine can produce ~1Gbyte of vibration data per hour of flight;
  - if irregularities are found, part of the data can be stored
  - reports can be written (event reports)
  - pictures can be taken

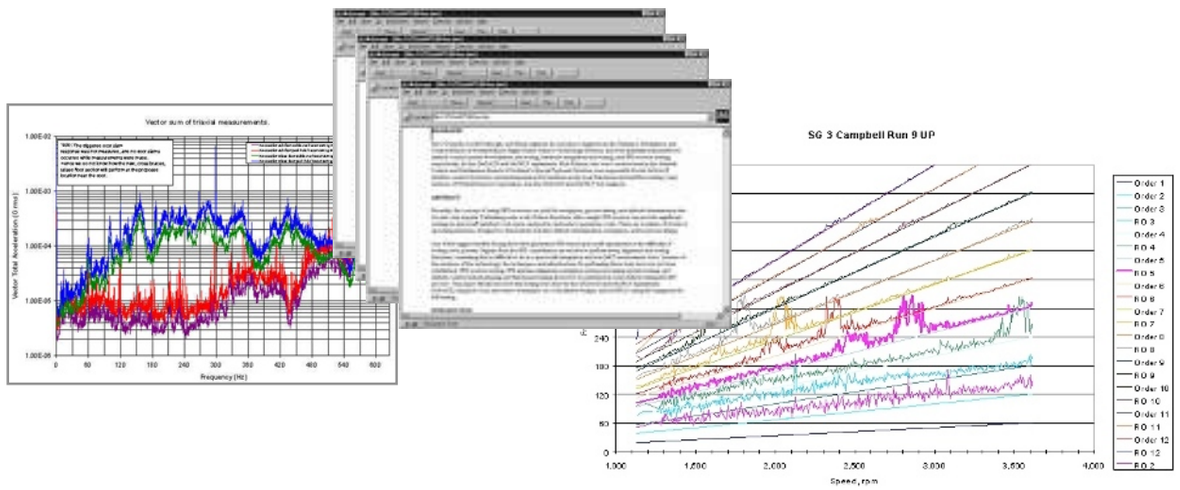
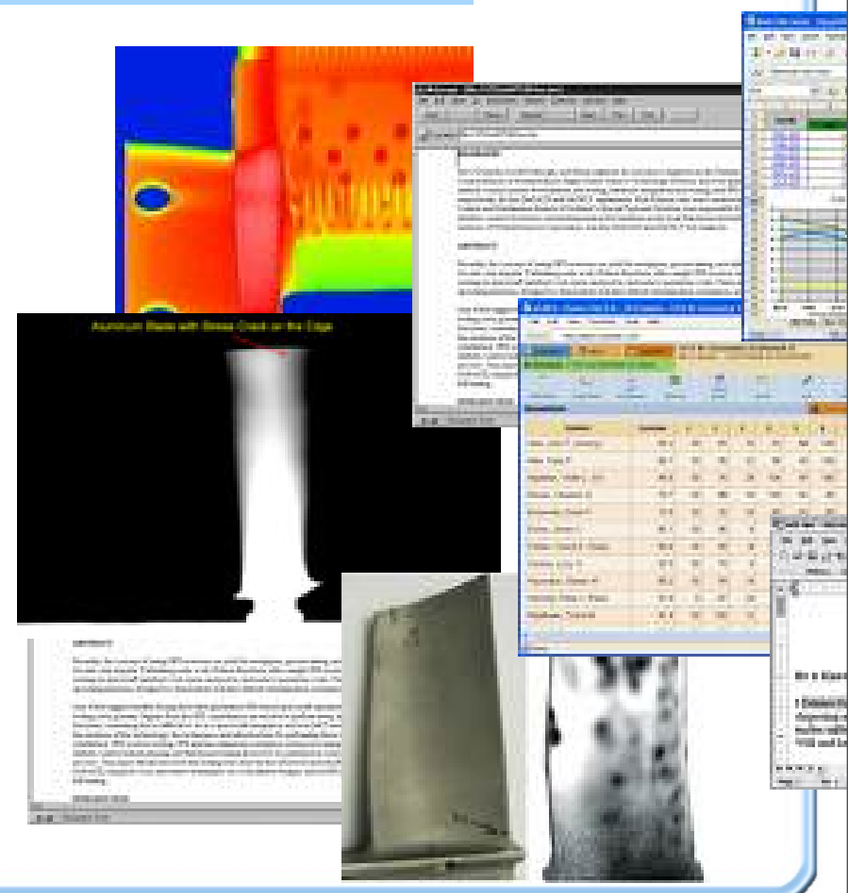


image © www.rolls-royce.com

Jet engine example (3)

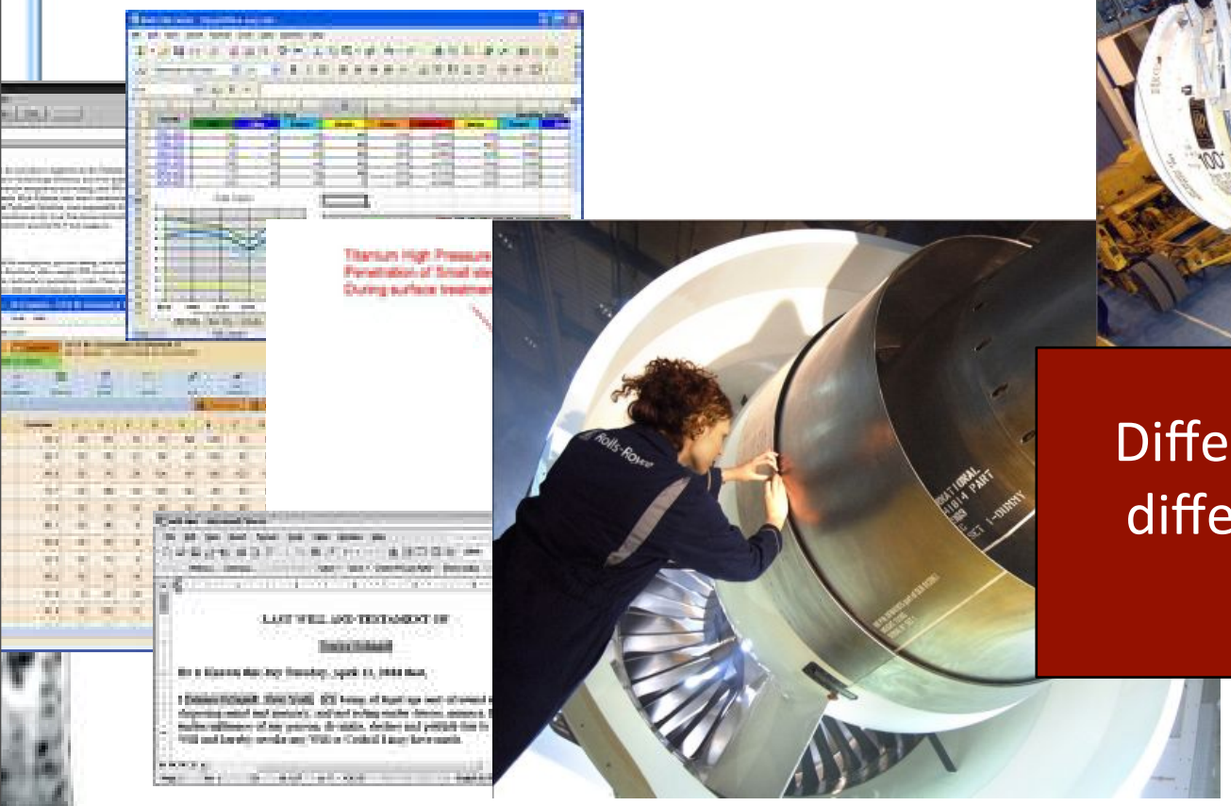
When engine is serviced (e.g. overhaul)

- financial information is produced.
- if issues are found,
  - pictures are taken
  - reports are written
  - engine is tested



Jet engine example (4)

- If problem is recurring (or suspected so)
  - a problem resolution group is established
    - existing evidence is retrieved
    - further evidence is collected
    - a learned lesson is generated
    - same problem is investigated across models



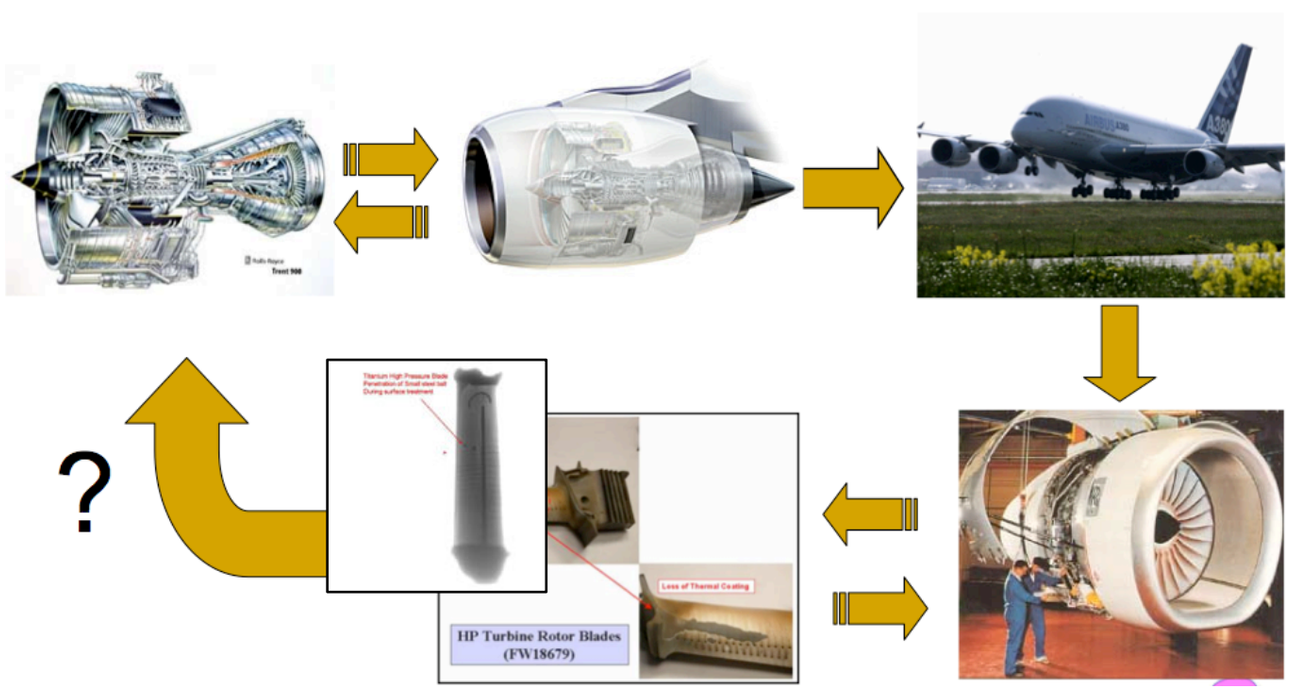
Different repositories represent different communities point of view!!

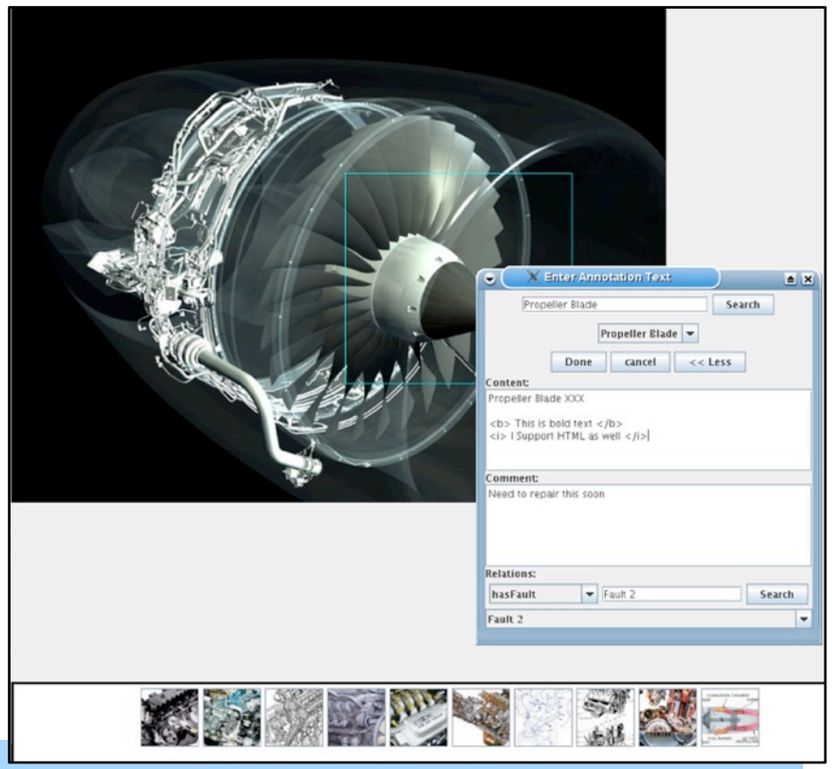
images © www.rolls-royce.com

Document Type
AROC proforma
AROC results
Development
EHM data
Emails
ONWING emails
Images
Lab findings
Monitoring Requir
Presentations
Procedures
RCP
Risk Assessment
Solution Reports
Technical Reports
TS&O Reports

Jet engine example (4)

- Lifecycle "folder" will easily sum up to several Terabytes
- Folder will contain highly interrelated information stored in different media



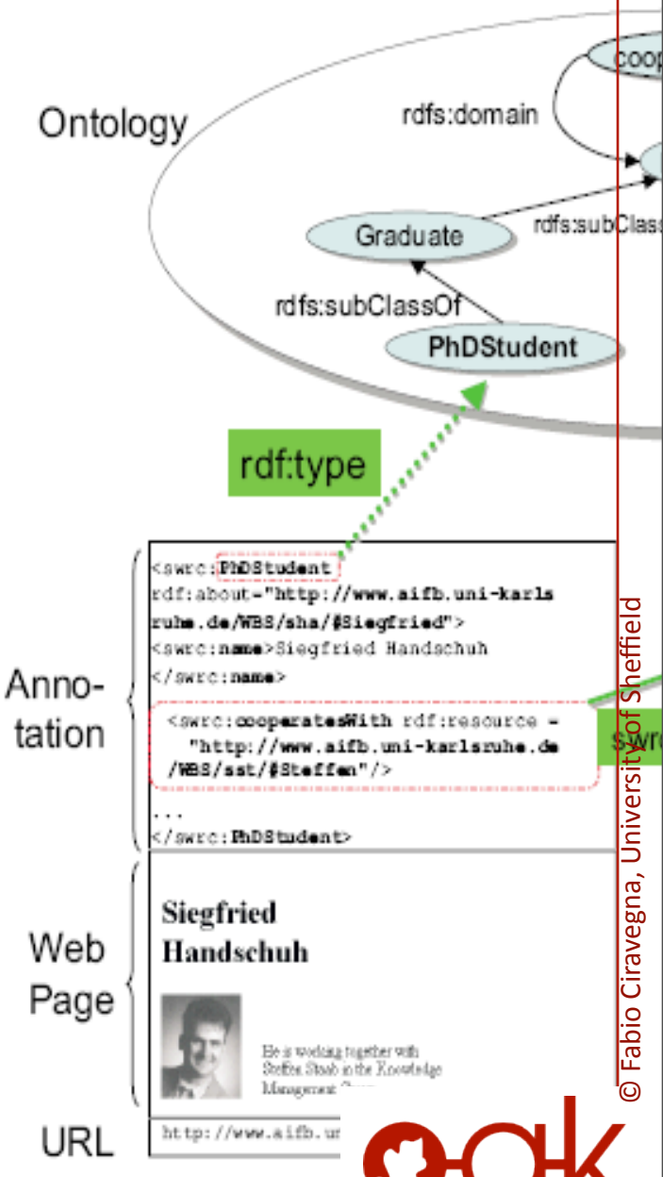


- Goal for Knowledge Management:
- Making information available independently from
  - Data format (structured/unstructured)
  - The archive
- Making it available for automatic processing
- Making it easily accessible and manageable despite its size

Ontologies and KM

Motivations for use:

- To represent an organisation's general view on the domain
  - How does the organisation work?
  - What is the organisation's official dictionary?
- As a middle layer to connect information from different information sources
  - The Web of data (as opposed to Web of documents)
- To represent communities' views of domains
  - e.g. marketing dept, customers, design and service departments have different views of the same products.
- Ontology mapping to navigate information sources
  - Mapping enables seamless communication among different worlds



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Capturing Knowledge from the Semantic Web

11

Crawling the Semantic Web

Sindice

12

Giovanni Tummarello, Renaud Delbru, and Eyal Oren
Sindice.com: Weaving the Open Linked Data
6th International Semantic Web Conference and the 2nd Asian Semantic Web Conference, Busan, Korea Dates: November 11 - 15 , 2007

Indexing Triples across Sites

- The Semantic Web can be seen as a large knowledge-base
  - formed by sources that serve information as RDF files or through SPARQL endpoints.
- A fundamental feature of the Semantic Web is that the graphs are decentralised:
  - it has no single knowledge-base of statements
  - instead anyone can contribute statements by making them available in a public web space
  - These sources might have nothing in common,
    - but by using shared identifiers (URIs) and shared terms, their information can be merged to provide useful services to both humans and software clients.

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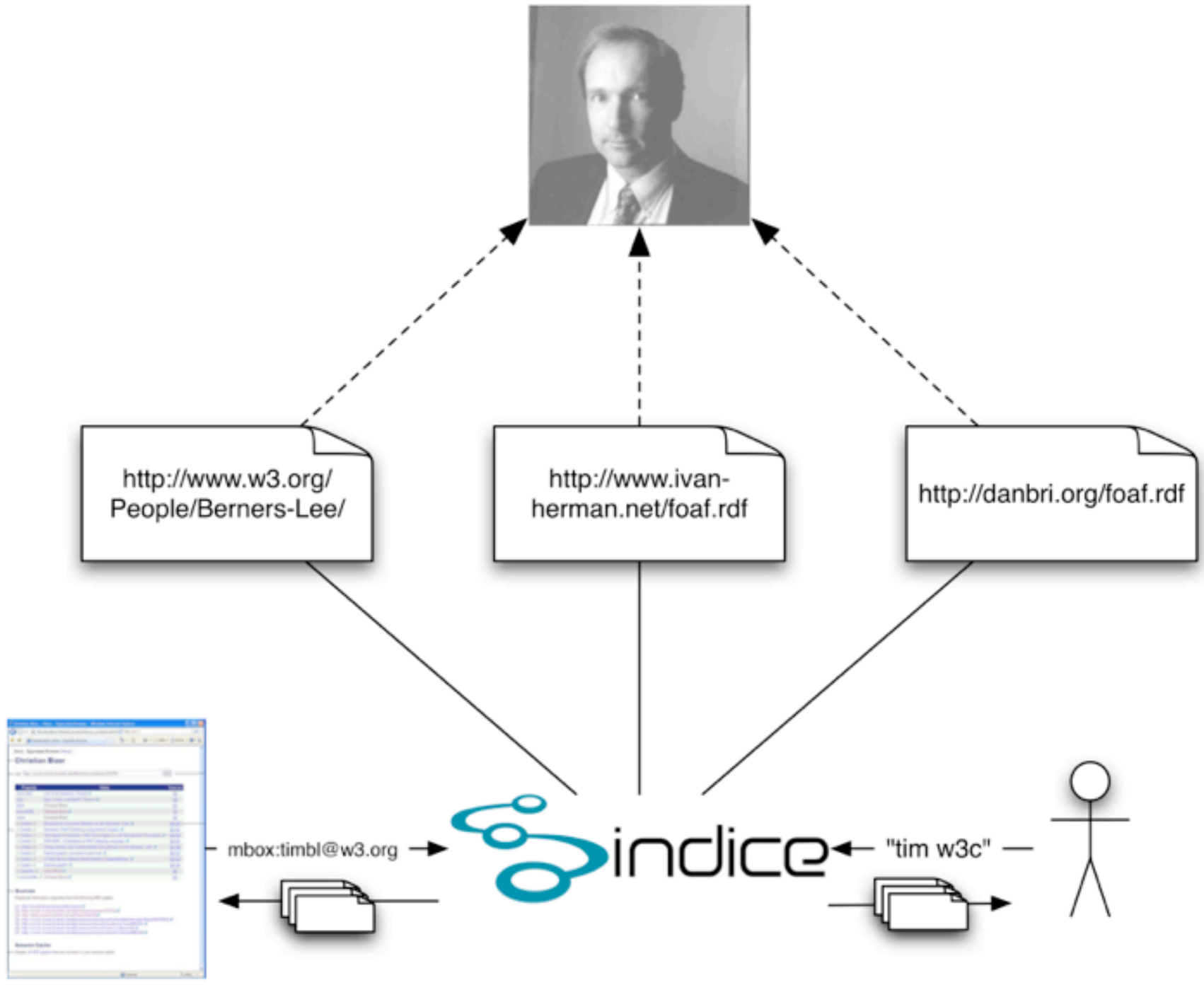
indice
THE SEMANTIC WEB INDEX

- Sindice crawls the Semantic Web and indexes the resources encountered in each source.
- A simple API offers to Semantic Web application developers
  - the ability to automatically locate relevant data sources
  - integrate the data from these sources into their applications
- Sindice collects RDF documents from the Semantic Web and indexes these on
  - resource URIs,
  - IFPs: inverse functional properties
  - Keywords
- It offers a user interface through which human users can find these documents, based on keywords, URIs, or IFPs

Example

- Example RDF documents mentioning Tim Berners-Lee, either by using his URI or by using IFPs that uniquely identify him.



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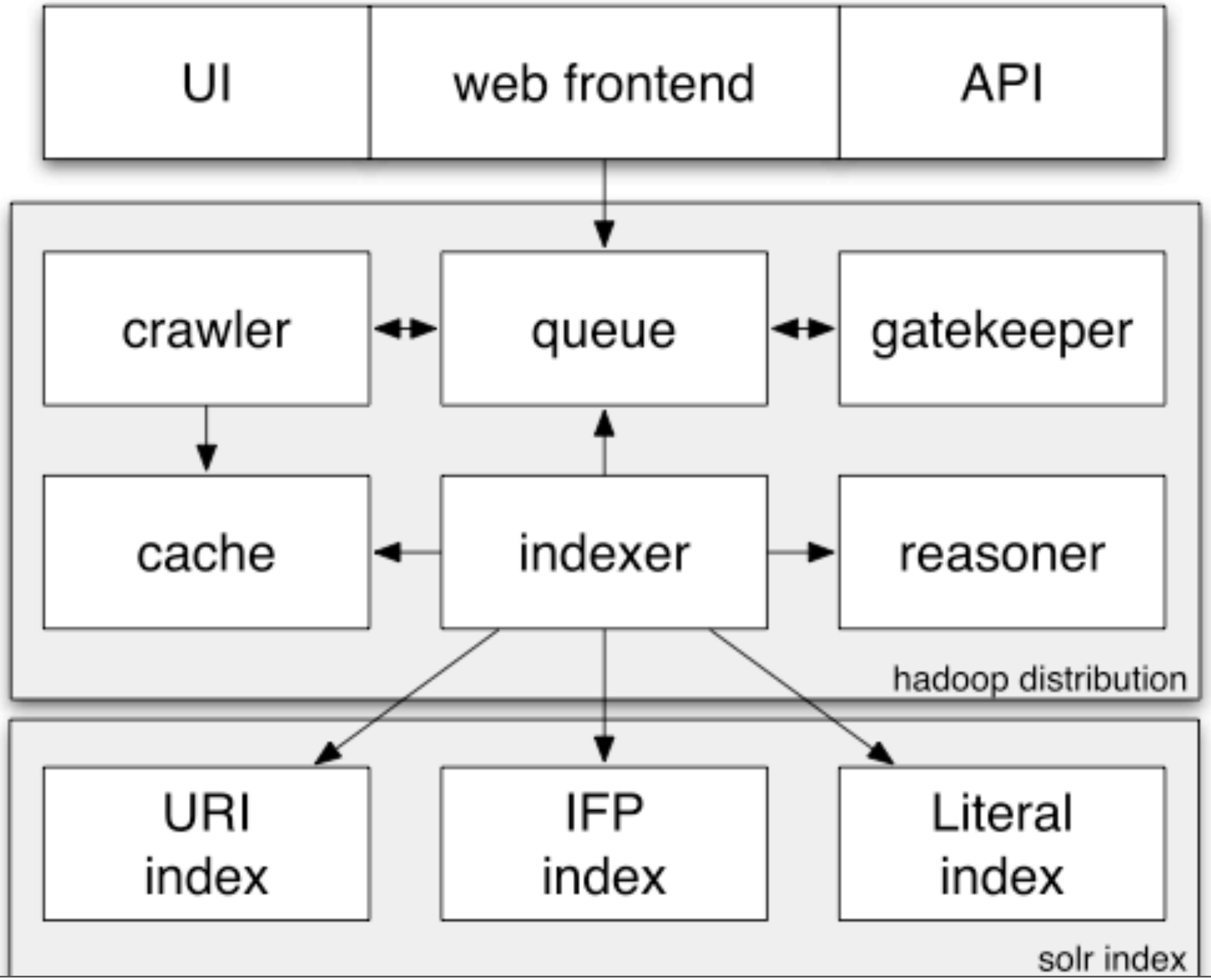
Sindice: Architecture



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Architecture (ctd)

- The crawler autonomously harvests RDF data from the Web and adds it to the indexing queue
  - It can be pinged (through the human interface or the API) to parse new documents, these are also added to the queue.
- The gatekeeper evaluates each entry in the queue and decides
  - whether, and with which priority, we want to index it,
    - based on whether we have seen the document before, its last modification date, its content digest, etc.
- The indexer extracts URIs, IFPs and keywords from each document and adds these to their respective index
- During lookup, the interface components
  - passes the queries to the relevant index,
  - gathers the results,
  - generate the required output such as HTML pages

Indexes

- The URI index contains an entry for each resource URI
  - It returns the list of document URLs where this resource occurs
- The IFP index uses the uniquely identifying pair (property, value) as index key.
  - It returns the list of document URLs where this pair occurs
- The literal index contains an entry for each token (extracted from the literals in the documents), again pointing to a list of document URLs
  - Just for text literals (no numbers!)

Index Size for a Billion Triples

- The index size of the crawl on the simple persistent hashtable of URI occurrences was around 2.5GB for 3.2 million URIs.
  - Given the scale-invariance of the URI/URL ratio we can extrapolate from this data and estimate to need around 785 bytes per resource;
  - Indexing a billion unique resources would thus require around **785GB**, an ordinary capacity for commodity harddisks

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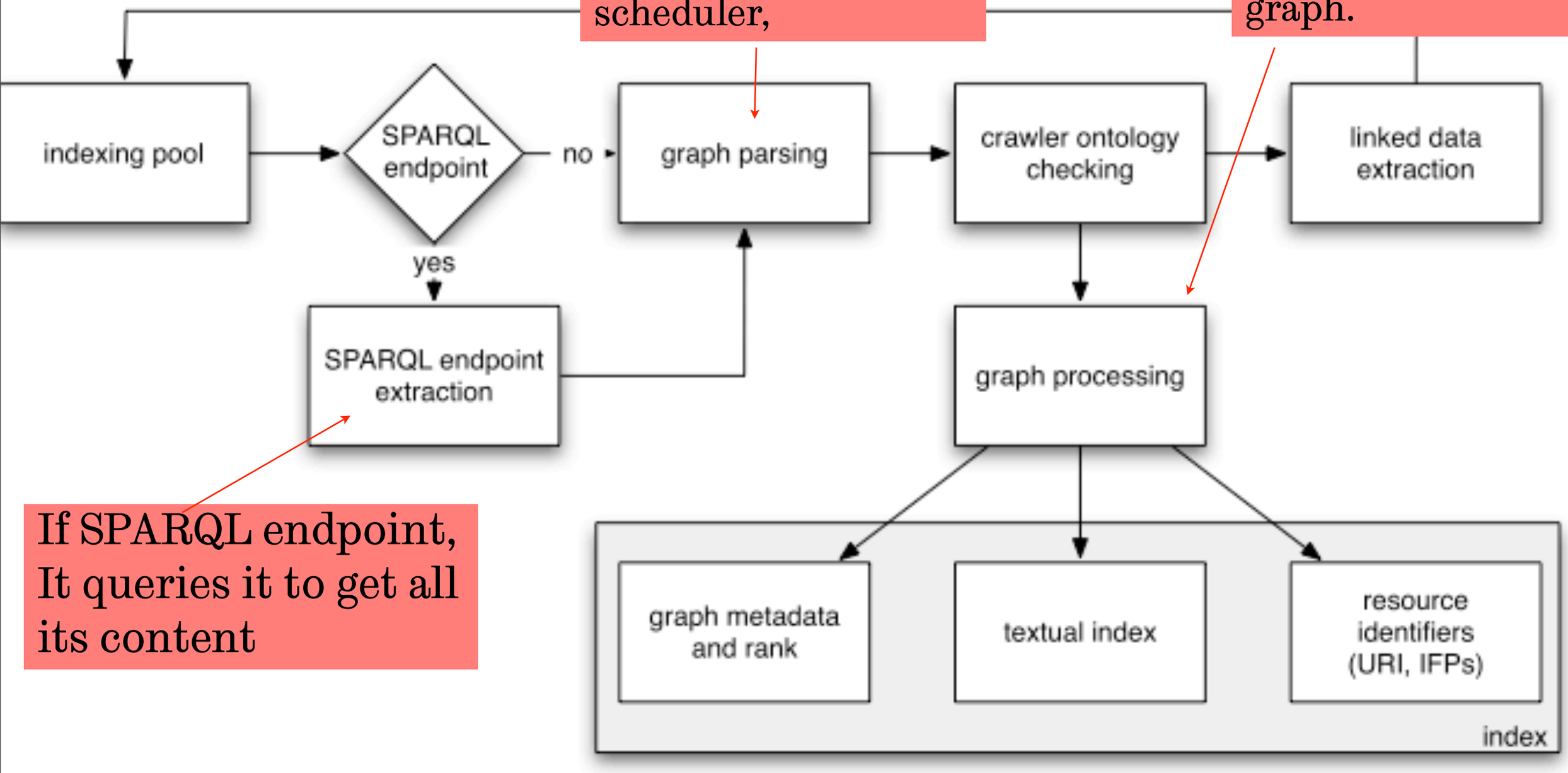
Indexing Pipeline

Extracts all URIs from the graph and injects them into the scheduler,

The graph processor then extracts and indexes the full- text and all resource identifiers in the graph.



If SPARQL endpoint, It queries it to get all its content

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Querying pipeline

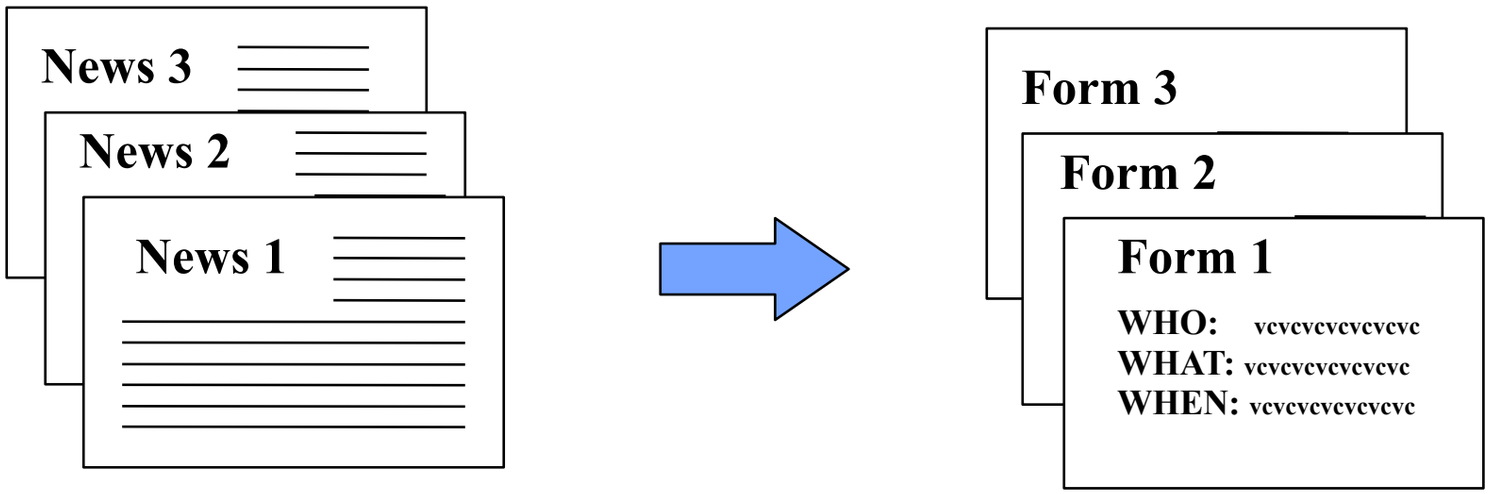
- Index retrieval
  - The query is looked up in the inverted index,
    - implemented either as an on-disk hashmap or in an information retrieval engine.
  - The list of results is cached for later reuse (refreshed daily)
- Ranking phase
  - Results are ranked according to various metrics
    - Hostname: we prefer sources whose hostname is the same as the resource's hostname, For example, we consider that more information on the resource *http://eyaloren.org/foaf.rdf#me* can be found at the source *http://eyaloren.org/foaf.rdf*
    - External rank: we prefer sources hosted on sites which rank high using traditional Web ranking algorithms.
    - Relevant sources: we prefer sources that share rare terms (URIs, IFPs, keywords) rather than common terms with the requested terms. This relevance metric is comparable to the TF/IDF relevance metric (Frakes and Baeza-Yates, 1992) in information retrieval.

Querying (ctd)

- Result generation
  - Sindice can export results into different syntaxes, such as the HTML Web interface, RDF, XML, JSON, and plain text.

Extracting Information from Unstructured Documents

Information Extraction



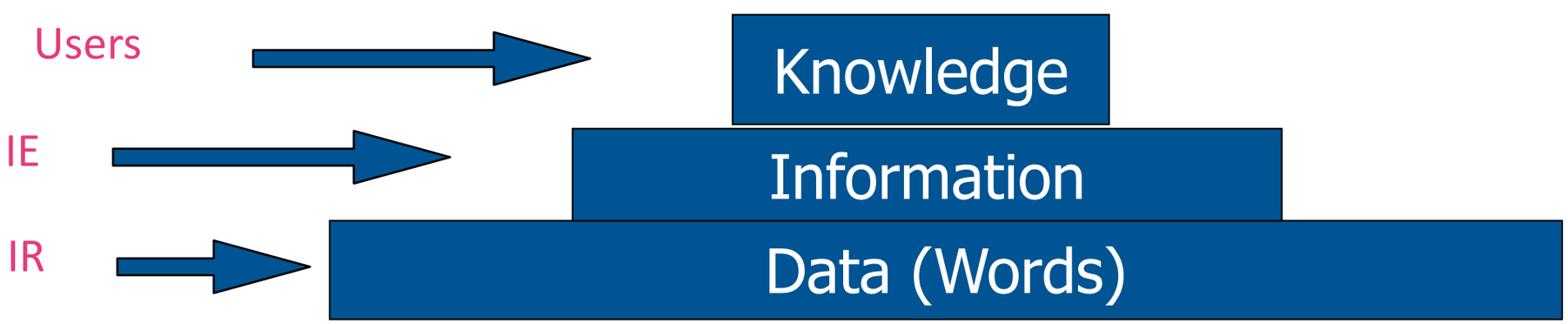
- Automatically extracting pre-specified information from natural language texts
  - salient facts about pre-specified types of events, entities or relationships.
- Populating a structured information source from a semi-structured, unstructured, or free text, information source.

Why Texts and IE?

- Textual documents are pervasive (e.g. Web)
  - Contained knowledge cannot be queried
    - Q: How many cases of swine flu have been identified in the UK in the last three months that involve children under 5 years old
    - therefore knowledge cannot be
      - Used by automatic systems
      - Easily managed by humans
- IE can identify information in documents
  - e.g. to populate a database/ontology
  - e.g. to annotate documents
- Method: some forms of language analysis

IE Vs Information Retrieval

	IR	IE
Task	Data Indexing	Information Extraction
Returns upon User Query	Relevant Documents	Relevant Information
Query Generality	Full	Limited to target information



IE tasks

WASHINGTON, D.C. (October 5, 1999) -
nQuest Inc. today announced that P Paul Jacobs. rmer
Vice-President of E-Commerce at SR SRA International
has joined the company's executive management team
as president.

Named Entities → Relation Extraction → Event Extraction

IE tasks

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as president.

Company: nQuest Inc.
Date: today
InPerson: Paul Jacobs
InRole: president

Company: SRA International
OutPerson: Paul Jacobs
OutRole: Vice-President of E-Commer

Named Entities → Relation Extraction → Event Extraction

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Tasks

- Entity Extraction/Ontology Population
  - –Terminology Recognition
  - –Classic NER
- Event Extraction
  - –Field/Table Extraction
  - –Relation Extraction
  - –Cross-Media Extraction

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Document Type	Term	Tables	Entity	Relat	X-Media
AROC proforma	X	X	X	X	
AROC results					
Development	X		X	X	X
EHM data					
Emails	X	X	X		X
ONWING emails	X		X		
Images					X
Lab findings	X	X	X	X	X
Monitoring Requirements			X	X	X
Presentations	X		X		X
Procedures	X				X
RCP	X	X	X	X	
Risk Assessment	X	X	X		
Solution Reports	X				
Technical Reports	X	X	X	X	X
TS&O Reports	X	X	X		X

A Table by Jose' Iria

Requirements for IE

- Coping with large scale, in terms of size of corpus, of ontology and KB
- Efficiency: the system must be efficient
  - both in terms of speed and memory
- Ability to focus on information and knowledge that is infrequent
  - in contrast with redundancy based methods which extract the most frequent information

Req (ctd)

- Ability to use the background knowledge provided
  - –By users (e.g. gazetteers)
  - –By other media
- Portability:
  - –Across corpora
  - –Across domains
- Robustness:
  - –being able to gracefully cope with unexpected situations
    - E.g. broken html

Approaches at a Glance

- Coping with technical terminology
  - –Complex terms and URI identification
- Entity Recognition
  - –Few labeled data, a lot of unlabelled
  - –Problem: scalability
  - –Problem: portability across corpora sub-domains
- Coping with tables
- Cross-Media
- Annotation:
  - –Can we annotate?

Coping with Documents Formats

33

How do we

Represent documents across formats

Correlations across media?

Lei Xia, Jose Iria: An Approach to Modeling Heterogeneous Resources for Information Extraction, Proceedings of the Sixth International Language Resources and Evaluation (LREC'08), Marrakech, Morocco, May 2008

Coping with Multiple Formats

- Multiple document formats:
  - –OpenDocument, Microsoft Office's, HTML, PDF, etc.
  - –Carrying a mixture of
    - textual content,
    - metadata about the text (e.g. style information),
    - images, tables and other media objects
  - –Carrying relational information
    - Valuable features to an IE algorithm

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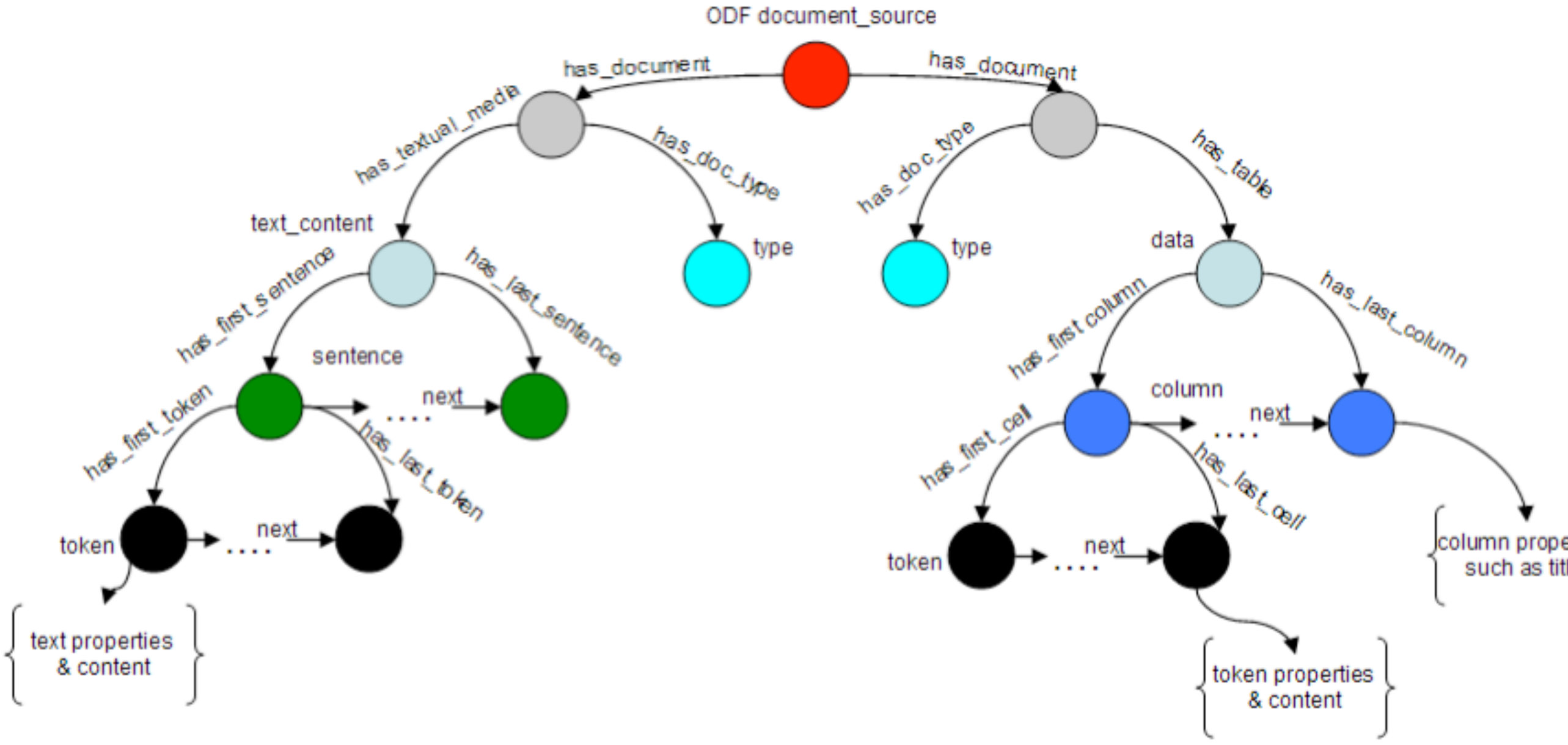
Modelling ODF



Preparing ODF Docs

- The algorithm is divided into two stages,
  - –Document is split into coarse-grain-blocks according to document headings and sections
    - Using e.g. explicit formatting (⟨head⟩, ⟨P⟩,⟨style⟩, ⟨bold⟩, ⟨size⟩, ⟨underline⟩, etc).
  - –Further analysis generates finer-grain-blocks of text and other nearby content types
    - Sliding-window of predefined size
    - Also for images -- see next slides

Entity Extraction

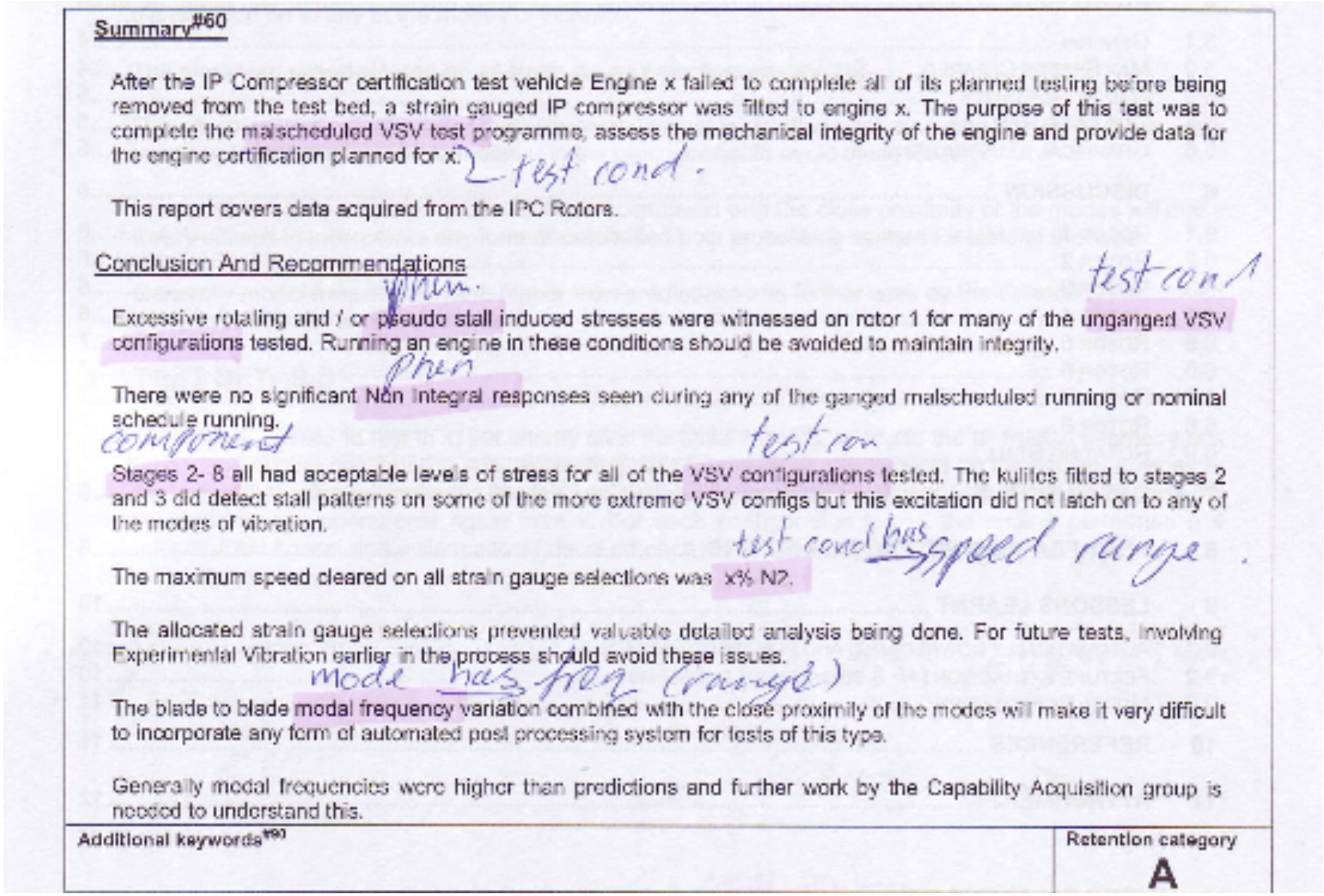
Using semi-supervised Methods for Entity Extraction

37

Jose' Iria: Automating knowledge capture in the aerospace domain, in Proceedings of the fifth international conference on Knowledge capture, Redondo Beach, California, 2009

Goal

- Mimic domain experts in classifying pieces of text



Summary[#60]

After the IP Compressor certification test vehicle Engine x failed to complete all of its planned testing before being removed from the test bed, a strain gauged IP compressor was fitted to engine x. The purpose of this test was to complete the malscheduled VSV test programme, assess the mechanical integrity of the engine and provide data for the engine certification planned for x. 2 test cond.

This report covers data acquired from the IPC Rotors.

Conclusion And Recommendations

test con 1

Excessive rotating and / or pseudo stall induced stresses were witnessed on rotor 1 for many of the unganged VSV configurations tested. Running an engine in these conditions should be avoided to maintain integrity.

There were no significant Non Integral responses seen during any of the ganged malscheduled running or nominal schedule running.

component

test con

Stages 2- 8 all had acceptable levels of stress for all of the VSV configurations tested. The kulites fitted to stages 2 and 3 did detect stall patterns on some of the more extreme VSV configs but this excitation did not latch on to any of the modes of vibration.

test cond has speed range

The maximum speed cleared on all strain gauge selections was x% N2.

The allocated strain gauge selections prevented valuable detailed analysis being done. For future tests, involving Experimental Vibration earlier in the process should avoid these issues.

Mode has freq (ranged)

The blade to blade modal frequency variation combined with the close proximity of the modes will make it very difficult to incorporate any form of automated post processing system for tests of this type.

Generally modal frequencies were higher than predictions and further work by the Capability Acquisition group is needed to understand this.

Additional keywords[#90]	Retention category
	A

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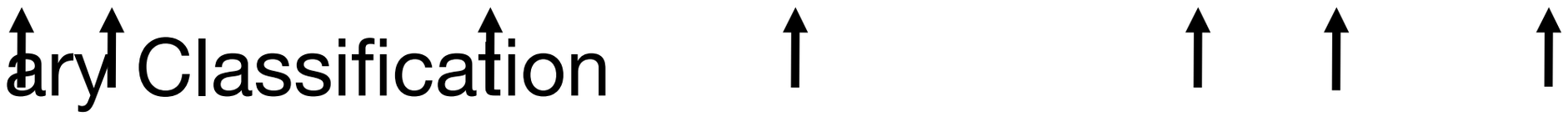
Extraction by Boundary Classification

- Boundary: virtual separator between any two tokens
- [...] in <location>London</location> this week [...]
- Binary Classification



  - set of binary classifiers classify boundaries as start/end of relevant text fragments
  - positive instances for start/end classifier for a given type become negative instances for all other classifiers

Encoding Features for Learning

- Binary features
- Concatenation of feature type, feature value, and position with respect to boundary

[...] in <location>London</location> this week [...]

"-1_str_in"
"1_str_this"
"1_pos_DT"
"1_orth_alllow"
"2_str_week"
...

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Reducing Annotation Needs

- Exhaustive annotation and training is very complex and difficult
- Solution:
  - Use of semi-supervised methods for learning

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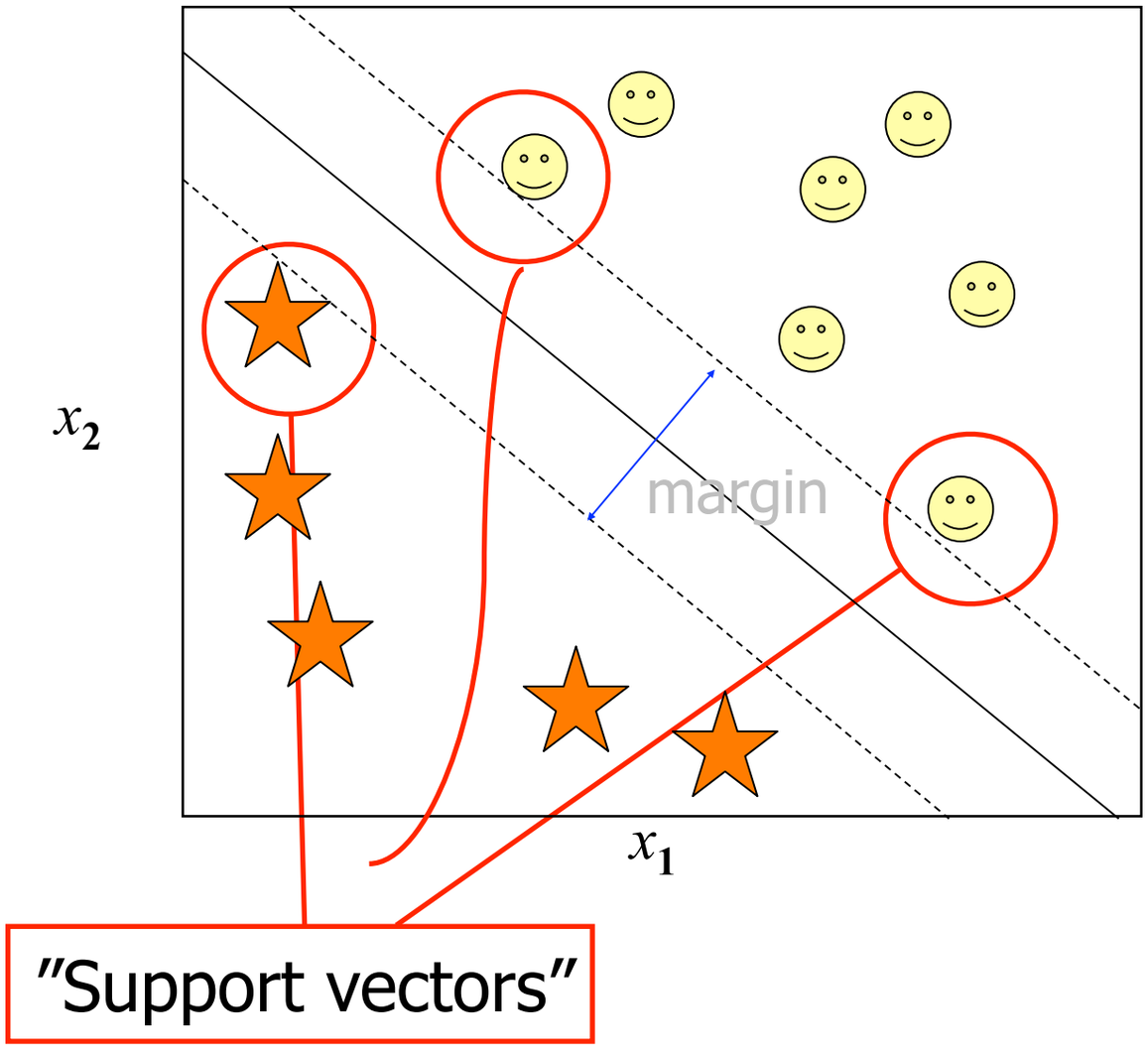
Baseline: SVM

- Margin-based classifier, identifies support vectors in the data
- Optimisation procedure has quadratic complexity
- Requires complete annotation



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Label Propagation

- Graph-based semi-supervised methods define a graph where
  - Nodes are both the labelled and unlabelled examples in the dataset
  - Edges (may be weighted) reflect the similarity of examples
- In label propagation,
  - Known labels are used to propagate information through the graph in order to label all nodes.
  - Goal is to learn a labelling function that:
    - Is close to the given labels on the labelled nodes,
    - Is smooth on the whole graph

C-SVC algorithm

- Starting with nodes 1, 2, ..., l labelled with their known label (1 or –1) and nodes l+1, ..., n labelled with 0, each node starts to propagate its label to its neighbours, and the process is repeated until convergence

Compute kernel matrix K
Compute the diagonal degree matrix D by $D_{ii} \leftarrow \sum_j K_{ij}$
Initialize $Y^0 \leftarrow (y_0, \ldots, y_l, 0, \ldots, 0)$
Iterate
1. $Y^{(t+1)} \leftarrow D^{-1}KY^t$
2. $Y^{(t+1)} \leftarrow Y_l$
until convergence to $Y^{(\infty)}$
Label point x_i by the sign of $y_i^{(\infty)}$

- Complexity $O(kn^2)$
  - for a sparse graph where each data point has k neighbours

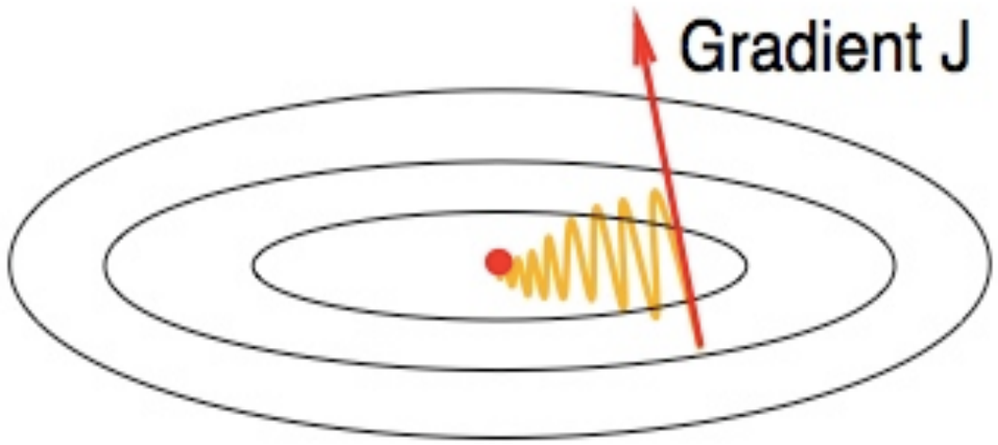
It can be seen as optimising a cost function that can be expressed as an average over the training examples

Large-scale: Stochastic Gradient Descent

- Try and exploit the availability of lots of data
- Iterative procedure, linear complexity to convergence

Iterate

- $w_{t+1} \leftarrow w_t - \eta \frac{\partial E_n(f_{w_t})}{\partial w}$

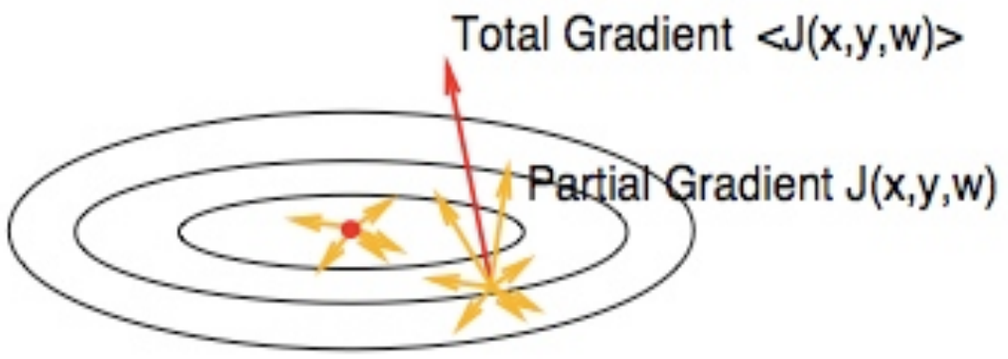


Stochastic Gradient Descent

- In stochastic (or ”on-line”) gradient descent, the true gradient is approximated by the gradient of the cost function only evaluated on a single training example
- The parameters are then adjusted by an amount proportional to this approximate gradient

Iterate

- Draw random example (x_t, y_t).
- $w_{t+1} \leftarrow w_t - \frac{\eta}{t} \frac{\partial \ell(f_{w_t}(x_t), y_t)}{\partial w}$



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Experiments

Runes, plus tokenizer, pos etc. provided the preprocessing (annotation) of the corpora

- 70 documents
- 661,117 words
- 14 tags
- over 2500 annotations

Engine	
Engine Module	HP Compressor
Engine Serial Number	HP Turbine
Module Serial Number	IP Turbine
Customer Number	LP Turbine
Document Title	Tube
Document Date	Groove
Observed Damage	Ring

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Validation Methodology

- Test three algorithms:
  - SVM, Graph Label Propagation, Stochastic Gradient Descent
- General test conditions:
  - Using a linear kernel
  - 5 fold cross-validation for svm and svm-sgd
  - Same underlying framework, just change algorithm
- Datasets generated for learning:
  - One per concept start/end
- Evaluation measure: F-measure
  - Exact matching on the predicted and gold standard boundaries

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Results (cont.)

- F-measures obtained are virtually the same
  - Graph label propagation obtains slightly better results
  - SVM and SGD differ mostly in recall
- However, training times vary dramatically
  - SVM-SGD ideal for application scenarios where on-the-fly analysis is required

Algorithm	Average Precision	Average Recall	F-measure	Training Time
SVM	0.75	0.65	0.70	4m 58s
Label Propagation	0.77	0.66	**0.72**	2h 11m
Stochastic Gradient Descent	0.75	0.62	0.68	**28s**

$O(kn^2)$

$O(n)$

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Terminology Recognition in the Aerospace Domain

Jonathan Butters and Fabio Ciravegna:
Authoring Technical Documents for Effective Retrieval
17th International Conference on Knowledge Engineering and Knowledge Management
Lisbon October 2010

Rolls-Royce

Runner up at the
Director of Research's Creativity Award 2009

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Terminology Recognition

"Low Pressure Turbine Stage 2 Rotor Blade"
"LP2 Blade"
"FK42164"
"LPT 2 Blade"
"72-41-12"
"T800 LP Turbine Blade Stage 2"
"Turbine Blade"
"72-41-12-400"
"Blade, Turb l2"
"Blade, LPT"
"TurbinneBladee"
"FK12548"

- Task of reducing a term to a URI

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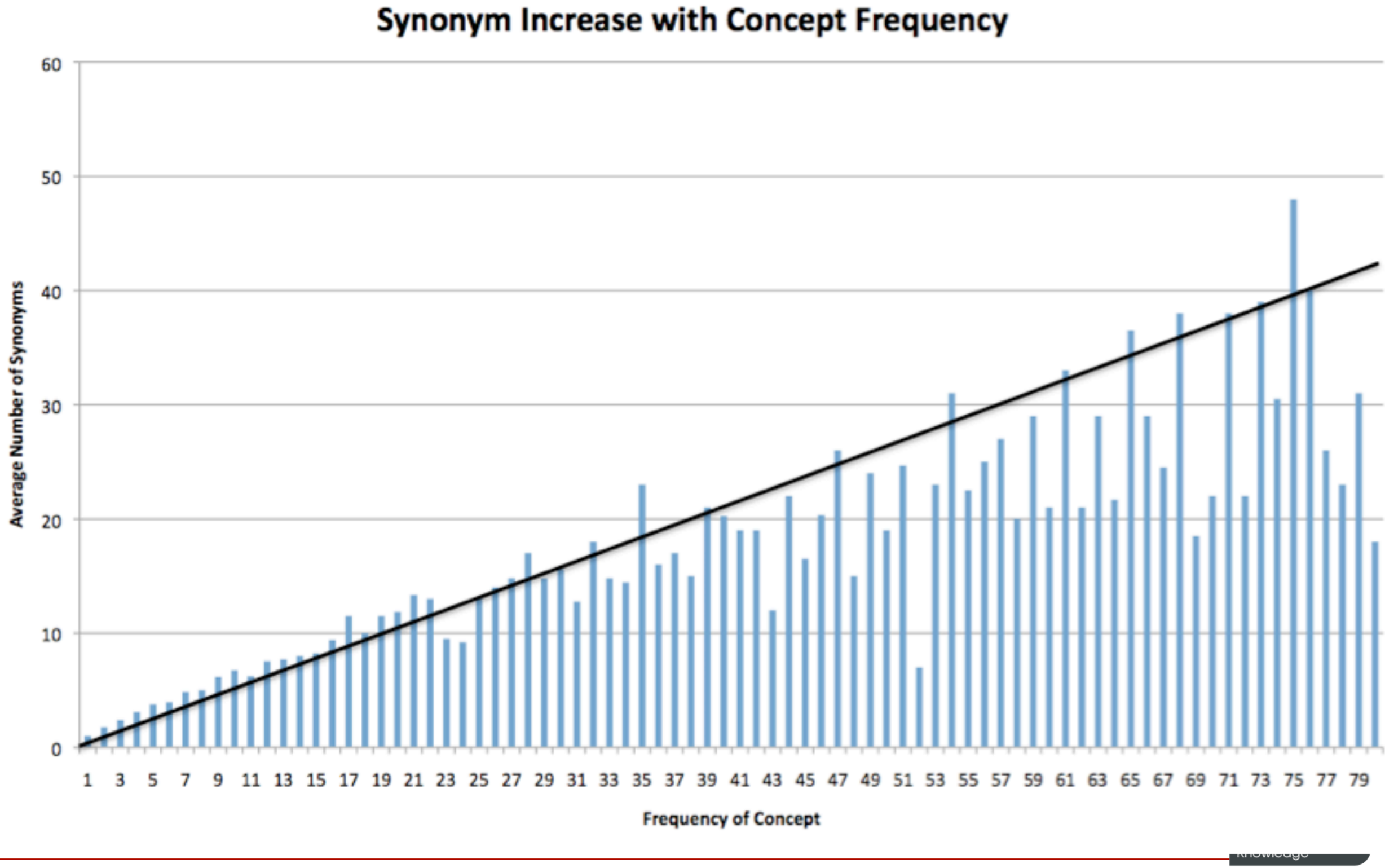
A Pervasive Issue



Term Variation

- Aerospace Terms Typically Comprise Long Strings of Nouns – [Lehrberger & Kittredge, 1982]

- *"low press comp frnt ring assy."*
- [LP], [COMPRESSOR], [FRONT], [RING], [ASSY]
- 5 3 7 3 5

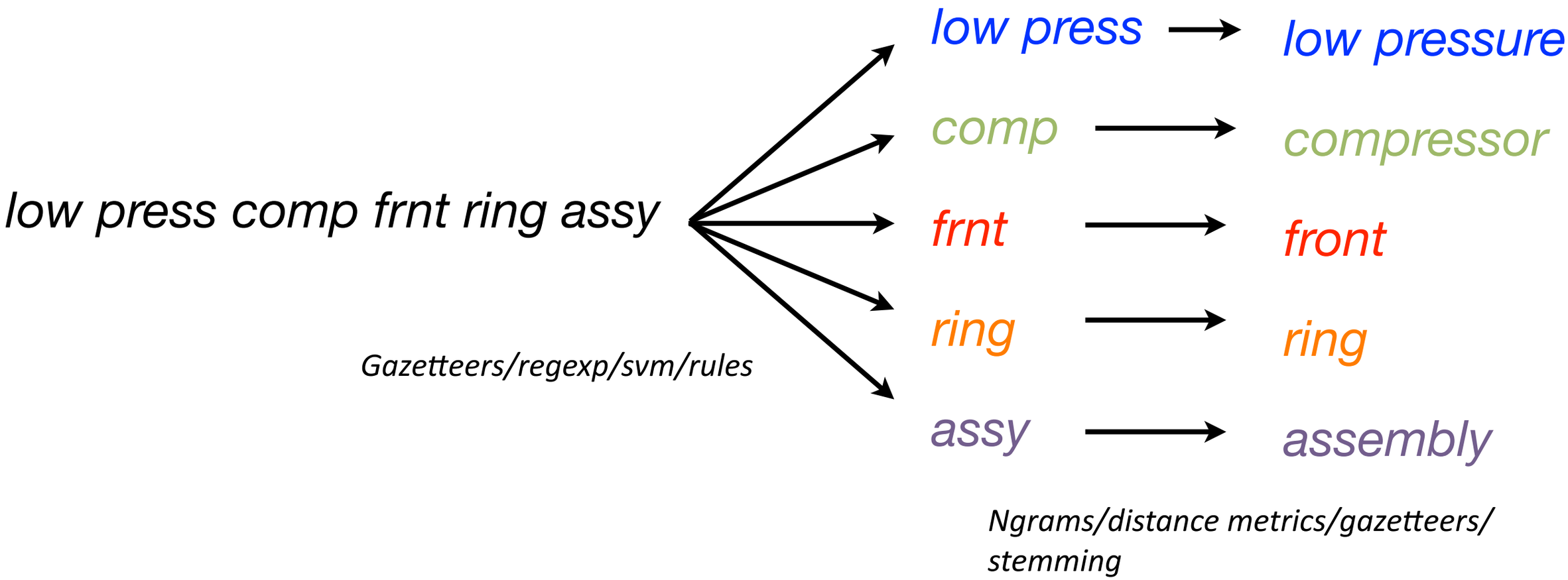
This is just a string of characters!

These are the 'sub-concepts'

These are the numbers of terms that can represent each sub-concept

- That gives 1575 combinations (not counting word order!)
  - E.G: "front ring assembly, m34"
- A Gazetteer list of 1575 terms for one master term is NOT practical!
- So, our Approach..

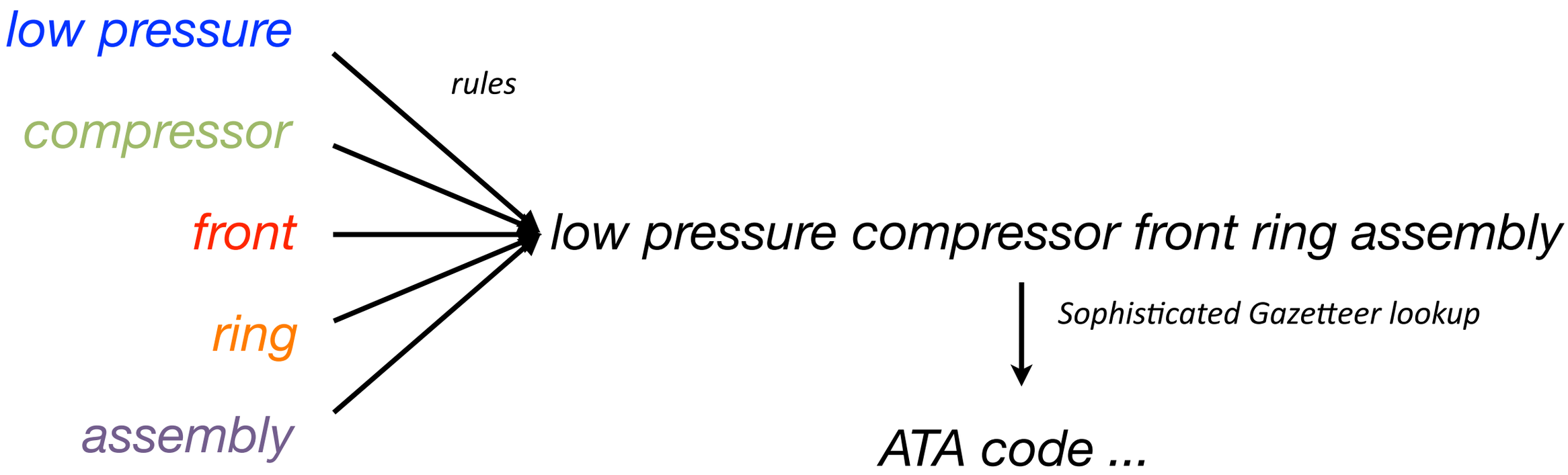
Approach: stage 1&2



- All possible solutions carried forward in parallel
- A new recognition at each stage makes the algorithm cycle

Patent Pending

Approach: stage 3&4



All possible solutions carried forward in parallel

Patent Pending

Comparative Evaluation

- 88,213 reports marked with ATA100 number
- Data set 2 comprised 4,394 complete documents randomly selected from across 6 corpora

	Corpus A			Corpus B		
	Pre	Rec	F1	Pre	Rec	F1
TF-IDF	12.00%	8.54%	9.98%	14.62%	7.32%	9.76%
Termex	41.69%	18.02%	25.16%	49.82%	21.30%	29.84%
C-Value	52.87%	34.86%	42.02%	62.40%	41.85%	50.10%
TR	69.03%	97.12%	80.70%	92.77%	98.30%	95.45%

	Corpus C			Corpus D		
	Pre	Rec	F1	Pre	Rec	F1
TF-IDF	16.33%	5.83%	8.59%	13.59%	6.21%	8.52%
Termex	41.34%	25.34	33.34%	51.43%	22.73%	31.53%
C-Value	60.29%	39.93%	48.04%	64.76%	43.86%	52.30%
TR	94.49%	98.10%	96.26%	85.14%	94.03%	89.36%

The RR Application

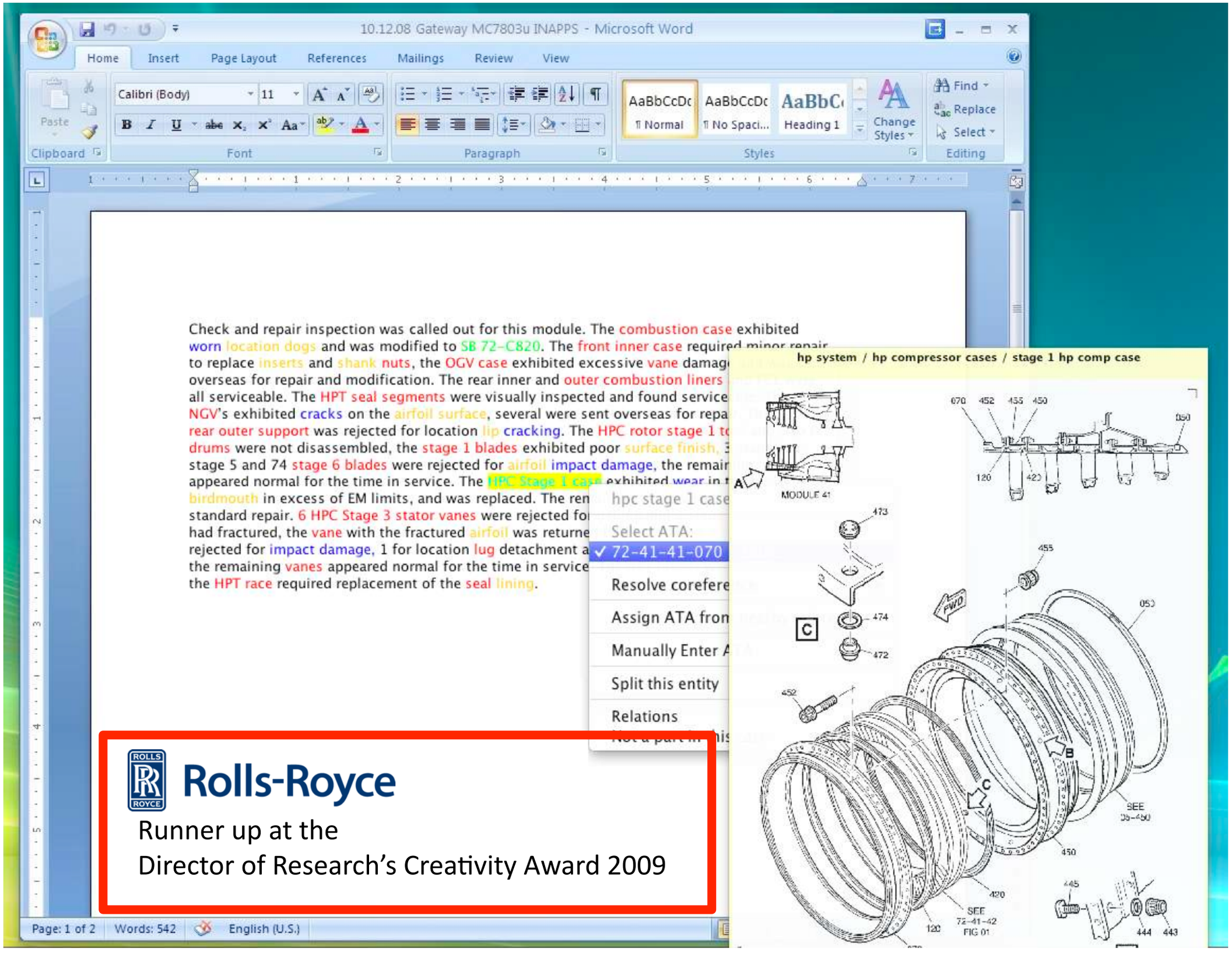


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Table Extraction

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Tables

- Are pervasive
- Carry implicit relations
  - That need making explicit
- Can be created at any time by anyone
  - Semantics must be discovered

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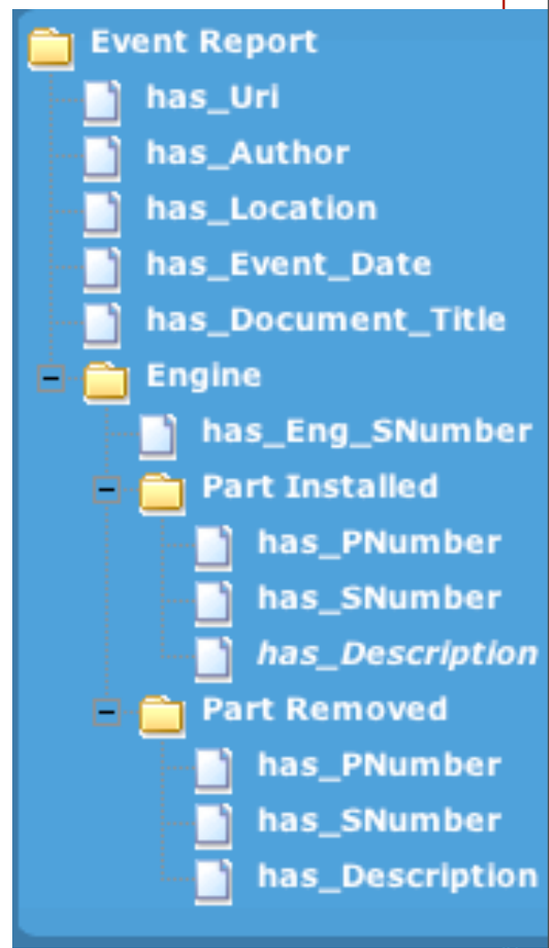
Annotating Documents

- Automatic extraction of information from event report
  - –18,000 documents analysed
    - Mainly Forms implemented in Word
- Metadata generated according to an ontology developed by Aberdeen U
- Automatic extraction of metadata and indexing of documents



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An Experiment on Event Report for Jet Engines

Event Report No. COMPANY2698 /

1263 **Prepared By:** Richard Williamson **Originated/Revised on:** 13 March 2004

Event Report Data

engine type

company

Aircraft

LN144

Event Date: 12-Mar-04 **Engine S/N:** 51179 **Flight Regime:** Unknown **Hazard Type:**
Aircraft Regn: 9V-SRA **Installed Posn:** Right **Location:** SIN **No Hazard**
Airframe Hours: 20779 **Engine TSN/CSN:** 14242 / 4014 **Event Type:** Operational
Airframe Cycles: 5609 **Engine TSF/CSF:** 6249 / 1814 **Event Category:** Basic

Reactions to Event:

Primary: None **ABTO Speed** **Operational Effect:** No Effect **SERAPH Symptom Codes:**
Secondary: None **(Knots):** N/A **Delay Time (mins):** N/A NREP NREP NREP
Third: None **Fuel Dumped?:** No
Fourth: None

EICAS Messages (If Any) :

Maintenance Messages (If Any):

Parts/Components Removed or Installed (If Any):

On/Off	Part Number / Serial Number	Part Description	Hours / Cycles	Qty	Destiny / Disposition	Pull Category / Pull Code
Installed	9-217-62 Y487	FUEL FLOW TRANSMITTER		1	SE - Serviceable	
Removed	921762 Y403	FUEL FLOW TRANSMITTER		1	R4 - Return to Manufacturer US - Unserviceable	U - Unplanned I - Inspection/Investigation

Description of Event:

a short sentence

91

61

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Examples of tables in Event Reports

module/accessory details			
item	**part number**	**s/n removed**	**s/n installed**
	p39-401revf	04-0721257 tsn/csn: 268/106	04-1012229 tsn/csn:0/0

Part numbers
04-0721257 tsn/csn: 268/106 off
04-1012229 tsn/csn:0/0 on

s/n removed	04-0721257 tsn/csn: 268/106
s/n installed	04-1012229 tsn/csn:0/0

Parts/Components Removed or Installed (If Any):

On/Off	Part Number / Serial Number	Part Description	Hours / Cycles	Qty	Destiny Disposit
Installed	FK30840		11129 TSN	1	
		TO SB72-C629)	1954		
	RGG12340				
Installed	FK21221		11652 TSN	1	
	EC092		2119		
Installed	FK30840		11129 TSN	1	
			1954		
	RGG12501				
Installed	FK30840		11129 TSN	1	
			1954		
	RGG12208				
Installed	FK30840		11129 TSN	1	
			1954		
	RGG12391				

Applying information extraction

- AktiveMedia to annotate texts
- SVM to train and extract (supervised)
- IE captures <u>all</u> the information in tables
  - 99% of the information captured (recall=99)
  - 98% of proposed information is correct (precision=98)

As said using semi-supervised would not have made much difference

	POS	ACT	CORR	WRONG	MISSED	PREC	REC	F1
airport	120	120	120	0	0	100	100	100
has_airframe_cycles	104	104	104	0	0	100	100	100
has_airframe_hours	104	104	104	0	0	100	100	100
has_author	120	120	120	0	0	100	100	100
has_engine_serial_number	120	120	120	0	0	100	100	100
has_engine_type	120	120	120	0	0	100	100	100
has_event_date	120	120	120	0	0	100	100	100
has_event_report_no	356	358	356	2	0	99	100	100
has_part_description_installed	120	113	111	2	9	98	93	95
has_part_description_removed	120	133	120	13	0	90	100	95
has_part_number_installed	120	113	111	2	9	98	93	95
has_part_number_removed	120	133	119	14	1	89	99	94
TOTAL	**1644**	**1658**	**1625**	**33**	**19**	**98**	**99**	**98**

Porting across Domains

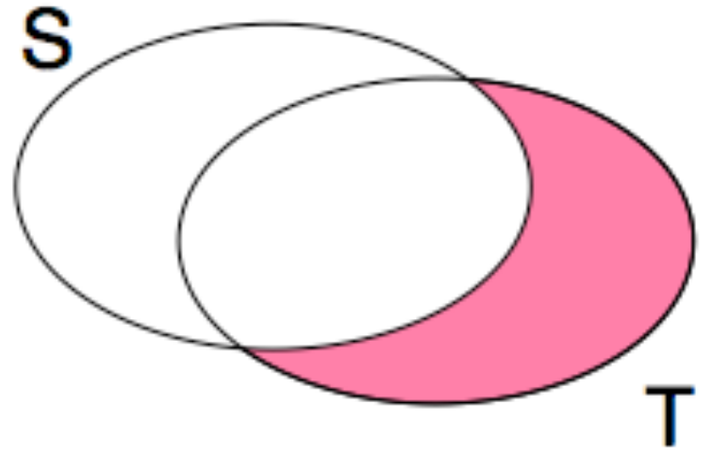
Jing Jiang: Domain Adaptation in Natural Language Processing
PhD Thesis, University of Illinois at Urbana-Champaign, 2008

Large no. of Corpora

- Given the number of corpora under consideration
  - –it will be very difficult (if not impossible) to process each from scratch.
- Requirement:
  - –ability to process one corpora and then
    - port the learned models (with minor work) to other corpora.

Transfer Learning

- The domain difference comes from some special characteristics
  - –in the target domain or
  - –in the source domain or
  - –in both



- In transfer learning the goal is to use training data from a related domain, along with training data from the target domain, to train the target classifier

Jing Jiang: DOMAIN ADAPTATION IN NATURAL LANGUAGE PROCESSING
PhD Thesis, University of Illinois at Urbana-Champaign, 2008

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Domain Adaptation

- In domain adaptation
  - labeled data from source domain is used to train a model that maximises accuracy in a target domain
    - for which we only have unlabelled data available
- Previous work focuses on document classification on academic datasets
  - Our experiments concern the entity recognition task over real-world data
    - Corpora cover the same domain
      - but are distinct enough to be considered covering different sub-domains

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Approach

- Extending existing learning models according to new evidence obtained from previously unseen corpora from the same domain
- A bootstrapping approach that iteratively refines the learned models on the new corpus,
  - using as starting point a context-independent model derived from the initial corpus
  - and exploiting user interaction and terminology recognition at each iteration step

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- Context-independent patterns yield low-precision and variable recall
  - –Coupled with additional techniques designed to raise both precision and recall can address requirements of target domain
    - Terminology recognition can help raise recall

Information Integration

Information Integration

- Facts from different sources need to be integrated
  - To connect information/knowledge across docs
    - Assign unique URI
  - To solve discrepancies and ambiguities
- Steps
  - Unique instance identification (for entities)
  - Record linkage (for events)
- Information Integration strategies
  - Generic
    - Distance metrics (Chapman 2004)
    - Using Web bias
    - Statistical matching
    - Application specific
      - Rules

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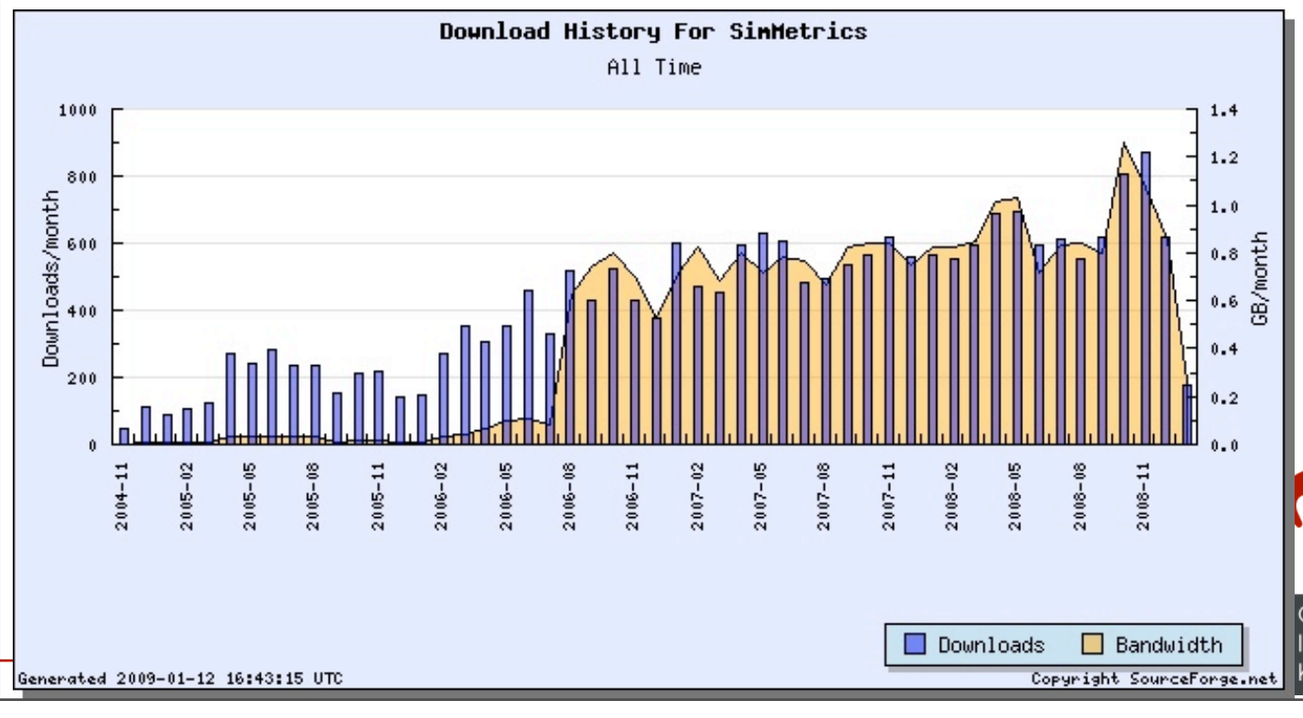
SimMetrics

- Library of distance metrics released as open source
  - http://sourceforge.net/projects/simmetrics/
  - >20,000 downloads since end of 2004
  - Most downloaded distance metrics library on the Web
    - for strings and records
  - Hundreds of applications
  - Developed by Sam Chapman, University of Sheffi



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Armadillo: Historical Data Mining

http://www.hrionline.ac.uk/armadillo/

The Marine Society Registers

The Westminster Historical Database

Eighteenth Century Fire Insurance Policies

Prerogative Court of Canterbury Wills

The Proceedings of the Old Bailey

AHDS Deposits

St. Martin's Settlement Exams Index
WESTCAT

Collage image databse
Guildhall Library

Harben's Dictionary of London

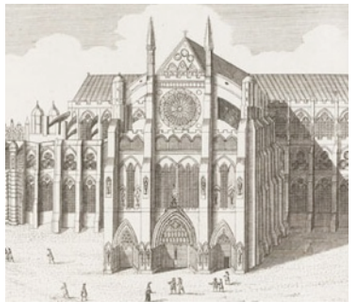
John Strype's "Survey…"

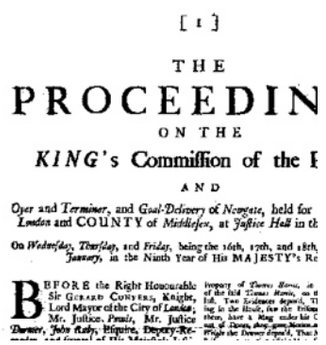
Metropolitan London in the 1690s
IHR

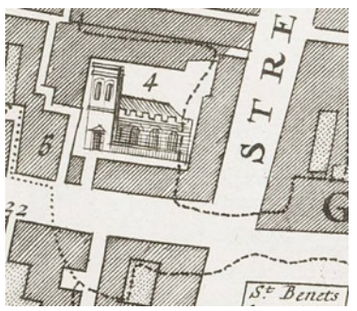
Selected Criminal Records
PRO

http://www.motco.com

House of Lords Journals
BOPCRIS





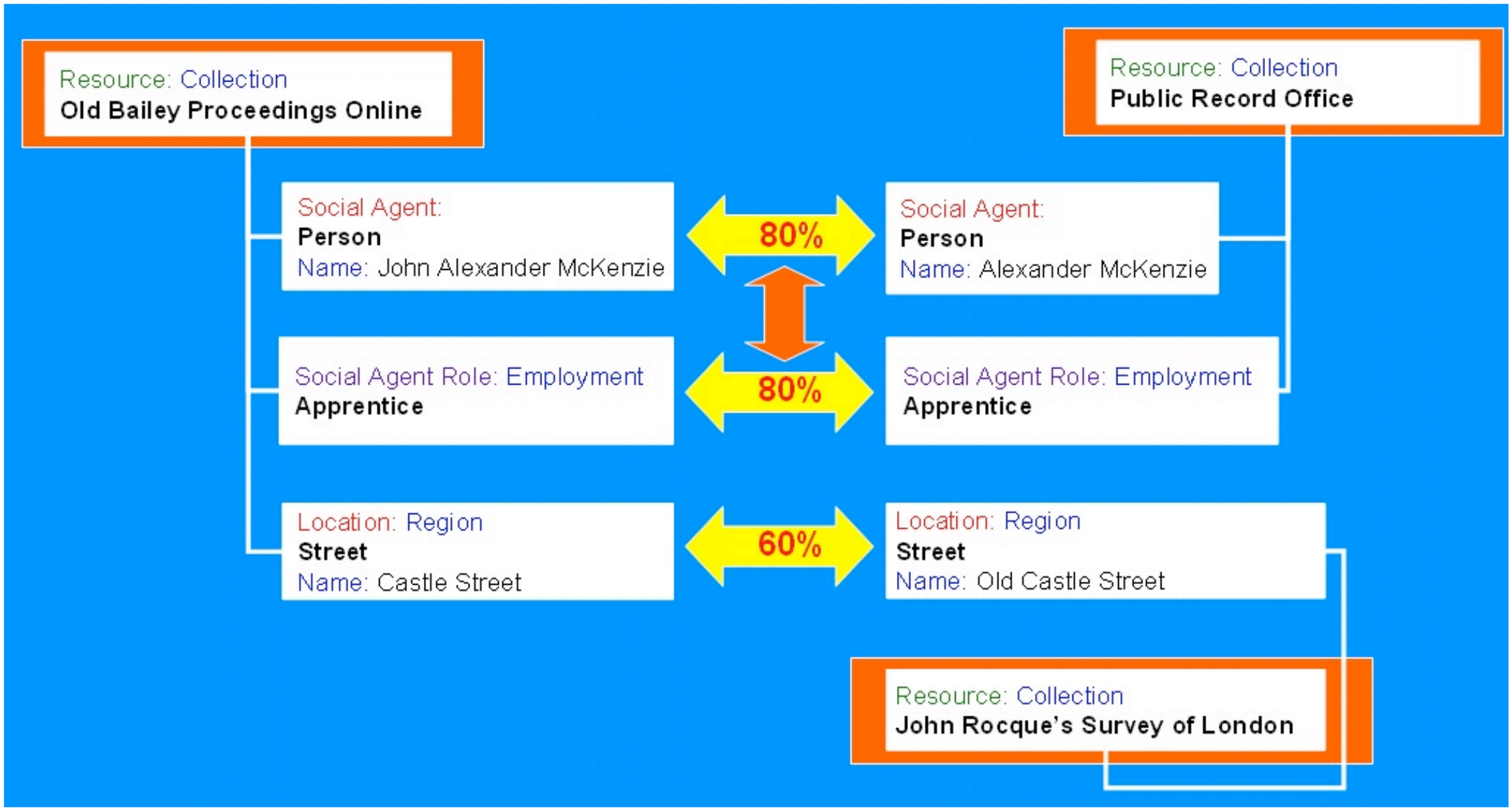


Arts & Humanities Research Council

Organisations, Information and Knowledge

Information Integration

Armadillo: **Historical Data Mining**



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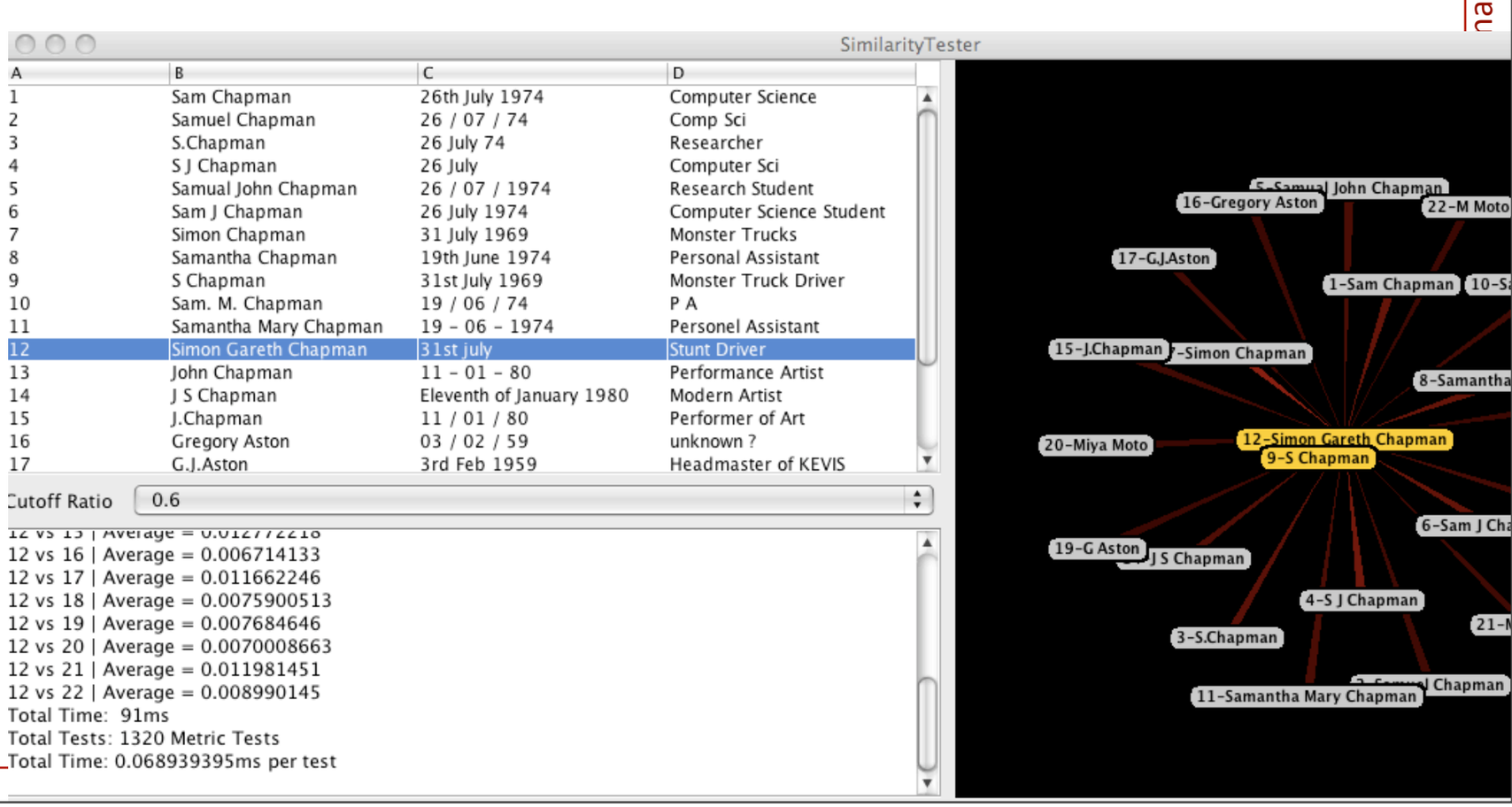
Department of W&P Appl

- Goal: identifying the most likely record matching a NL description
  - I want to become (formation)
    - A plumber (job)
    - In South Yorkshire (geography)
  - Given misspellings and lack of facility with computers
    - "become plumba in Sothyorks"



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- DU360: adaptive information integration for products/vendors from different suppliers and EU standards
  - Several large customers in detail commerce (supermarkets)

Sam Chapman and Fabio Ciravegna: K-Spend: Semantic Web Technologies for Spend Analysis. Sam Chapman and Fabio Ciravegna Industry Track, ISWC 2010
To be presented on Thursday, November 11, 10:30Am - 12:30 Pm
Industry Track: Session 1
Location: Room 3B

Organisations, Information and Knowledge

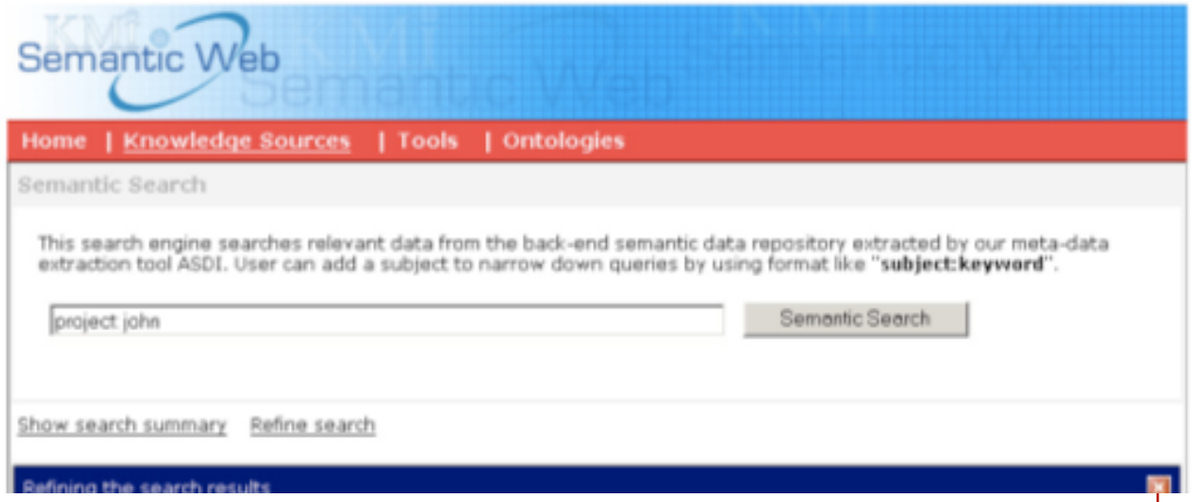
Retrieval

Semantic Search

77

Approaches to Semantic Search

- Keyword-based approaches
  - Require translating all the keywords in order to perform the query
    - E.g. SemSearch

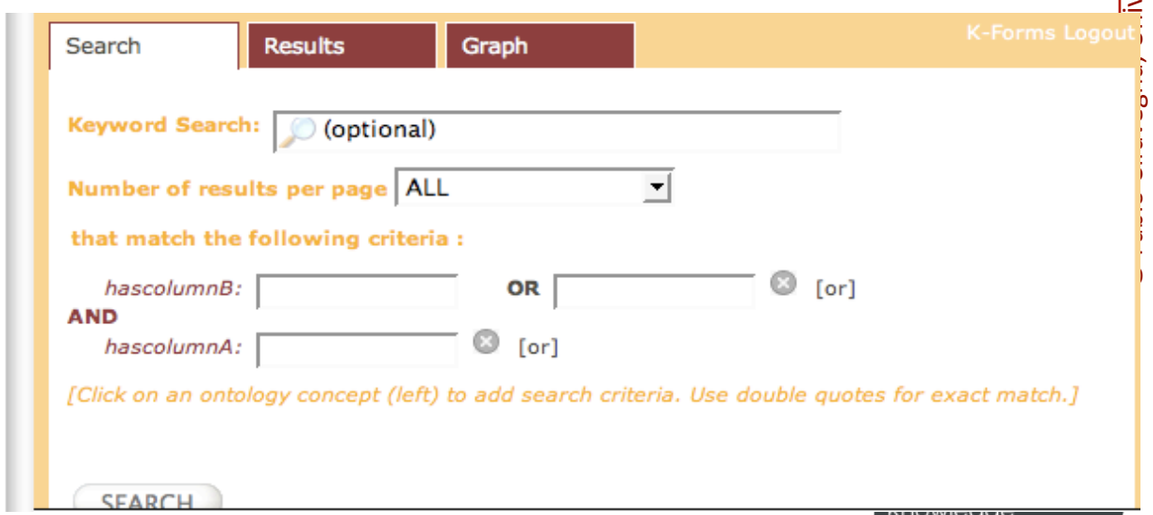


- View-based approaches
  - Based on querying by building visual graphs
    - E.g. Falcon

Search Strategy (ctd)

- A natural language approach
  - E.g. Aqua

- Form-based approaches
  - e.g. k-search



Ontology-based Querying: Issues

- Metadata can cover just part of the material of interest to the users
  - The information not annotated using metadata is irretrievable
- How many topics can we model with Information Extraction?
  - 21 topics/ 14 topics partially or not covered by annotations
    - given size of corpus there is no way that manual annotations are added

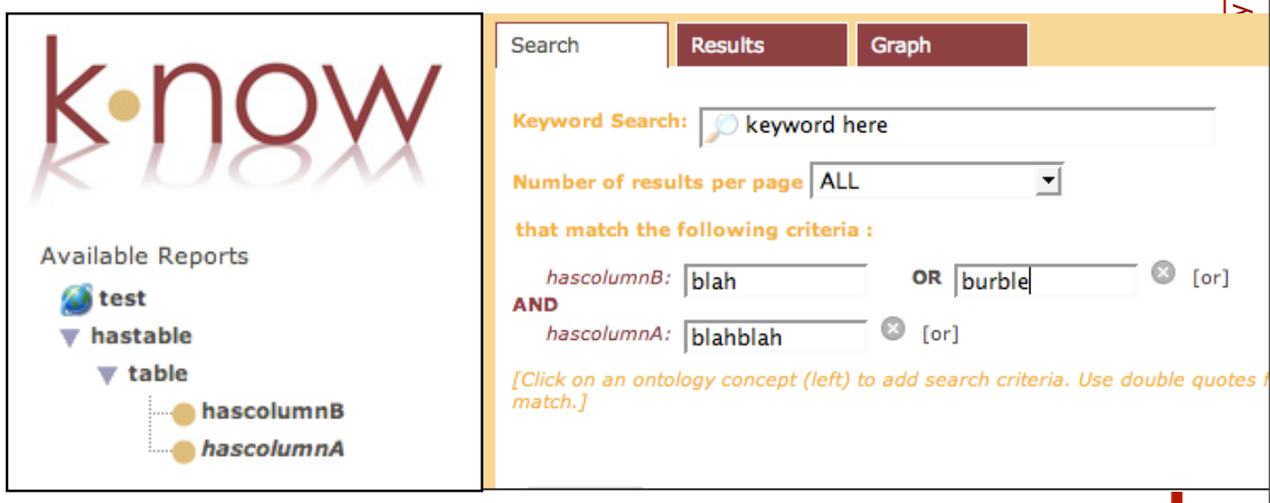
- Often the use people will do of information is impossible to foresee
  - communities organise forms for themselves
  - some information not structured
    - text fields
- Sometimes Information is impossible to retrieve reliably using automatic methods
- If automatic means are used, often some parts of the knowledge is beyond the current technical capability

Issues and Solutions

- Ontology can be extended
  - But increases effort in indexing
    - Equivalent to extending metadata in SDM
  - But it is impossible to foresee all uses of information
    - Ontology will always be insufficient somehow
- Information Extraction can be used to reduce burden of annotation
  - But some parts are irretrievable

Hybrid Search

- Keywords and ontology-based search can be mixed within the same query
  - Pure ontology-based searching
    - When metadata covers information precisely
  - Keyword-in-context of annotation
    - To match strings in text annotated with semantics (textual form fields)
      - e.g. “fuel” is matched only on snippets of texts annotated as removed parts
  - General Keyword querying
    - For searching on the document/form as a whole



Ravish Bhagdev, Sam Chapman, Fabio Ciravegna, Vitaveska Lanfranchi and Daniela Petrelli: Hybrid Search: Effectively Combining Keywords and Semantic Searches, in Proceedings of the 5th European Semantic Web Conference, ESWC 08, Tenerife, June 2008

K-Search

- Enables querying documents using hybrid search
- Enables quantification of unstructured information
- Currently applied at Rolls-Royce, University of Sheffield and several other organisations

Querying across Ontologies

- Distributed interconnected resources
  - Can be queried across via interconnected ontologies
    - Searching metadata rather than text
  - Retrieving information independently from the store/media
  - Enables querying resources using my ontological view
    - largely independently from the view used originally to create it

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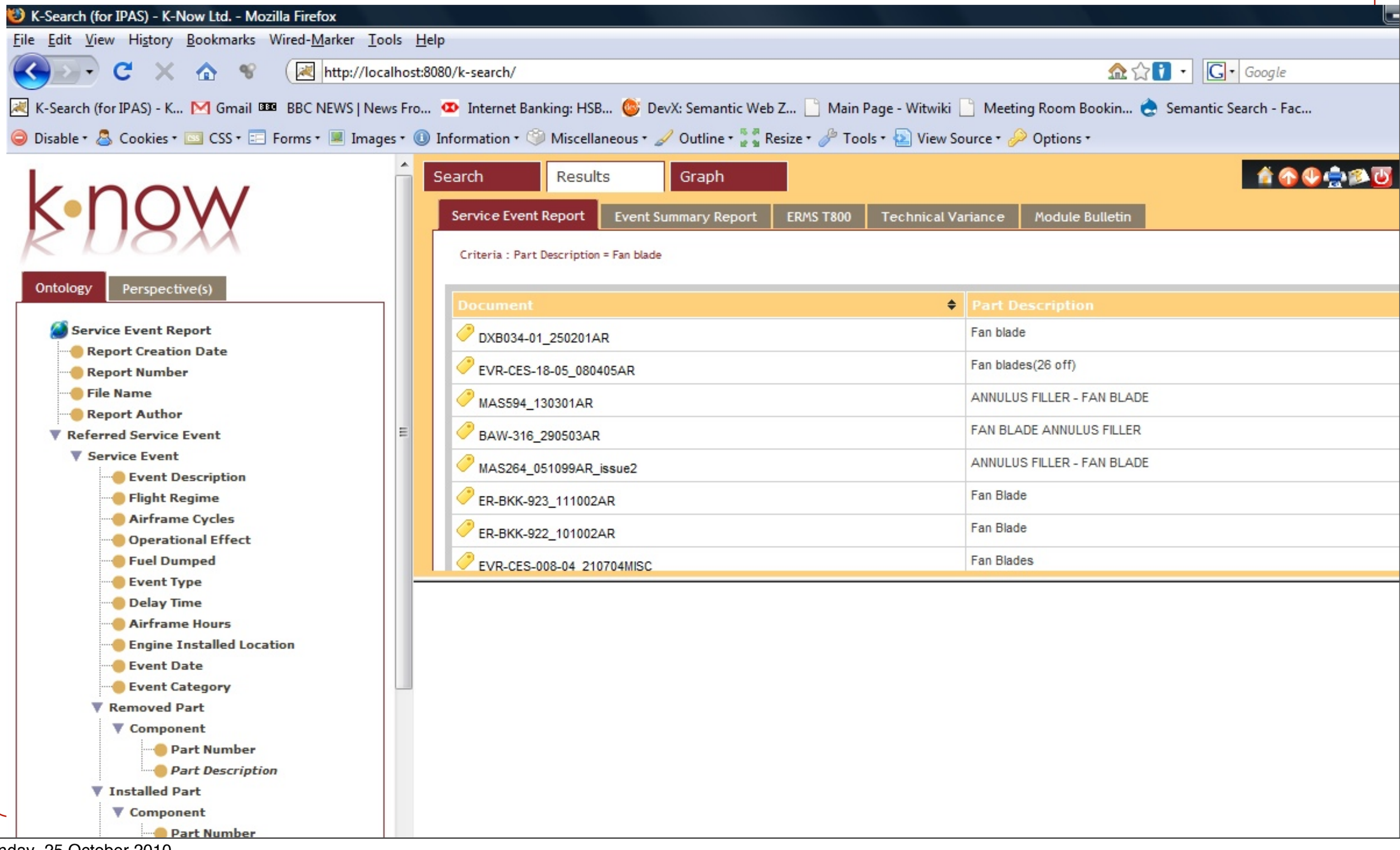
Searching Across



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Support for dynamic communities

- When an ontology different from the original is used
  - the original query is mapped to the original ontology via the formal links.
  - For the parts that are not mapped the restrictions are turned into keywords

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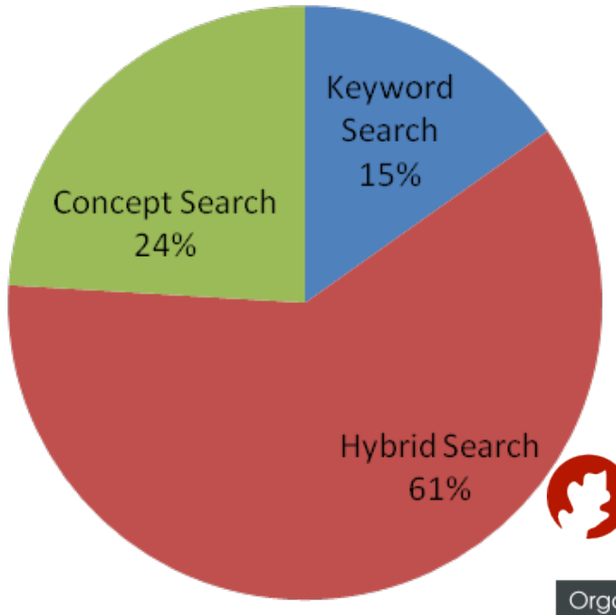
Search preferences: Service Engineers

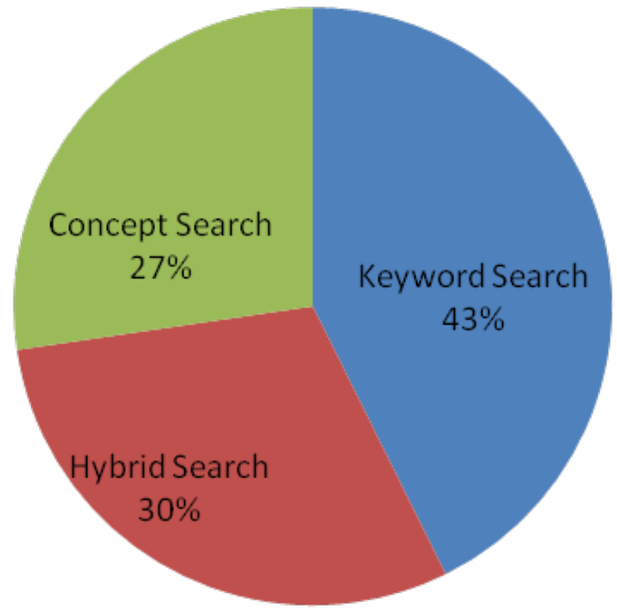
- Service engineers showed a clear predilection for hybrid search:
  - –61% of the search were executed using the hybrid modality
  - –24% using semantic search
  - –15% using keyword search.

Reason: data they were looking for was not all covered by the metadata



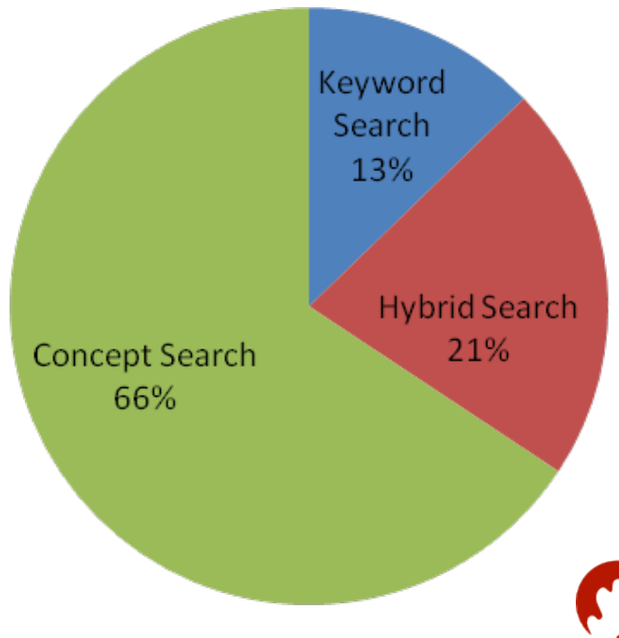
Search preferences: designers

- Designers tended instead to favour keyword search:
  - 43% of the searches were executed using keyword search
  - 30% using hybrid
  - 27% using semantic search.



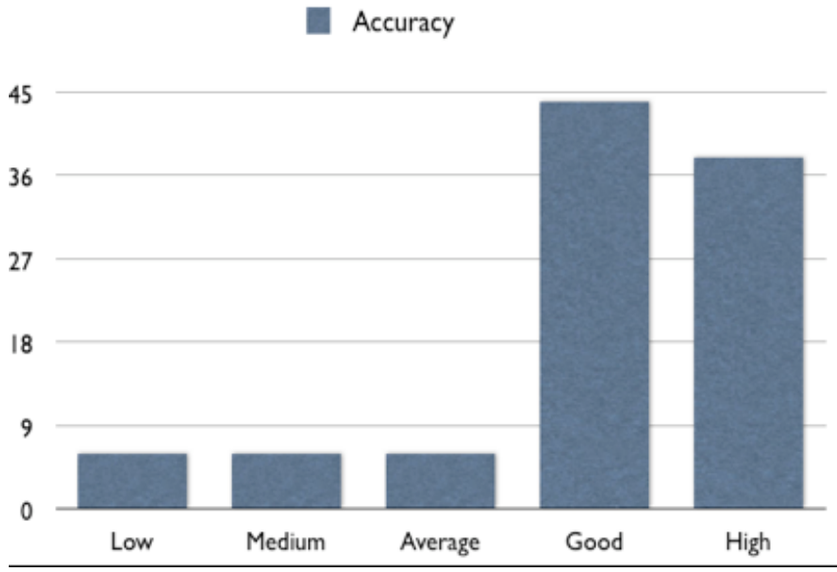
Search Strategies: Others

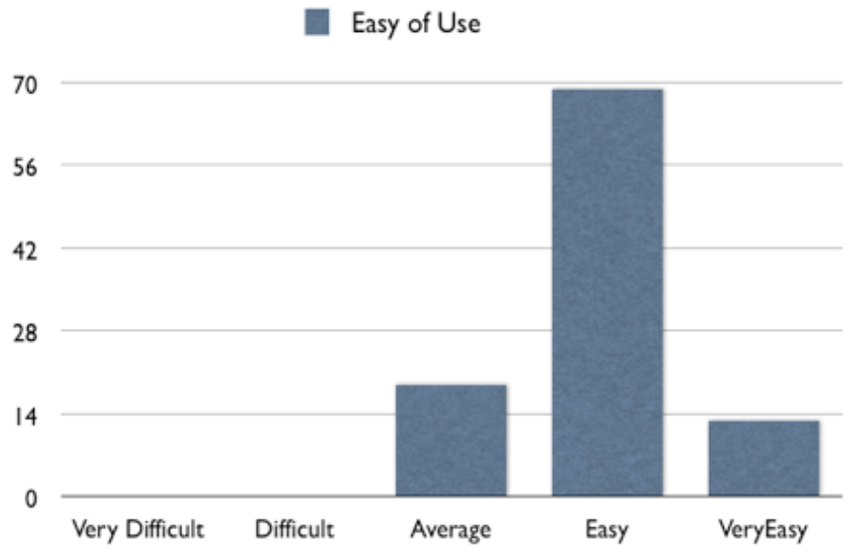
- The users belonging to other groups showed a predilection for concept search:
  - –66% of the searches were executed using semantic search
  - –24% using hybrid
  - –15% using keyword search.

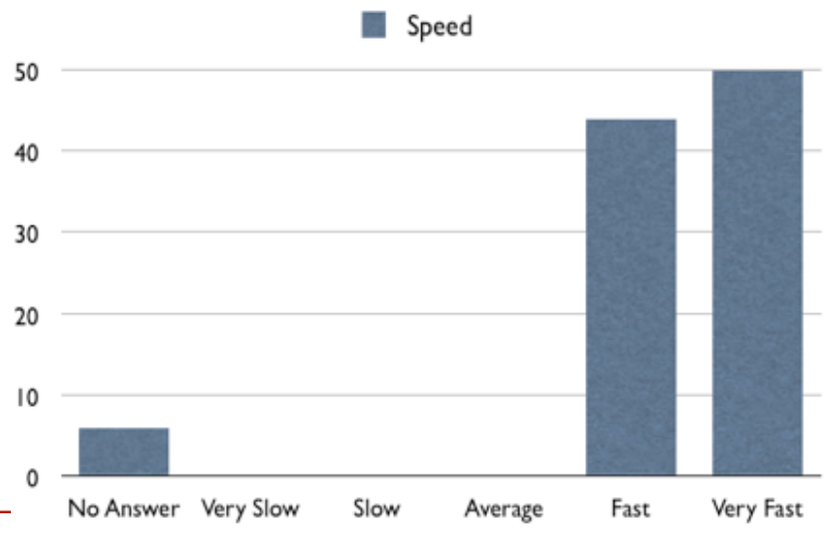


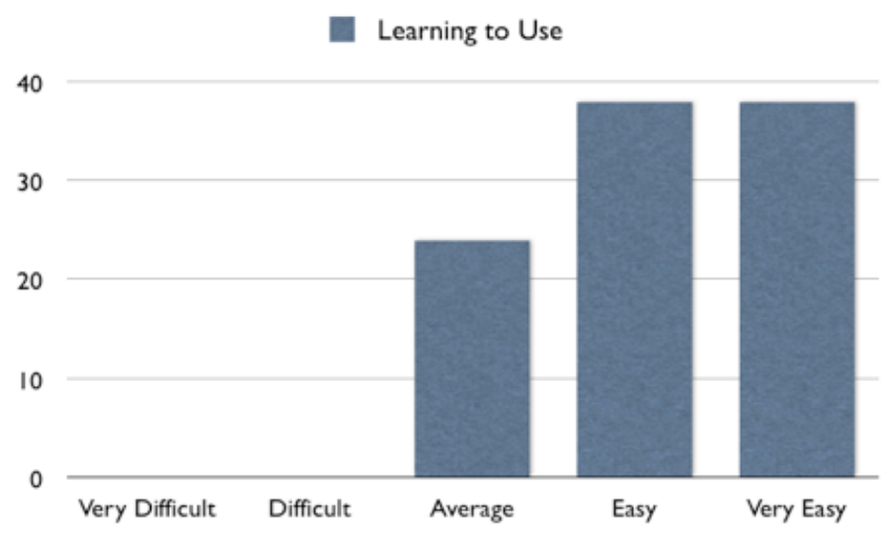
Liked by the users?

- K-Search + IE
  - Finalist of Rolls-Royce Creativity Award 2007
    - Voted by employes for its innovation potential









Liked by Users?

- Developed as part of IPAS collaboration
  - 2005-2008
    - £240,000 (50% Rolls-Royce)
- Support to the design of new Trent XWB
  - Porting to 9 Information Sources
    - 2008-2009
    - around £100,000 (100% R-R)

- Funds from Rolls-Royce for use of K-Tools for use in manufacturing
  - around £340,000

Enriching the User Experience

92

Augmenting the User's Experience

- Adding knowledge to documents
  - Document enrichment: helping connecting the document to the rest of the knowledge
    - Associating Services
      - Magpie (Dzbor et al. 2004)
    - Connected to other documents
      - COHSE (Goble et al. 2001)

NASA GISS: A Stratospheric "Clock" to Measure Upper Atmosphere Circulation - Microsoft Internet Explorer provided by T

File Edit View Favorites Tools Help

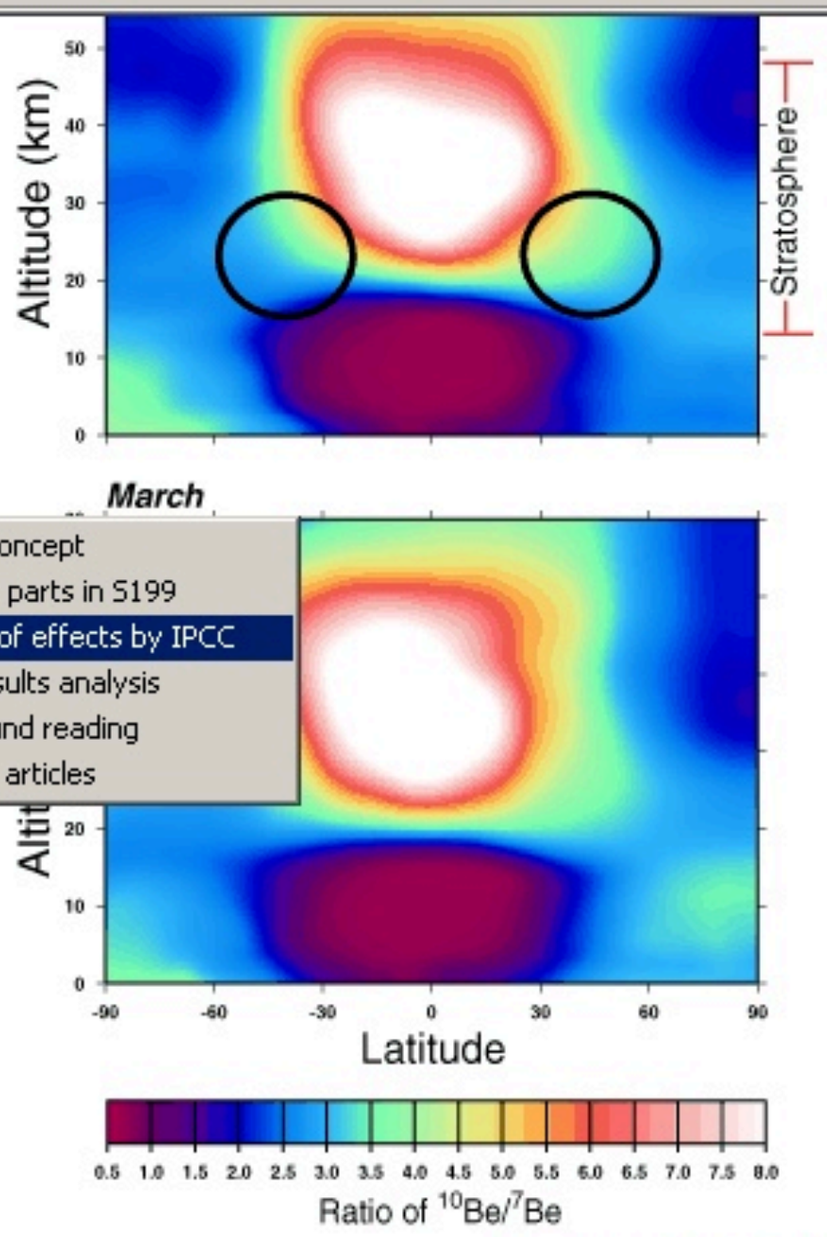
Back Search Favorites Media

Address http://www.giss.nasa.gov/research/intro/koch_01/ Go Links

Magpie Climatology Meteorology Physics Chemistry

collision of high-energy particles from space with nitrogen atoms in the atmosphere. Most tracer production occurs between about 30° 70° latitude in both hemispheres of the lower stratosphere, as indicated by the circled regions on the figure. These tracers, which are borne on aerosol particles, are removed from the stratosphere by radioactive decay. While beryllium-7 decays relatively quickly, with a half-life of 53 days, ^{10}Be's decay rate is negligible. The only sink for ^{10}Be occurs after it enters the troposphere, where the radionuclides are efficiently removed by precipitation. Therefore, if we look at the ratio of ^{10}Be/^{7}Be as air m from the midlatitude production region to other parts stratosphere, the ratio will generally increase, as ^{7}Be Thus, the ^{10}Be/^{7}Be acts as a "clock" of airmass age.

The figure shows the ^{10}Be/^{7}Be ratio calculated in the GISS general circulation model (GCM) during January and March. In the tropical stratosphere, air rises from the troposphere and continues to ascend, but exchange with higher latitudes is inhibited. The ^{10}Be/^{7}Be ratio is very high (white region) since slow penetration of air from the mid-latitude production region allows much of the ^{7}Be to decay. During the early northern hemisphere spring, air from the lower tropical stratosphere moves to higher latitudes relatively quickly. The result is the green blob of relatively high ^{10}Be/^{7}Be air at



^{10}Be/^{7}Be ratio calculated in the GISS general circulation model during January and March. Circled areas indicate maximum

Done Internet

http://www.slideshare.net/evhart/sparks-o3-browser-augmenting-the-web-with-semantic-overlays

Ivan Herman

My Work at W3C | Contact information | Short CV | Upcoming trips | Public presentations

My Work at W3C

I am Semantic Web Activity Lead; that is my main work at W3C. I am member of IW3C2 (International World Wide Web Conference Committee) (the committee coordinating the yearly WWW conference series), serving as a liaison for W3C, and of SWSA (Semantic Web Science Association), the committee responsible for the International Semantic Web Conferences series.

As part of my work, I also participate in lots of outreach activities, and I regularly make presentations, tutorials, etc. You can consult my list of presentations for further details.

Contact information

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(sha1sum: 5ac8032d5f6012aa1775ea2f33e1676bafd5e80b)
Postal address:
C/o Centre for Mathematics and Computer Sciences (CWI)
Kruislaan 413, P.O. Box 94079, 1090 GB Amsterdam, The Netherlands.
Phone numbers:
phone: +31-20-5924163
mobile phone: +31-641044153
fax: +31-20-5924312
PGP/GPG:
My GnuPGP key and signature is available on-line.
FOAF:
You can either extract a short FOAF information from this page, of consult my more complete, public FOAF file.
Misc:
I am often on freenode, (acc. name IvanHerman; primarily on the #swig channel).
I am (of course…) present on a number of online accounts and services, like: LinkedIn (acc. number 2352277), Dopplr (acc. name IvanHerman), Tripit (acc. name ivan_herman), Twitter (acc. name ivan_herman), Flickr (acc. ivan_herman).
My URI (as a real person): http://www.ivan-herman.net/foaf#me

Short CV

I graduated as mathematician at the Eötvös Loránd University of Budapest, Hungary, in 1979. After a brief scholarship at the Université Paris VI I joined the Hungarian research institute in computer science (SZTAKI) where I worked for 6 years (and turned into a computer scientist…). I left Hungary in 1986 and, after a few years in industry in Munich, Germany, I joined the Centre for Mathematics and Computer Sciences (CWI) in Amsterdam where I have a tenure position since 1988. I received a PhD degree in Computer Science in 1999 at the University of Leiden, in the Netherlands. I joined the W3C Team as Head of W3C Offices in …osition at CWI. I served as Head of Offices until June 2006, when I was asked to take the …, which is now my principal work at W3C.

…uite different areas (distributed and dataflow programming, language design, system …y research years in computer graphics and information visualization. I also participated in …zation activities and software developments. My separate "professional" home page contains

The University Of Sheffield.

Sparks O_3 Browser

The Sparks Ozone (O3) Browser is a new way for browsing visualy the hidden knowledge of RDFa documents through XHTML overlays.

Upcoming Trips

- 7 to 22 May, 2009: **Visits around Australia, organized by the local W3C Office**.
- 13 to 21 June, 2009: **Semantic Technology Conference**, San Jose, CA, USA.

References to my public presentations

I have a number of slide sets "in progress", which I use for finalized se. The list below refe presentations I have given or will give at various events.

The last 6 months:

15 January

Ivan Herman gives an invited talk on behalf of the Benelux Office wjaarsreceptie 2009 (I Years Reception)" on Thursday, 15 January 2009, in Amsterdam,

16 March

Ivan Herman gives a talk entitled *"Some W3C SW technologie* on Monday, 16 March Amsterdam, The Netherlands.

Upcoming:

12 May

Ivan Herman gives a talk entitled *"Introduction and Applications o antic Web Technologies* Presentation series "The future of web standards, HTML5, XHTM 9, in Brisbane, Australia

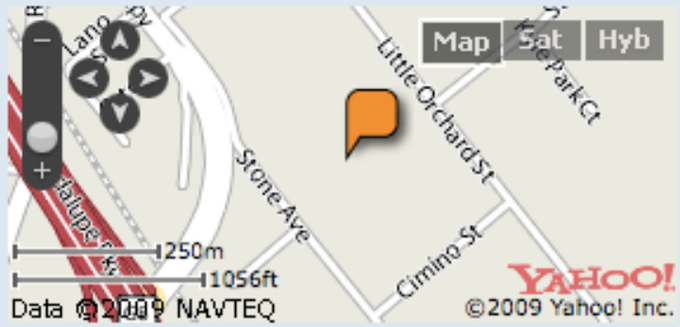
13 May

Ivan Herman gives a talk on behalf of the Australia Office entitled *"Introduction and Applications of Semantic Web"* at the "Presentation series "T

Sparks O3 Browser

Event: Semantic Technology Conference

Starts: 2009-06-13
Ends: 2009-06-22
Location: San Jose, CA, USA
Geo: 37.304,-121.873



Search

Show Developer View

Knowledge Visualisation

Visualisation

- “the Semantic Web emphasises formal, machine readable […] approaches. It focuses on the formal and even the meaning achieved through rigorously defined forms.
- Information visualization emphasizes the semantics and the meaning that can be conveyed by visual-spatial models to the users.” [6].

Requirements

- Going beyond the search/retrieval of documents and facts
  - –Supporting exploration
  - –Towards identification of trends
- Support flexible data exploration (search and browse) to make sense of a complex environment
  - –data can be very dense (large amount, very similar)
  - –ontology can be very large, several repositories
- Effective and efficient access to data

Semantic Data in Context

- Visualizations according to some main semantic dimensions familiar to users
  - –to make interaction transparent
  - –to engage them in data exploration
- Data exploration via dynamic query according to all semantic dimensions
  - –supports personal investigation strategies
  - –instantaneous change of investigation path

Example: Application to Jet Engines

- User studies found that most appropriate are:
  - –Visualizations:
    - Time: show reoccurring events
    - Geography: show flying-root related phenomena
    - Topology: show part(s) of the engine involved
  - –Data exploration:
    - According to dozens of filters
    - Defined by a company wide ontology

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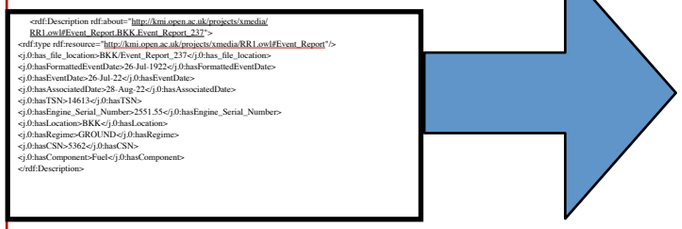
RDF triples

The University Of Sheffield.



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A row is a document, a column is a concept

A cell is a triple

Organisations, Information and Knowledge

RDF triples

The University Of Sheffield.

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RDF table

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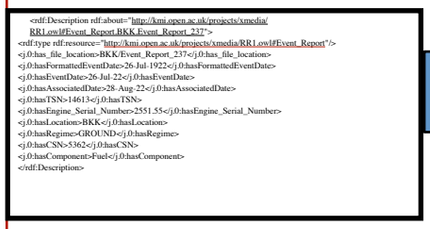
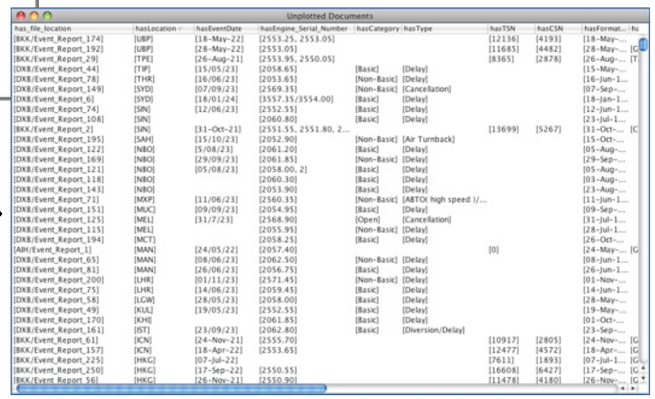
RDF triples

The University Of Sheffield.

RDF table





Some concepts are used to generate views

Organisations, Information and Knowledge

RDF triples

The University Of Sheffield.

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[DXB/Event_Report_169]	[NBO]	[29/09/23]	[2061.85]	[Non-Basic]	[Delay]			[29-Sep-...	
[DXB/Event_Report_121]	[NBO]	[05/08/23]	[2058.00, 2]	[Basic]	[Delay]			[05-Aug-...	
[DXB/Event_Report_118]	[NBO]		[2060.30]	[Basic]	[Delay]			[03-Aug-...	
[DXB/Event_Report_143]	[NBO]		[2053.90]	[Basic]	[Delay]			[23-Aug-...	
[DXB/Event_Report_71]	[MXP]	[11/06/23]	[2560.35]	[Non-Basic]	[ABTOt high speed)/...			[11-Jun-1...	
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[DXB/Event_Report_200]	[LHR]	[01/11/23]	[2571.45]	[Non-Basic]	[Delay]			[01-Nov-...	
[DXB/Event_Report_75]	[LHR]	[14/06/23]	[2059.45]	[Basic]	[Delay]			[14-Jun-1...	
[DXB/Event_Report_58]	[LGW]	[28/05/23]	[2058.00]	[Basic]	[Delay]			[28-May-...	
[DXB/Event_Report_49]	[KUL]	[19/05/23]	[2552.55]	[Basic]	[Delay]			[19-May-...	
[DXB/Event_Report_170]	[KHI]		[2061.85]	[Basic]	[Delay]			[01-Oct-...	
[DXB/Event_Report_161]	[IST]	[23/09/23]	[2062.80]	[Basic]	[Diversion/Delay]			[23-Sep-...	
[BKK/Event_Report_61]	[ICN]	[24-Nov-21]	[2555.70]			[10917]	[2805]	[24-Nov-...	[C
[BKK/Event_Report_157]	[ICN]	[18-Apr-22]	[2553.65]			[12477]	[4572]	[18-Apr-...	[C
[BKK/Event_Report_225]	[HKG]	[07-Jul-22]				[7611]	[1893]	[07-Jul-1...	[C
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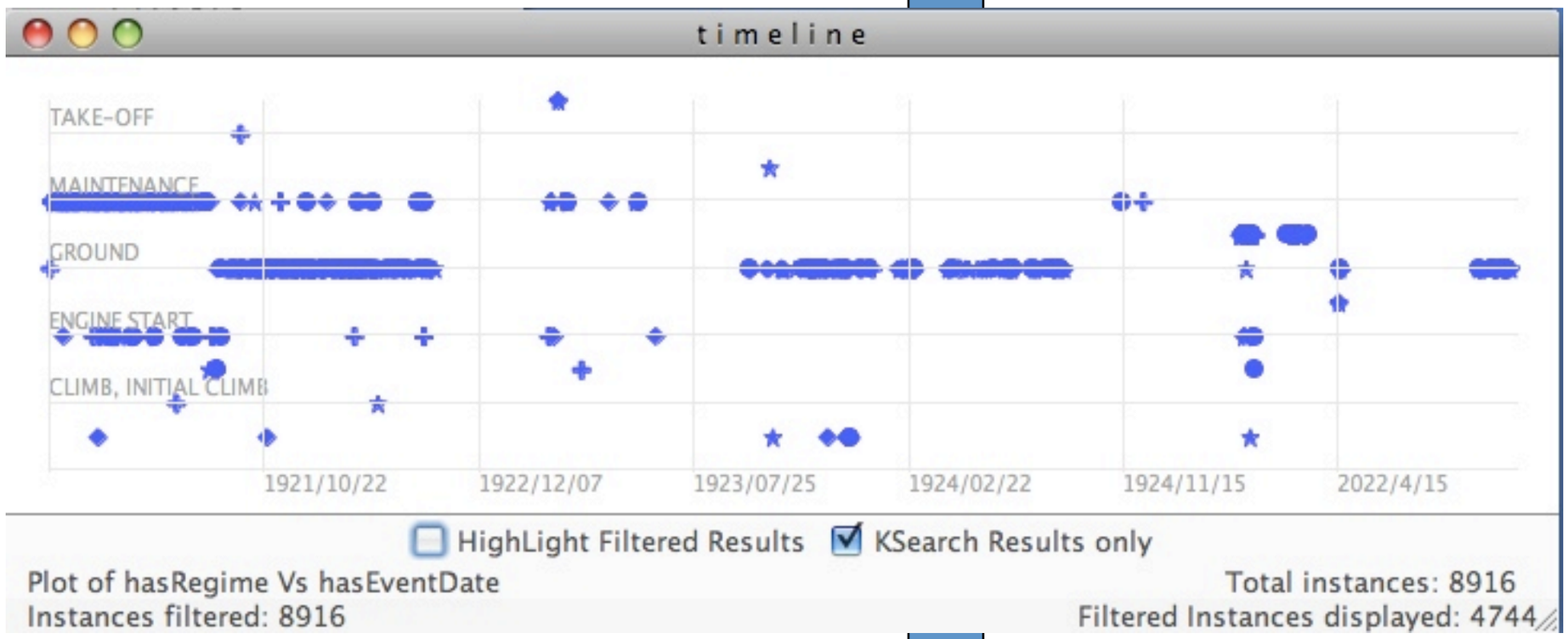

RDF triples

The University Of Sheffield.

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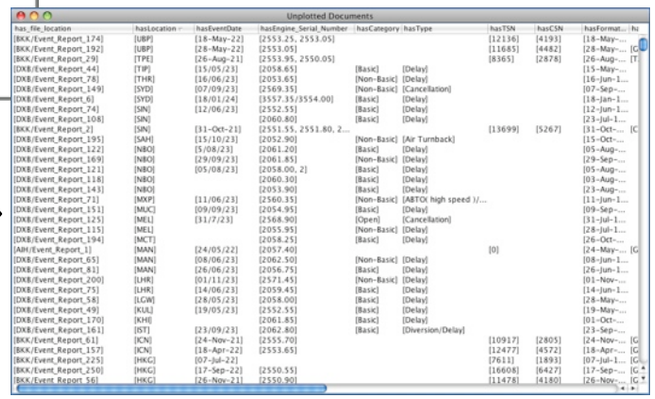
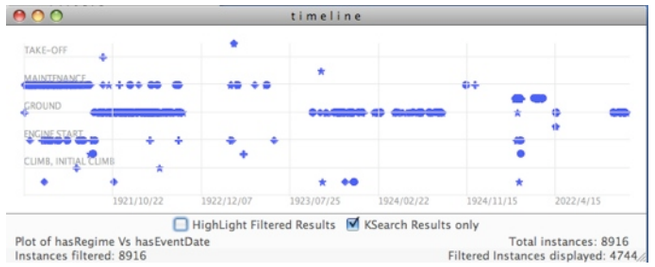


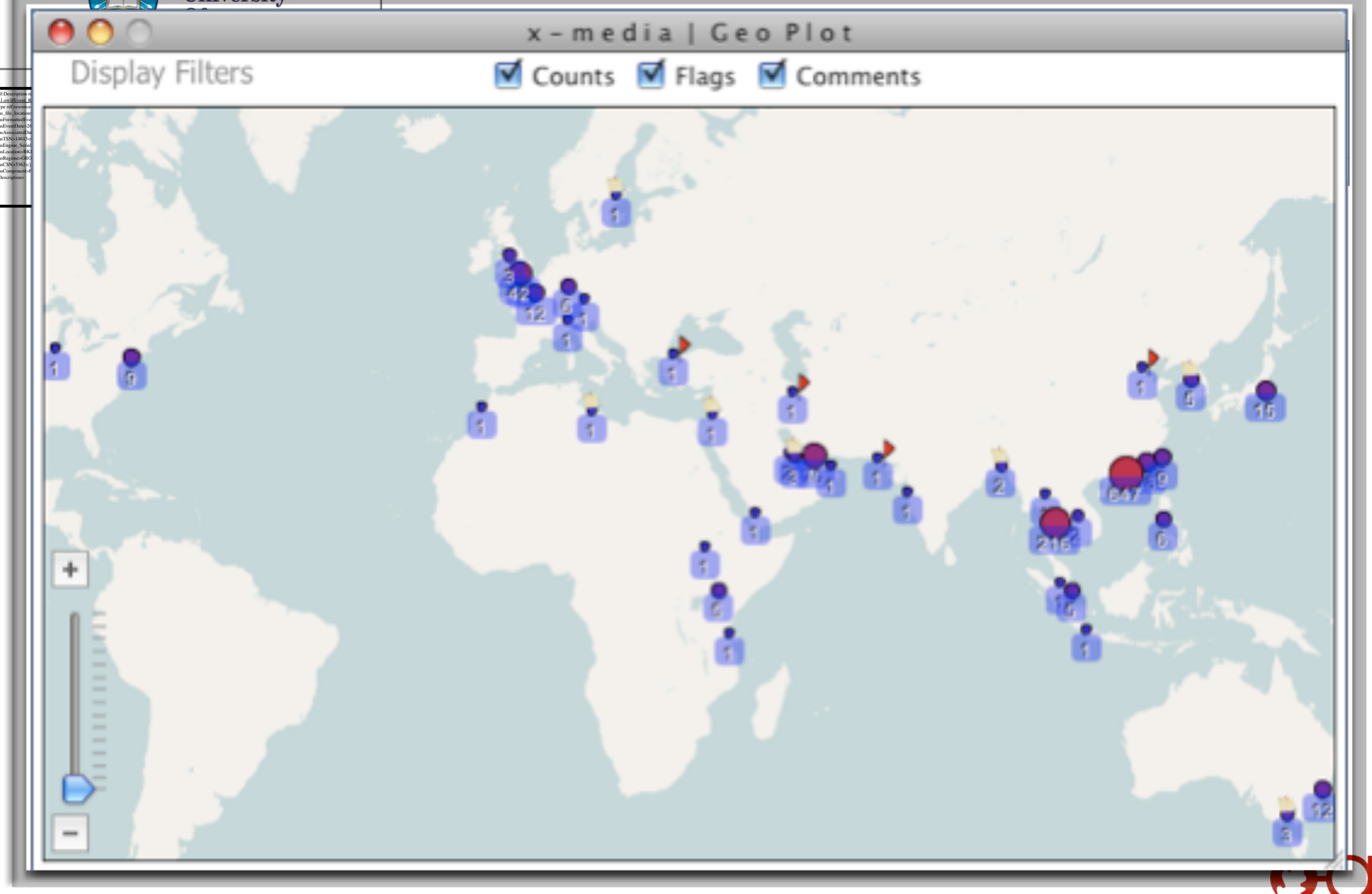
Timeline



RDF triples

RDF table

Timeline



RDF triples

The University Of Sheffield.

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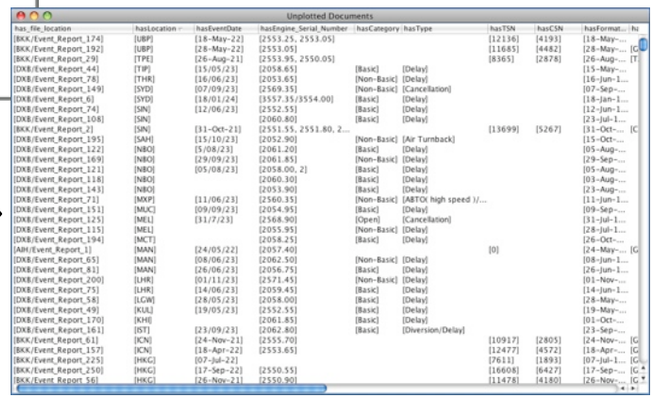

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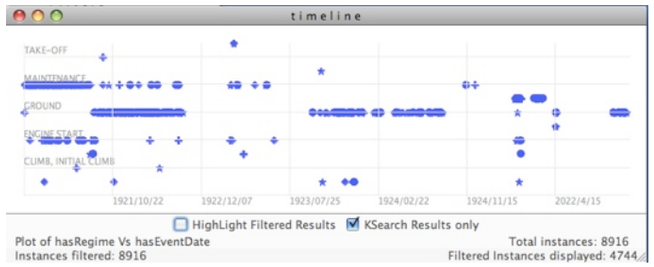
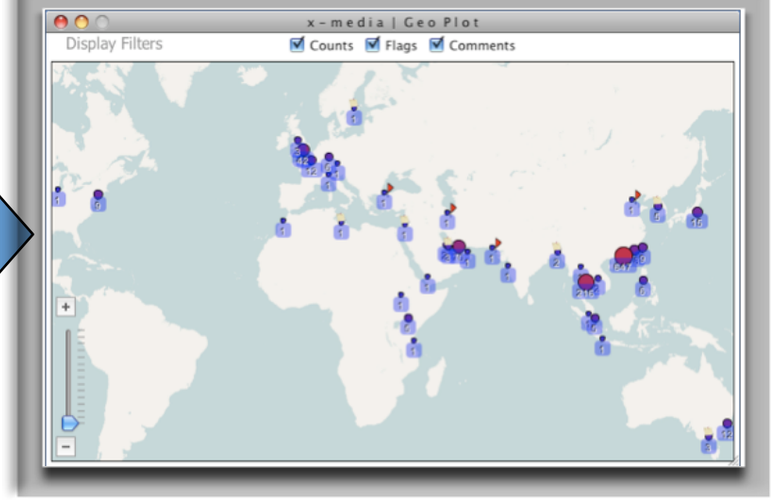
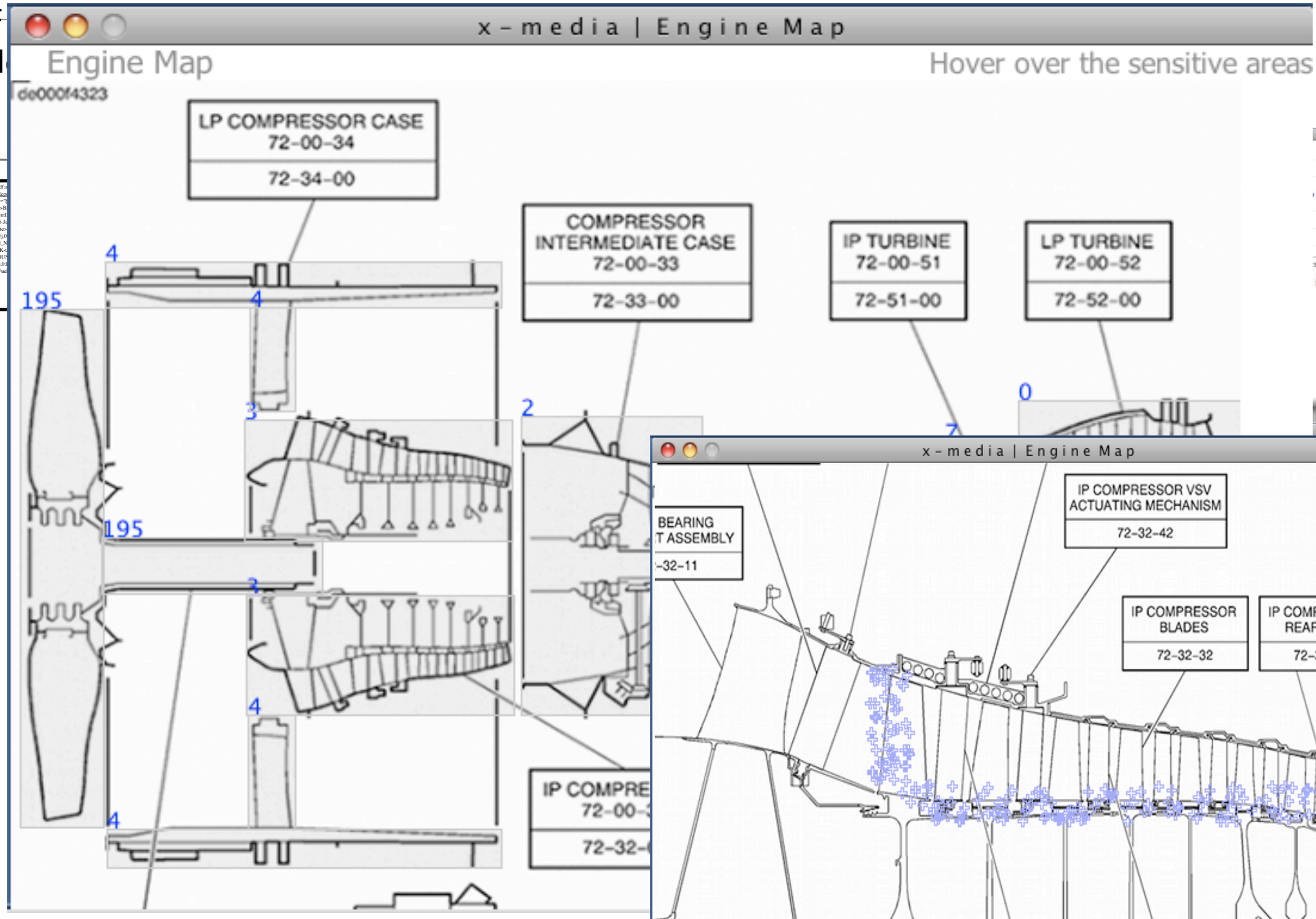


GeoPlot



Organisations, Information and Knowledge

RDF triple



Number of levels depends on ontology granularity

RDF triples

The University Of Sheffield.

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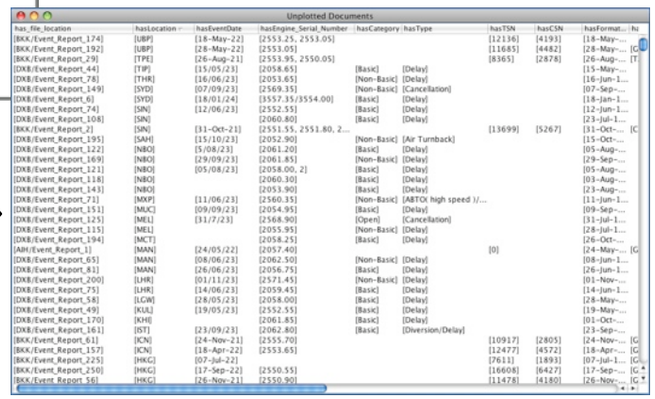

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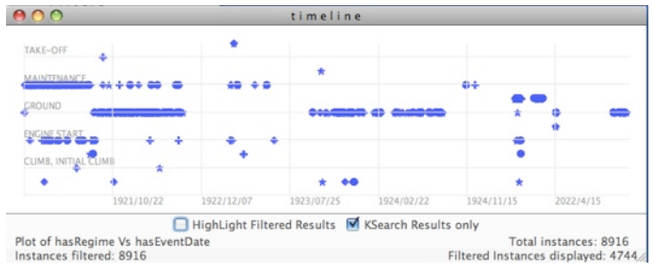

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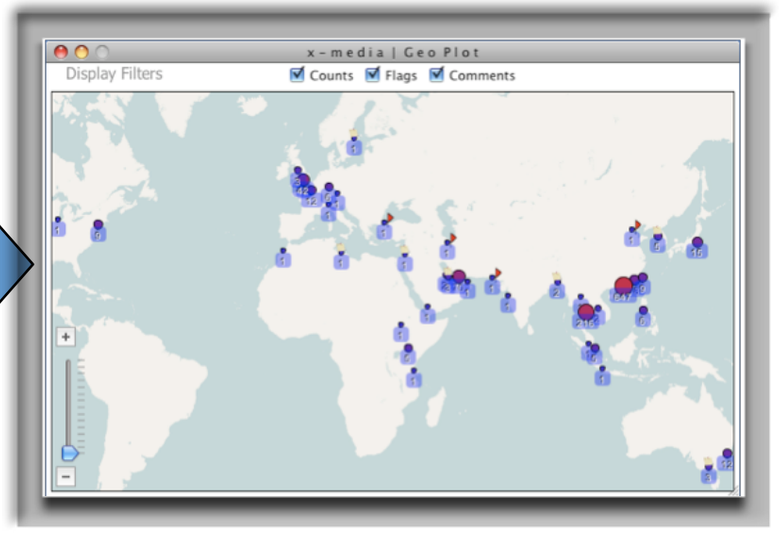
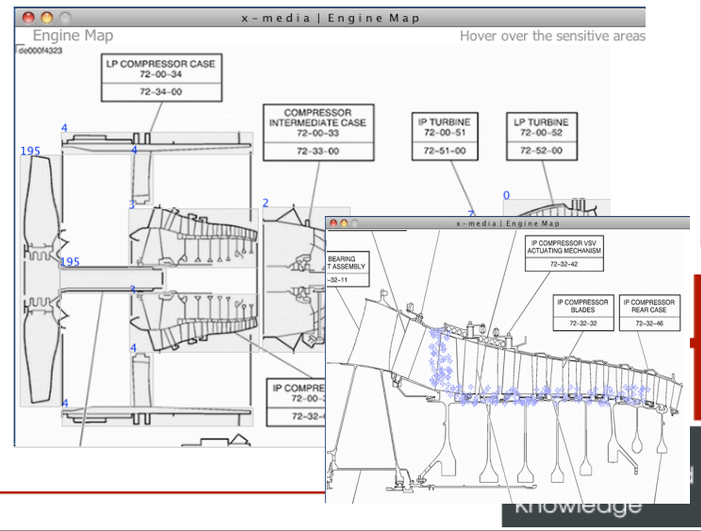


TopologicalMap



RDF triples

The University Of Sheffield.

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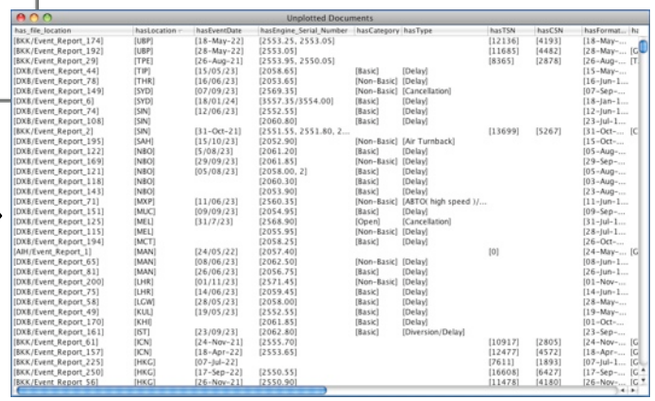
RDF table



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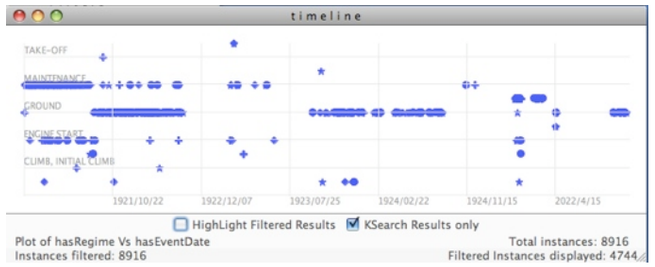
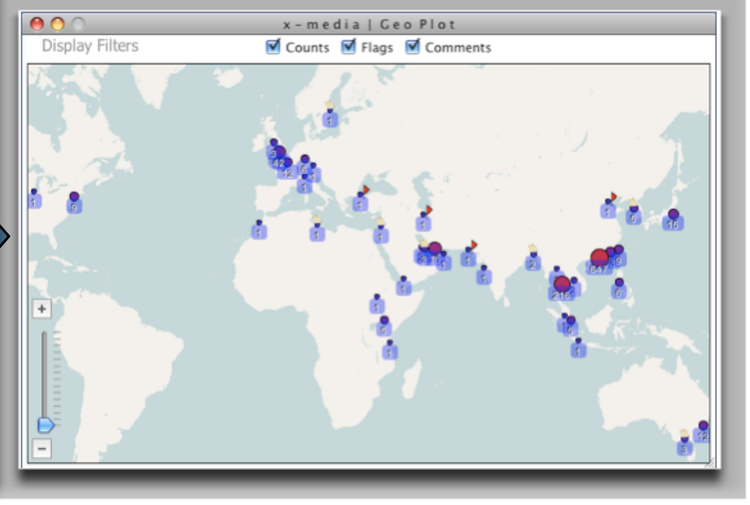
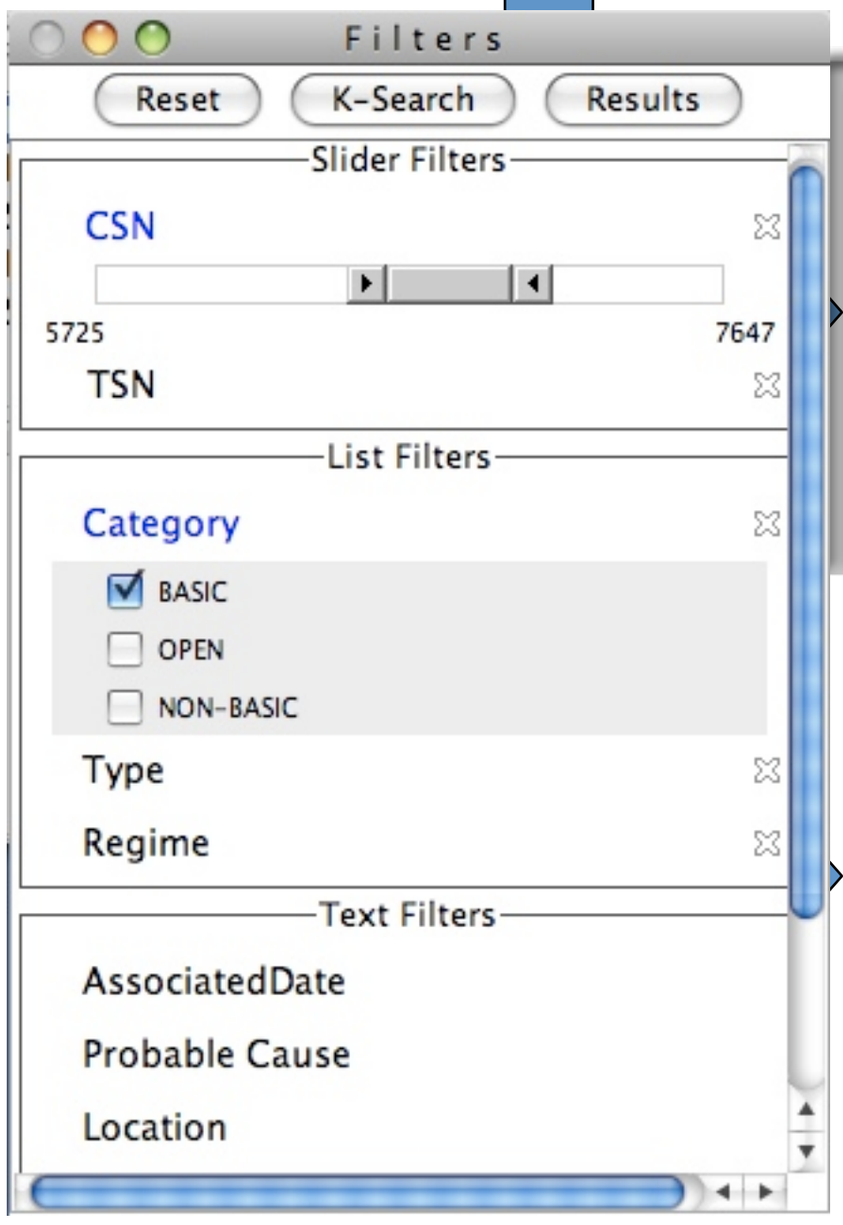


GeoPlot





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- list: small sets (<25)
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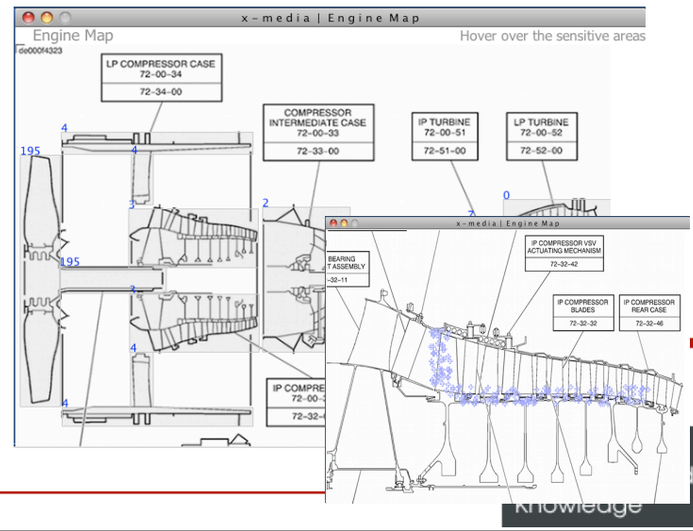
TopologicalMap



RDF triples

The University Of Sheffield.

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[DXB/Event_Report_108]	[SIN]		[2060.80]	[Basic]	[Delay]			[23-Jul-1...	
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[DXB/Event_Report_125]	[MEL]	[31/7/23]	[2568.90]	[Open]	[Cancellation]			[31-Jul-1...	
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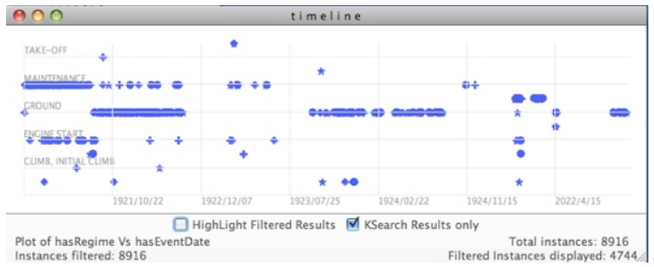
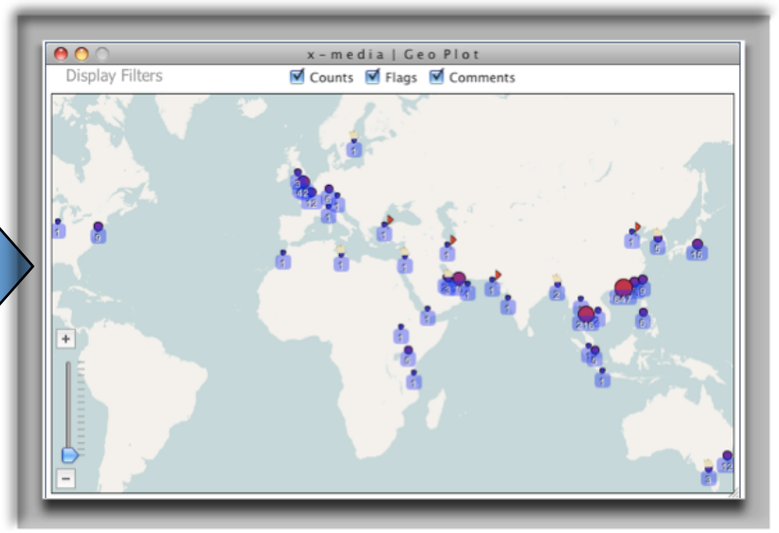
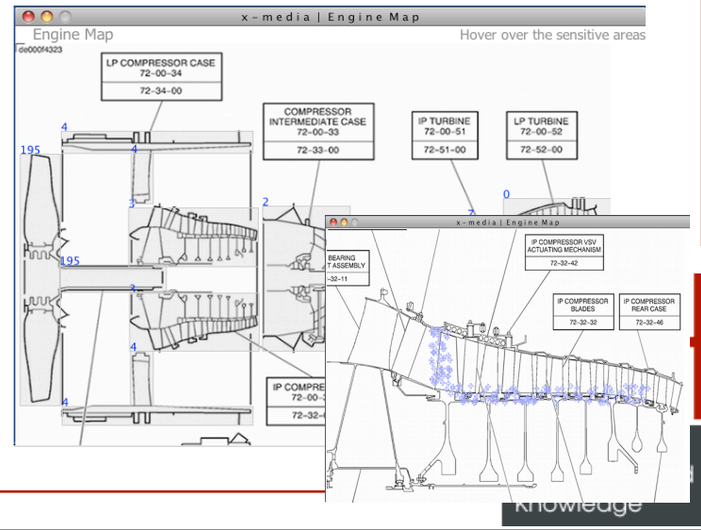
Timeline

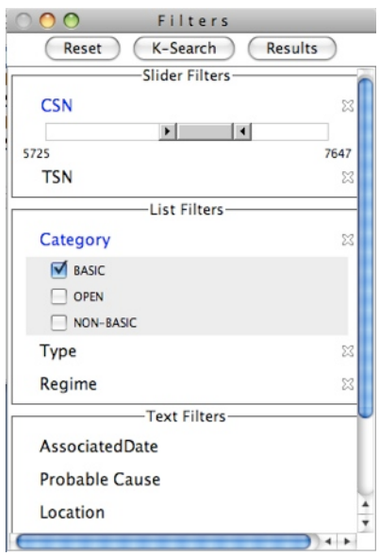


GeoPlot



TopologicalMap





Ontology

RDF triples

The University Of Sheffield.

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Unplotted Documents

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[BKK/Event_Report_174]	[UBP]	[18-May-22]	[2553.25, 2553.05]			[12136]	[4193]	[18-May-...	
[BKK/Event_Report_192]	[UBP]	[28-May-22]	[2553.05]			[11685]	[4482]	[28-May-...	[C
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[DXB/Event_Report_44]	[TIP]	[15/05/23]	[2058.65]	[Basic]	[Delay]			[15-May-...	
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[BKK/Event_Report_2]	[SIN]	[31-Oct-21]	[2551.55, 2551.80, 2...			[13699]	[5267]	[31-Oct-...	[C
[DXB/Event_Report_195]	[SAH]	[15/10/23]	[2052.90]	[Non-Basic]	[Air Turnback]			[15-Oct-...	
[DXB/Event_Report_122]	[NBO]	[5/08/23]	[2061.20]	[Basic]	[Delay]			[05-Aug-...	
[DXB/Event_Report_169]	[NBO]	[29/09/23]	[2061.85]	[Non-Basic]	[Delay]			[29-Sep-...	
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[DXB/Event_Report_71]	[MXP]	[11/06/23]	[2560.35]	[Non-Basic]	[ABTOr high speed)/...			[11-Jun-1...	
[DXB/Event_Report_151]	[MUC]	[09/09/23]	[2054.95]	[Basic]	[Delay]			[09-Sep-...	
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[DXB/Event_Report_194]	[MCT]		[2058.25]	[Basic]	[Delay]			[26-Oct-...	
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[DXB/Event_Report_170]	[KHI]		[2061.85]	[Basic]	[Delay]			[01-Oct-...	
[DXB/Event_Report_161]	[IST]	[23/09/23]	[2062.80]	[Basic]	[Diversion/Delay]			[23-Sep-...	
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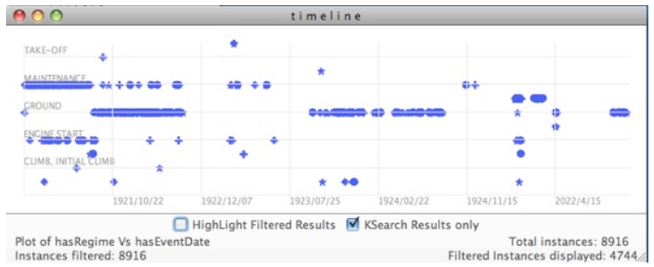
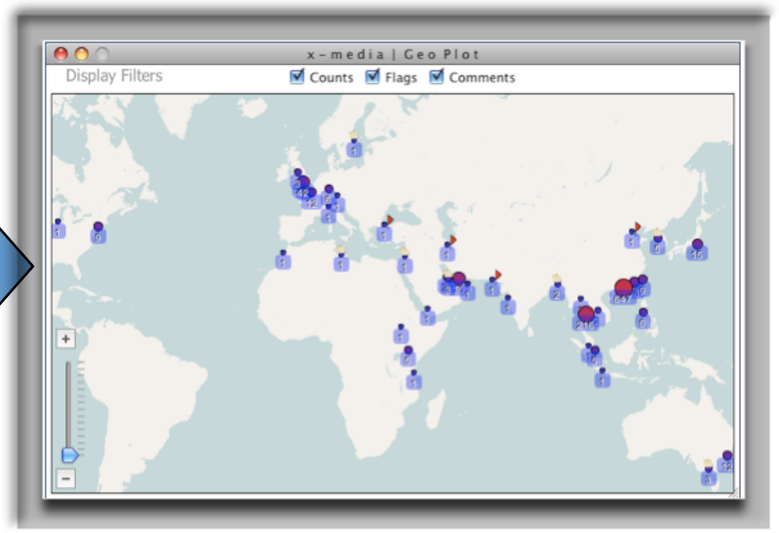
[BKK/Event_Report_225]	[HKG]	[07-Jul-22]				[7611]	[1893]	[07-Jul-1...	[C
[BKK/Event_Report_250]	[HKG]	[17-Sep-22]	[2550.55]			[16608]	[6427]	[17-Sep-...	[C
[BKK/Event_Report_56]	[HKG]	[26-Nov-21]	[2550.90]			[11478]	[4180]	[26-Nov-...	[C

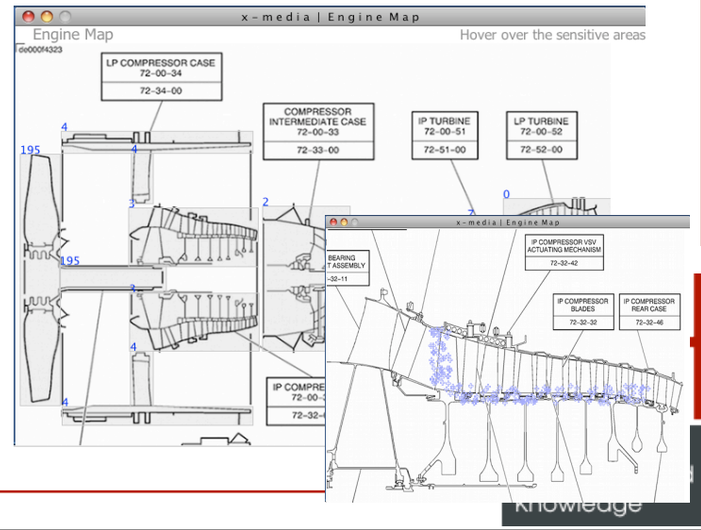
Timeline

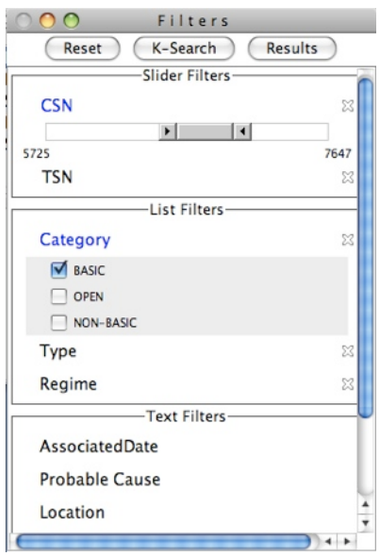


GeoPlot



TopologicalMap





User

Ontology

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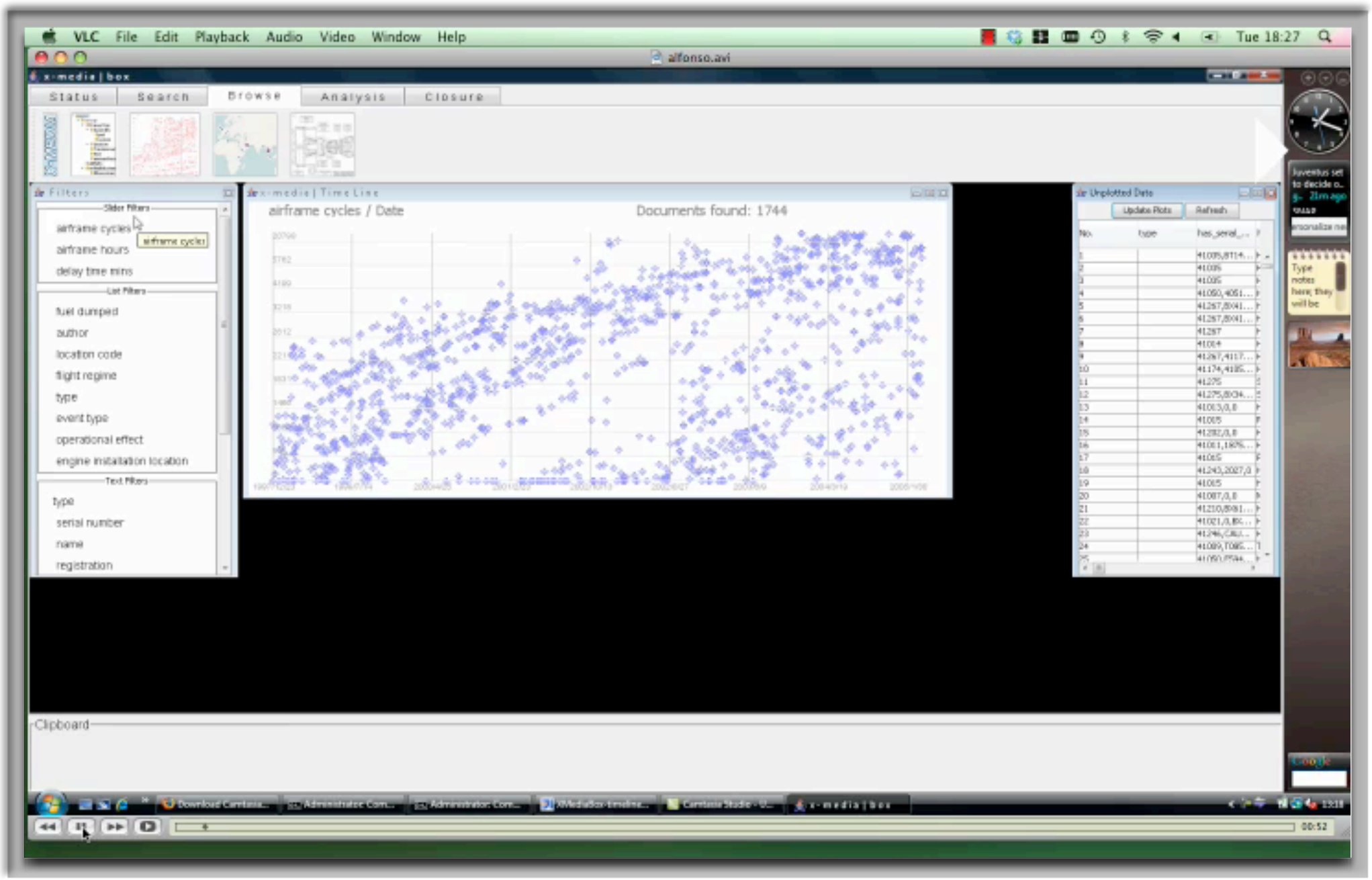

Interaction with TimeLine

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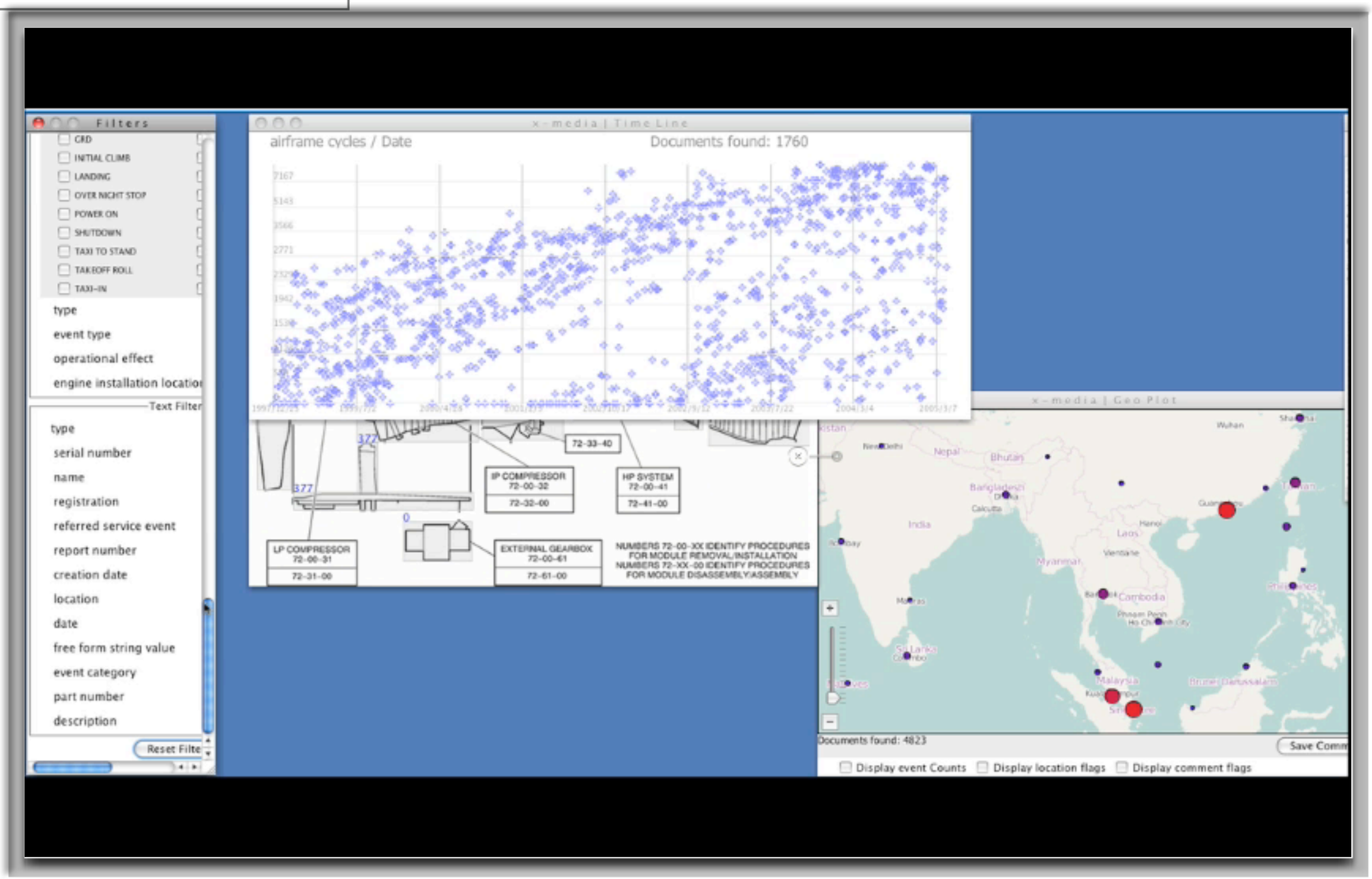
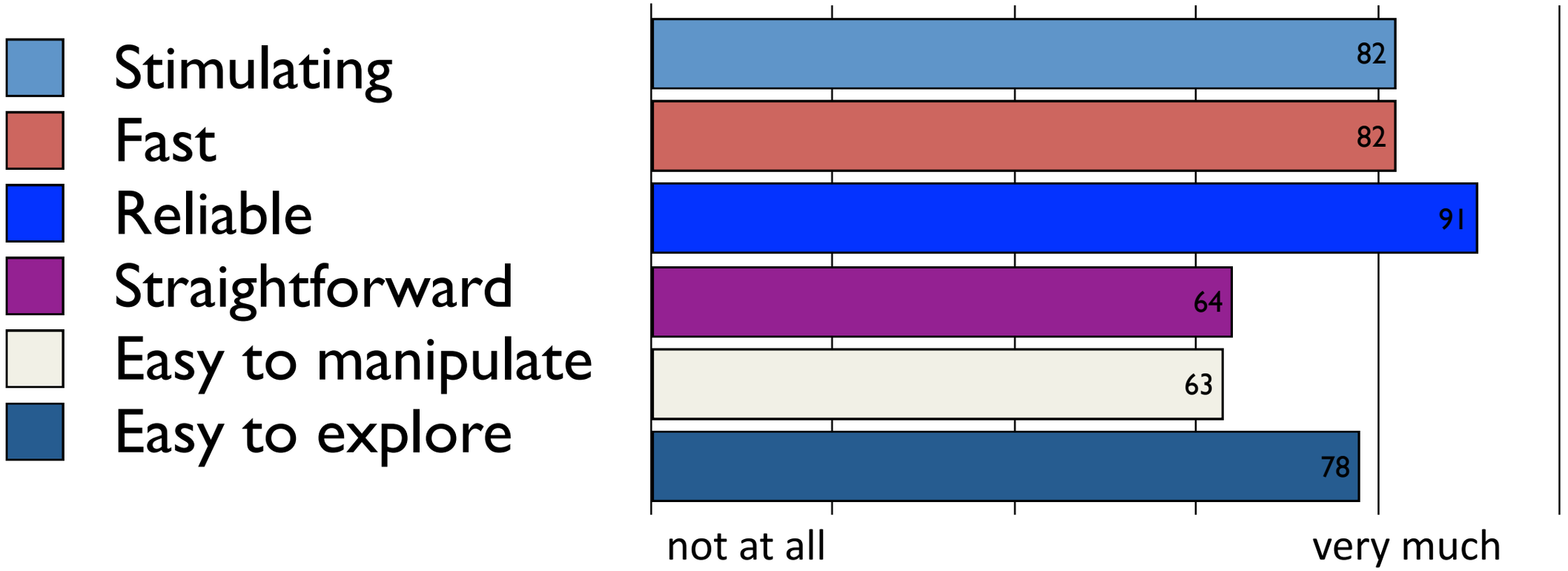


Multiple Visualisations

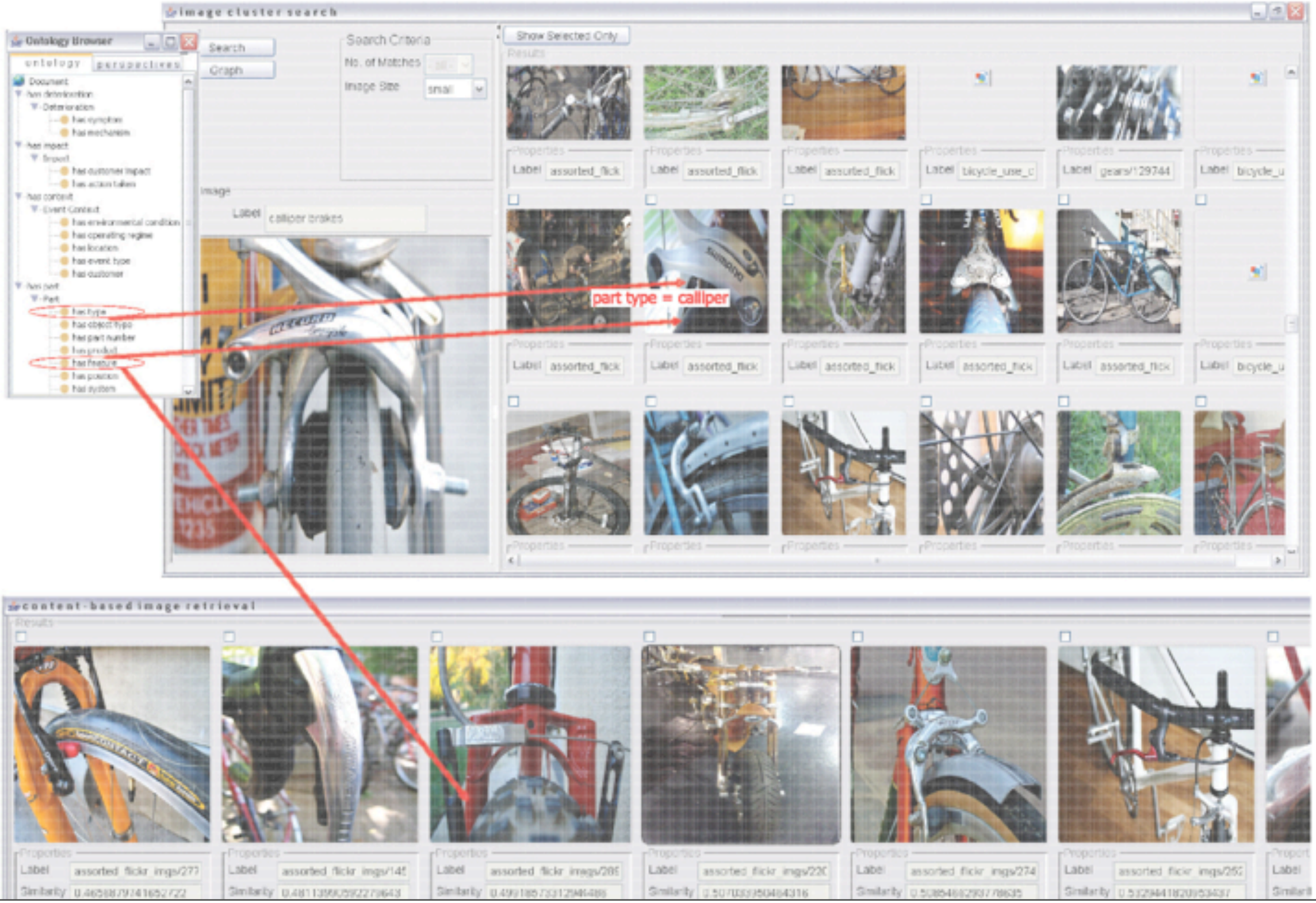
Organisations, Information and Knowledge

User Satisfaction

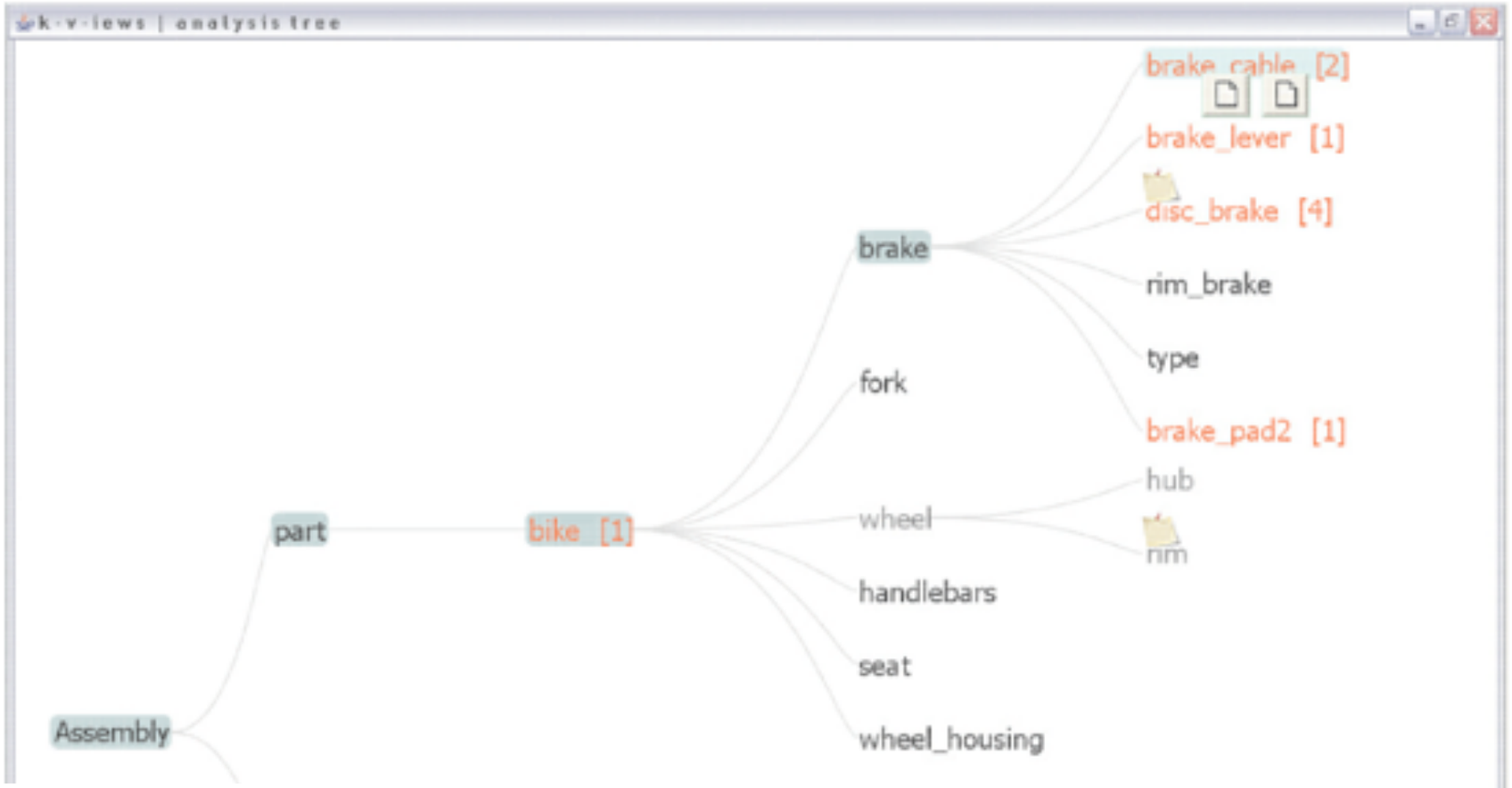


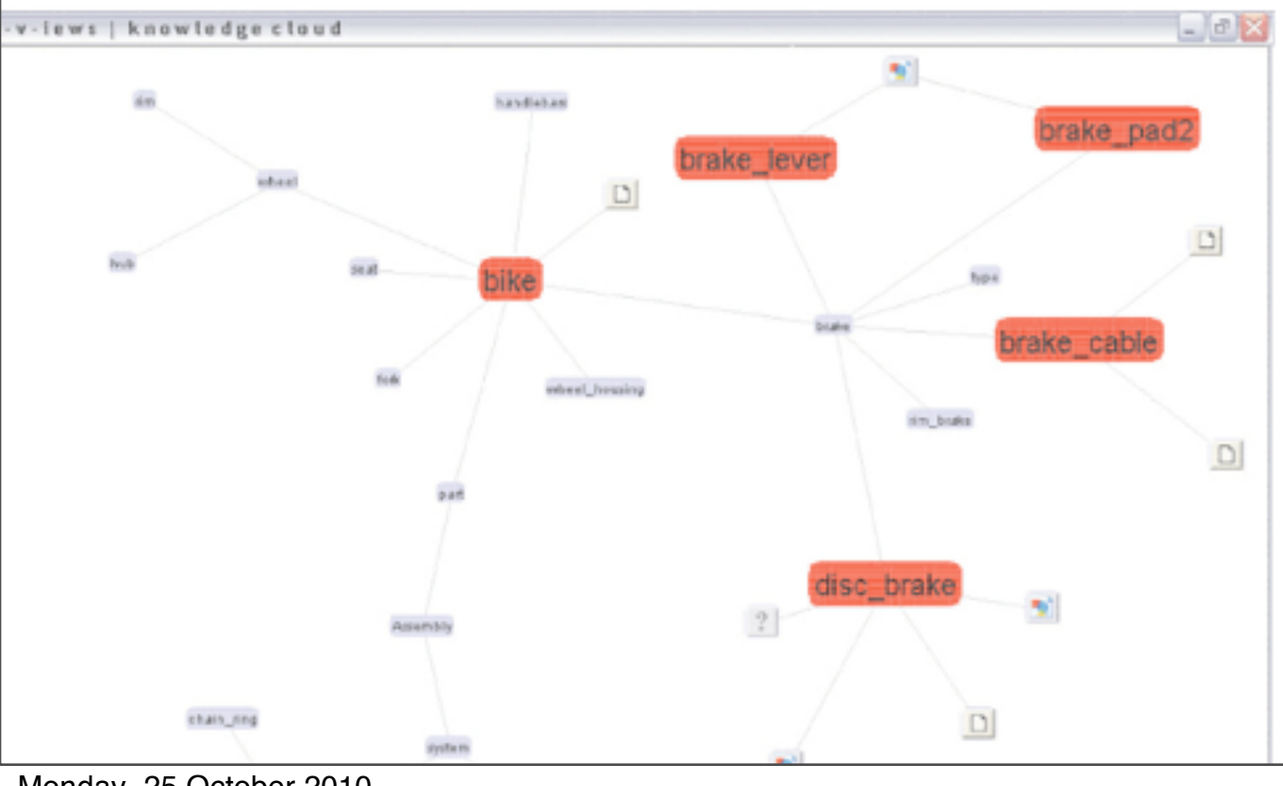
- Divide: value of the tool vs. manipulation difficulties

Visualising similarity



Visualising the Hypothesis Space



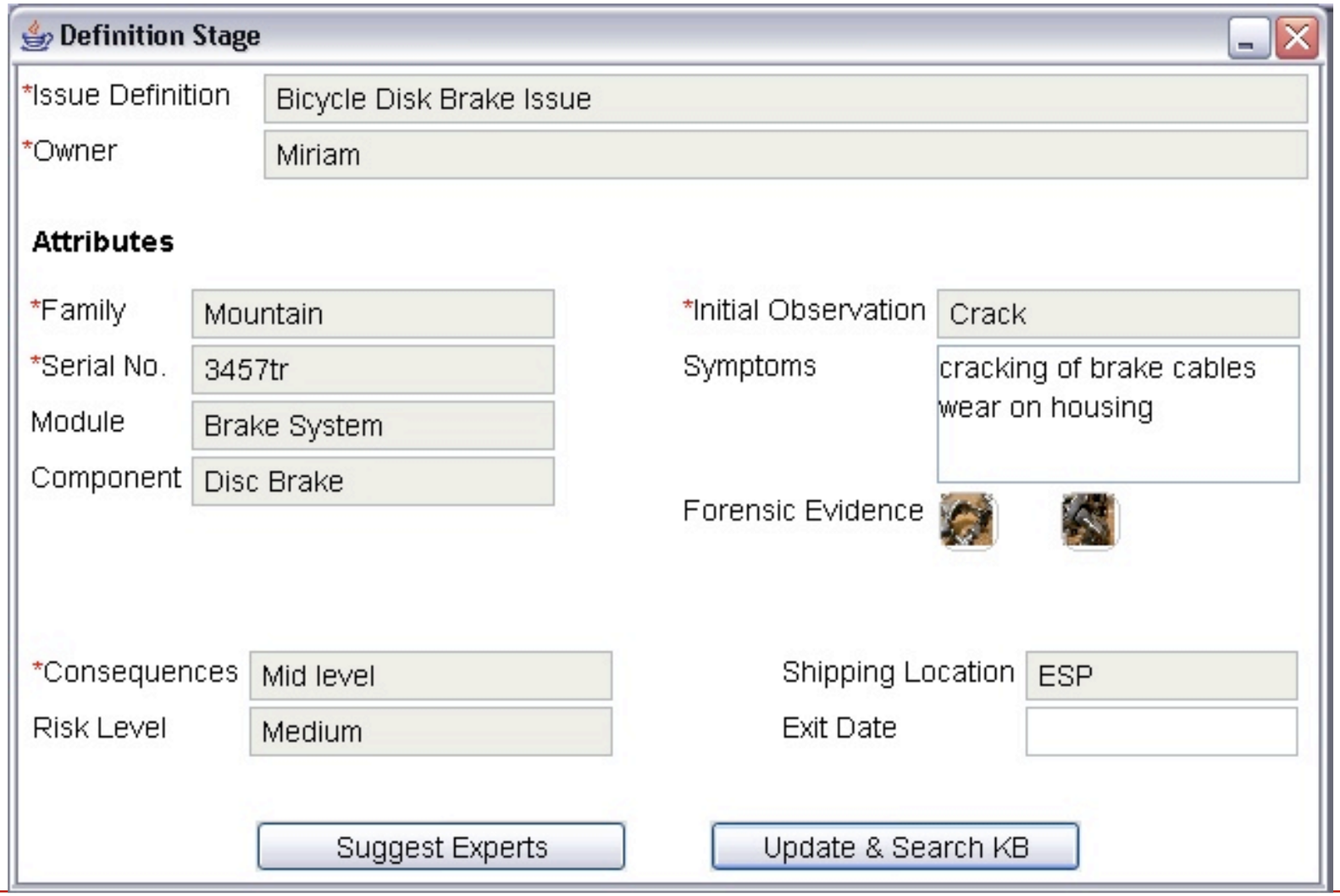


Reuse of Information and Knowledge

Steps in Reuse

- Set up:
  - the sense-making activity is triggered by the need for new knowledge.
  - Evidence in different forms and from all sources available must be collected

Context Definition

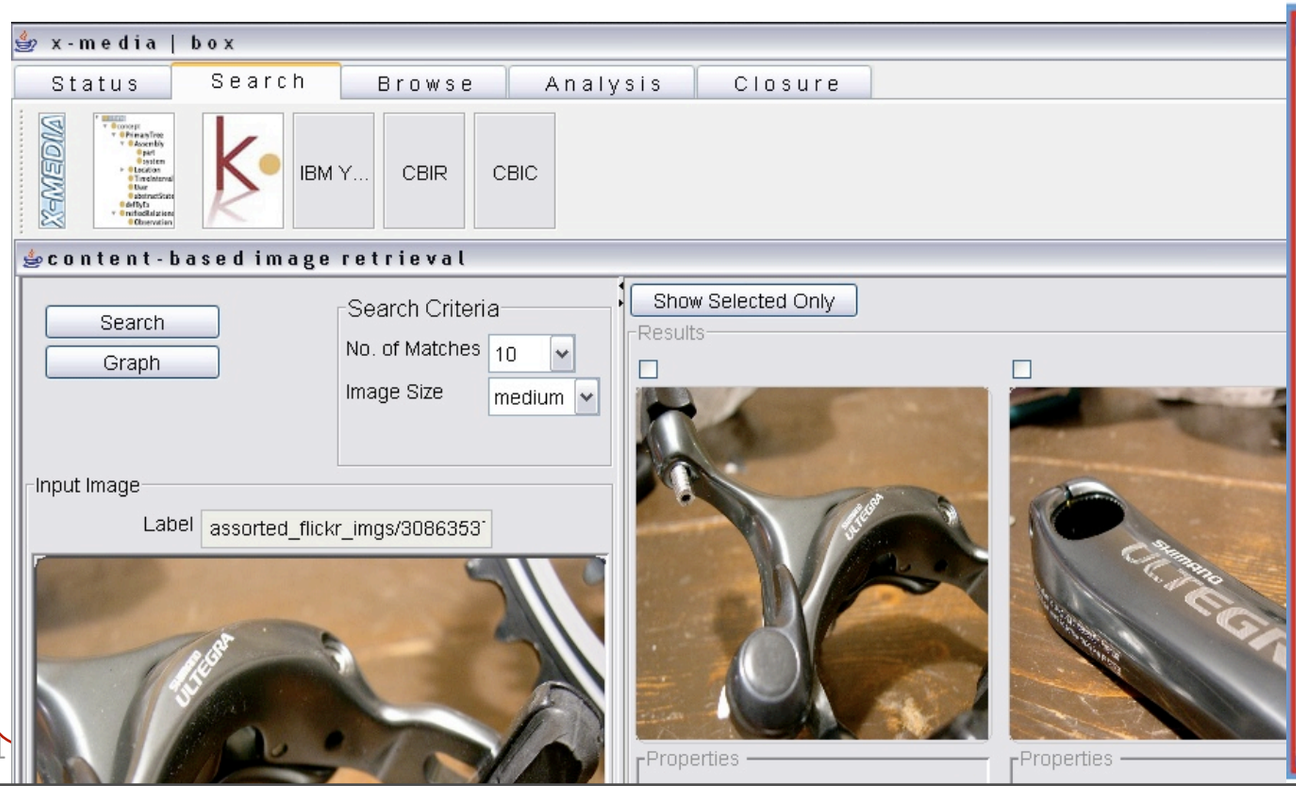


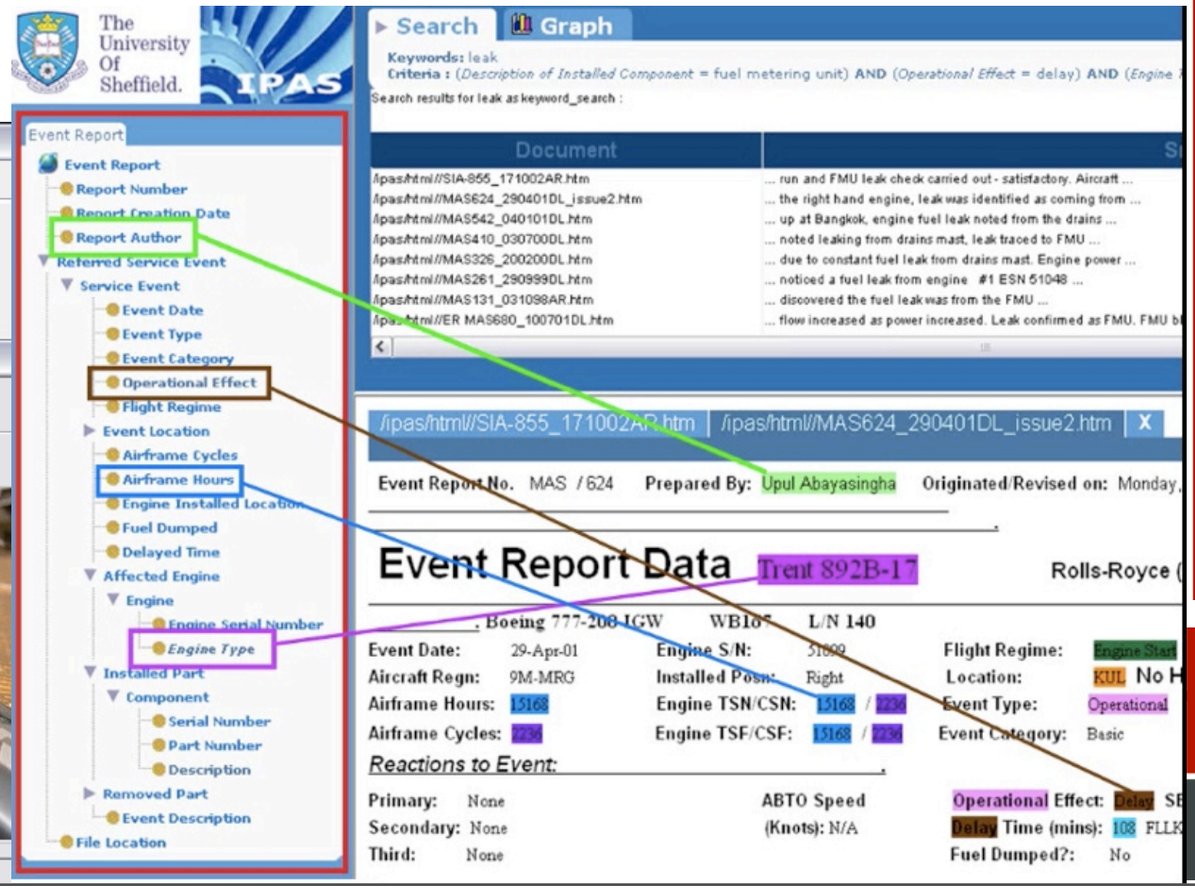
Steps in Reuse

- Knowledge gathering:
  - knowledge retrieval from the company repositories, supported by exploratory actions
  - The knowledge extracted:
    - document content and metadata describing provenance and uncertainty, is used in subsequent phases.

Semantic Search

Knowledge Browsing

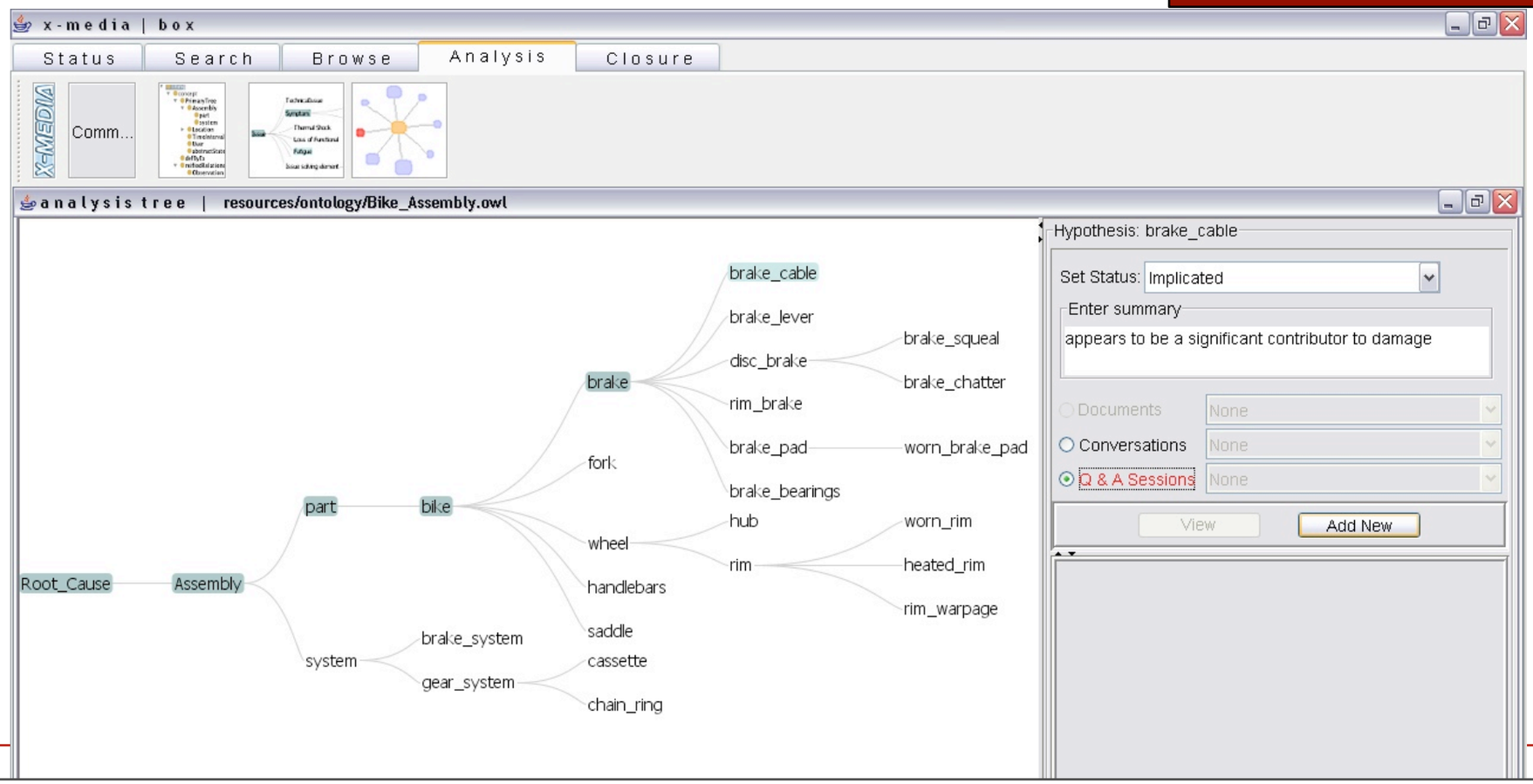




Steps (ctd)

- Knowledge analysis and manipulation:
  - support is required for interacting with knowledge, and for capturing the content and context of implicit information
    - e.g., comments, open requests and action lists
    - ontology-based annotations, in order to create new, explicit knowledge.

Knowledge Capture

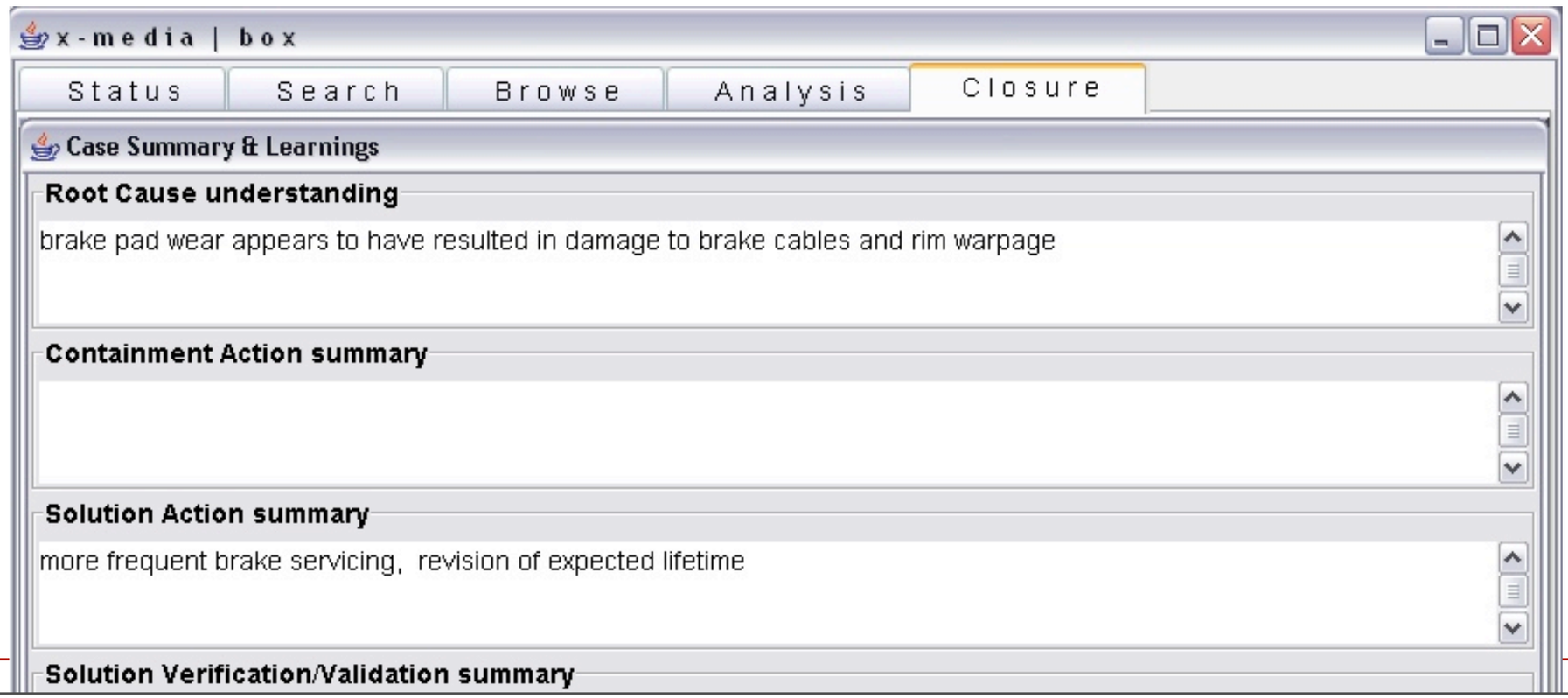


Steps (ctd)

Provenance

Knowledge Capture

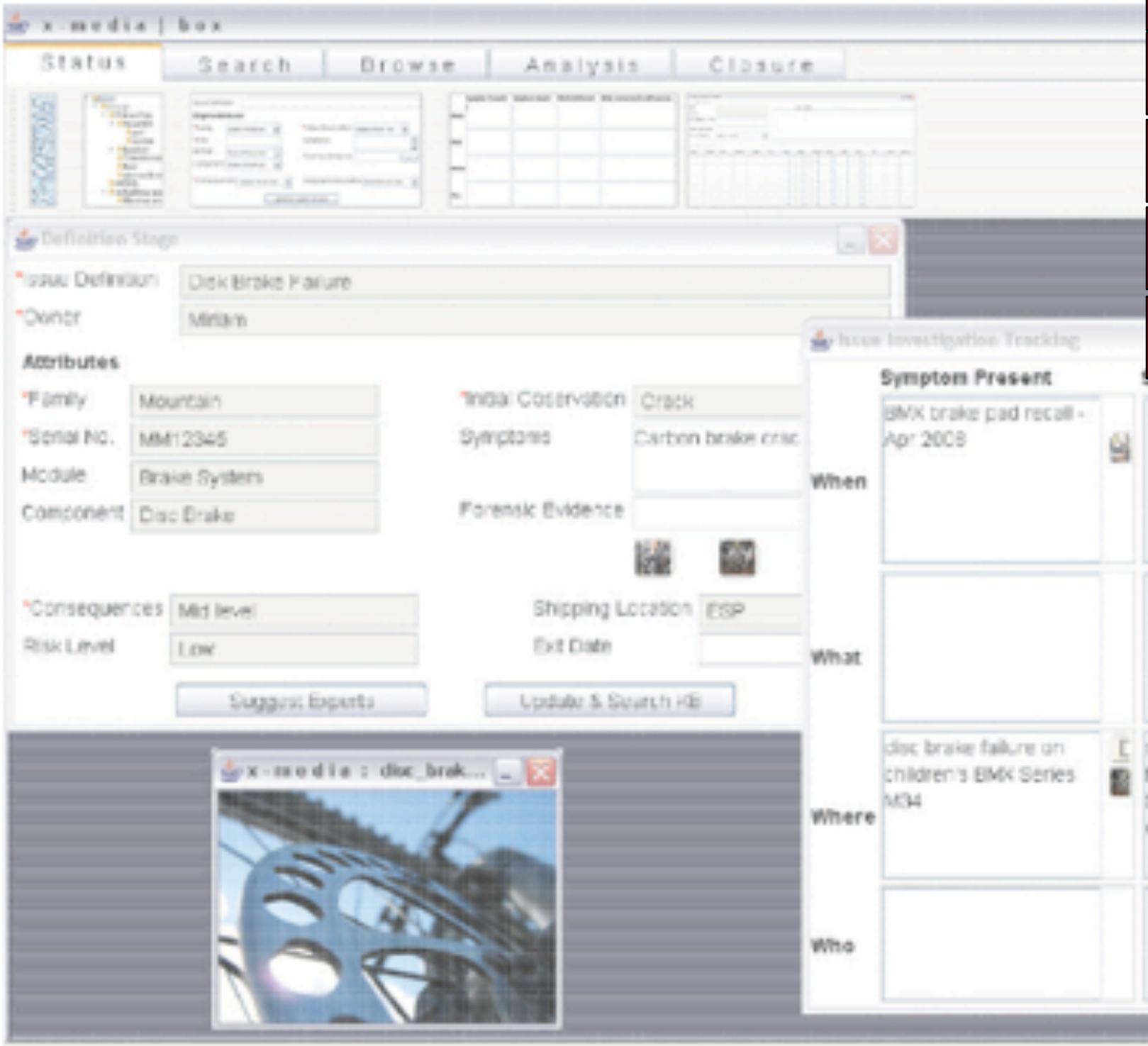
- Recording of the current status:
  - Sense-making may span an extended period.
  - Levels of abstraction that record its status from a high level using summaries, to the level of knowledge analysis
    - the visualisation of islands of knowledge and their ontological relations,
    - to the detail and context of the knowledge – information provenance and co-occurring facts.



Organisations, Information and Knowledge

Example: XMediaBox

- Set up
- Knowledge Retrieval
- Knowledge Browsing
- Analysis
- Closure



Conclusions

About Semantic KM

On KM and SW

- The Semantic WEB offers potentially key technologies to the development of future knowledge Management and the Web
  - More Web than Semantics, but:
    - A little semantics goes a long way (J. Hendler)
- The potential must be exploited addressing real world requirements
  - Rather than in principle AI-oriented requirements (e.g. closed world, small scale, etc.)
  - Scalability at no cost is mandatory (Google quality)
- Strong application pull can be obtained
  - Do not sell slogans, sell ideas and applications!
- Recent industrial funders of my activity:

Rolls-Royce Kodak Environment Agency LYCOS

- Our spin-out company

k-now.co.uk

Challenges for Knowledge Management

- Complexity of KM Task requires large coordinated effort
  - –Knowledge Acquisition is just one of them
    - Text Extraction is not enough
      - –Cross-media
      - –Integration
- New technologies are needed
  - Largely unsupervised technologies
  - Reasoning over imprecise input
  - Dynamicity of knowledge
- Innovation is across our special

User does not need to know it is SW technology

A final thought

- These technologies allow easy collection of and access to a *very* large amount of information/ knowledge
- Are we:
  - Preparing for a better Web/better world?
  - Preparing for a world with no privacy?
    - Big brother
    - Spam
    - Identity theft (e.g. Garlik)
  - Just adding hay to the haystack while searching for a needle?
    - Drowning in triples while trying to avoid drowning in texts?

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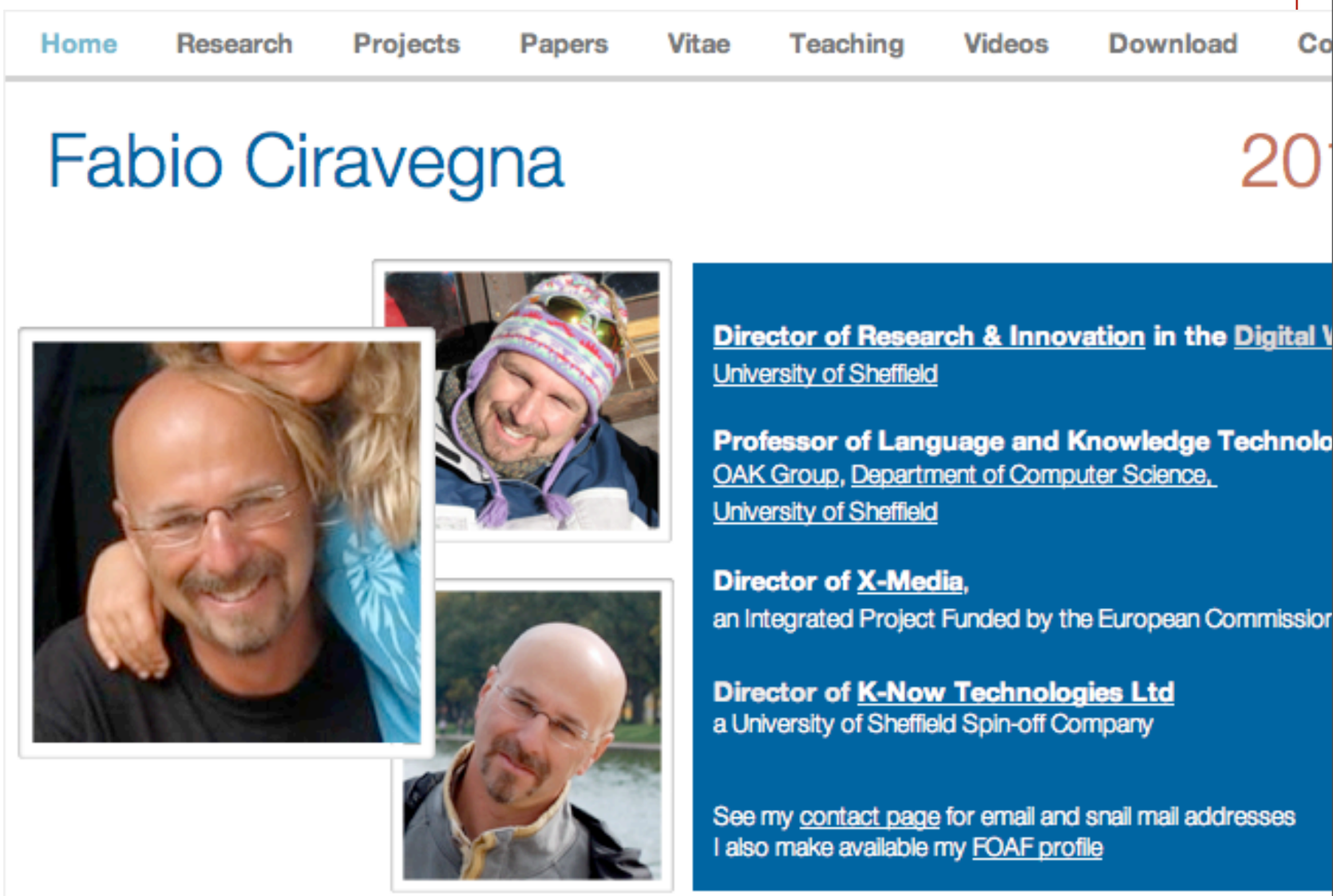
Thank You!



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