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**XBRL | EUROPE**



# EUROFILING XBRL WEEK IN FRANKFURT 6-7-8-9 JUNE 2017

19<sup>th</sup> XBRL Europe day | Eurofiling 23<sup>rd</sup> workshop | Tutorials | Academic Track

## SEMANTIC APPROACH TO FINANCIAL DATA INTEGRATION FOR ENABLING NEW INSIGHTS

EMMANUEL ASIMADI  
SEMANTIC WEB

Frankfurt,



# CONTENT

1. Introduction & XBRL Background
2. Our Approach
3. Our Model
4. Queries & Integration with external data
5. Challenges & Future Work.





# INTRODUCTION

Given the wealth of information stored in XBRL and the complexity of dealing with XBRL. This paper presents a **semantic approach** to process, **integrate** and **query** the financial information embedded in the XBRL to allow for **new insights** into the financial ecosystem.

# XBRL BACKGROUND

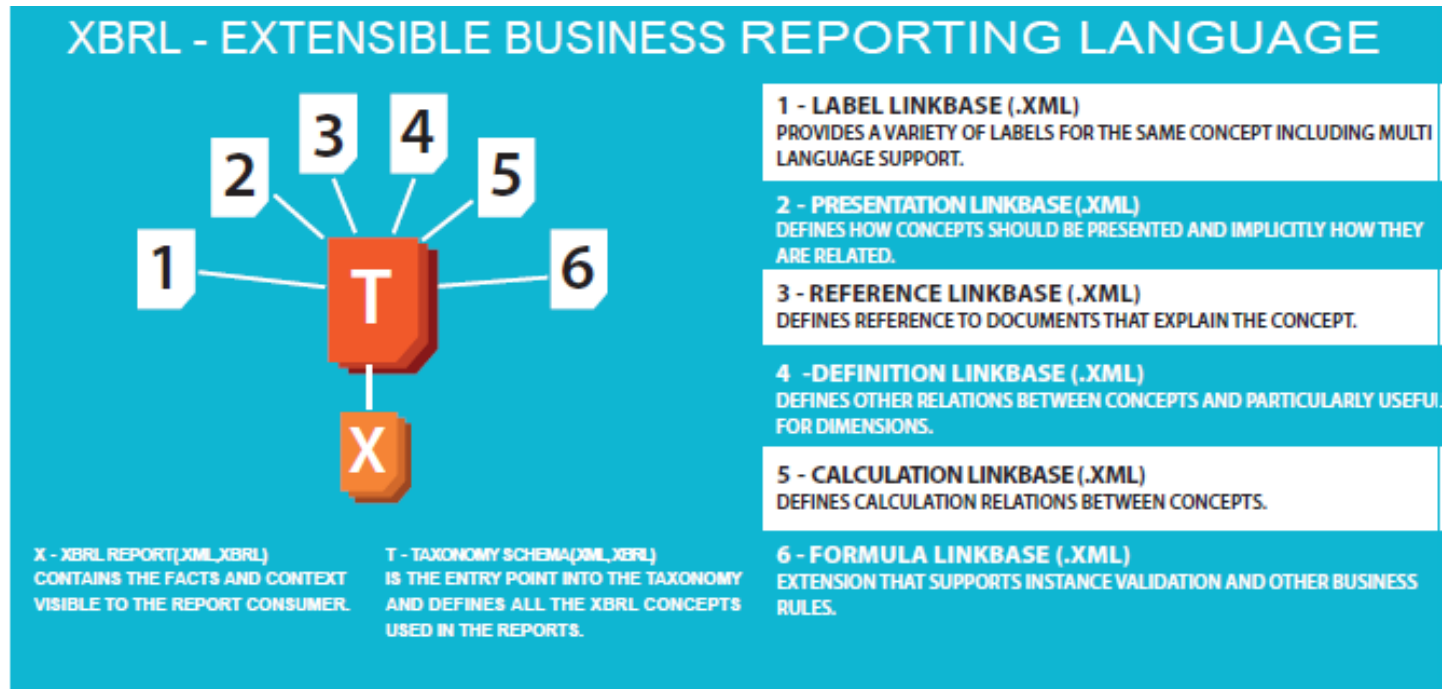
<b>Company XYZ</b>		
<b>Consolidated statement of comprehensive income for the year ended 31 December 2014</b>		
	2014 £000	2013 £000
Turnover	170,281	168,021
Cost of sales	126,006	127,026
<b>Gross profit</b>	<b>44,275</b>	<b>40,995</b>
Distribution costs	14,291	14,081
Administrative expenses	14,856	14,506
Other operating income	524	421
<b>Operating profit</b>	<b>15,652</b>	<b>12,829</b>

Fig. 1. Implicit Metadata in Financial Report [1, 2]

## Ideals of XBRL

- Provide same meaning humans will derive from report to machines.
- Digitizing financial data
- Standardised Self – describing documents.
- Flexible data format.
- Automated processing/validation to improve accuracy.

# INTRODUCTION – XBRL IMPLEMENTATION



- Similar Aspirations to Semantic Web without XML complexity
- What more can XBRL do aside facilitating regulatory reporting?
- How can we benefit from the improved annotation to support complex queries and integrate data.
- Detail Data Structure [XBRL Overview](#)

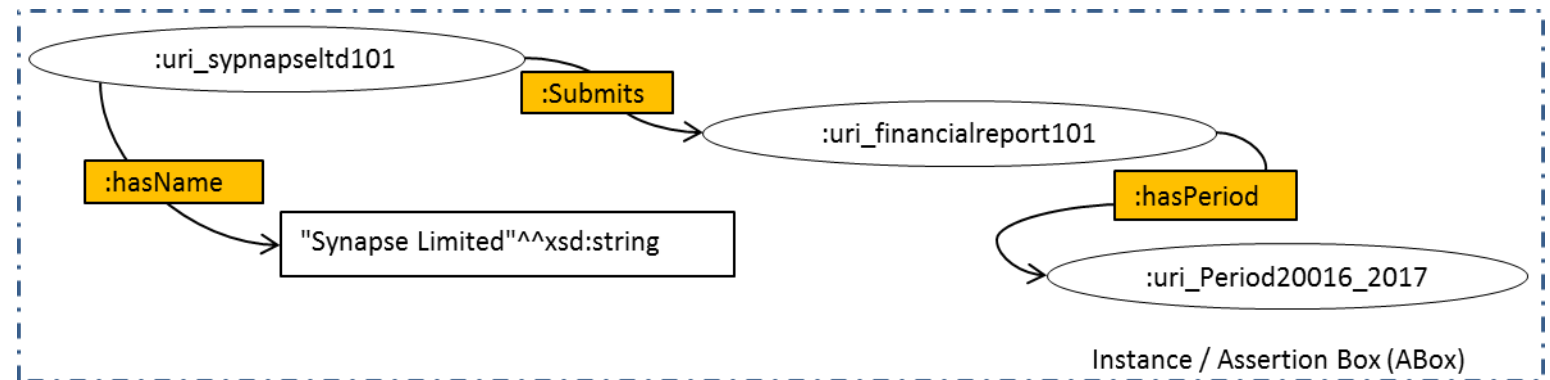
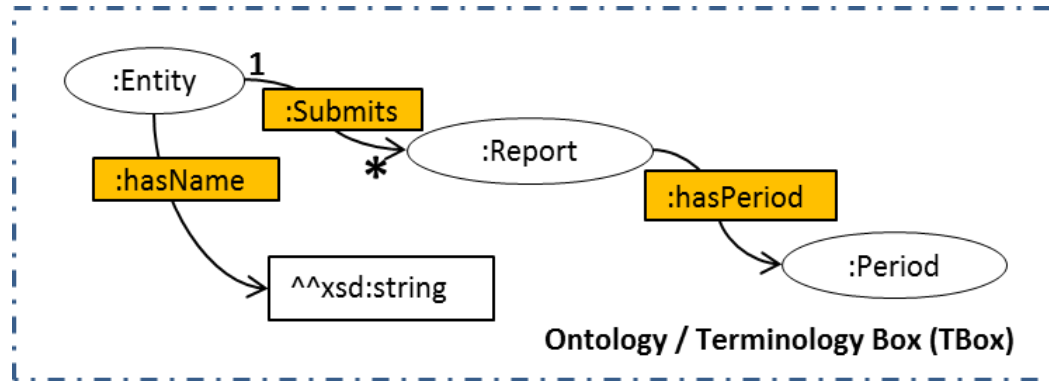
# INTRODUCTION - COMMENTS

XBRL is a complex data structure . Some approaches to query it

- 1) shred it back to relational tables and query with standard SQL or
- 2) query the xml struture with X-Query and recently
- 3) No-SQL approaches like [cellstore](#)....etc.

- A Semantic web approach seems intuitive and follows many of the aspiration of XBRL of creating self-describing documents that can be consumed for advanced analysis. Popular [work](#) by Roberto Garcia et al

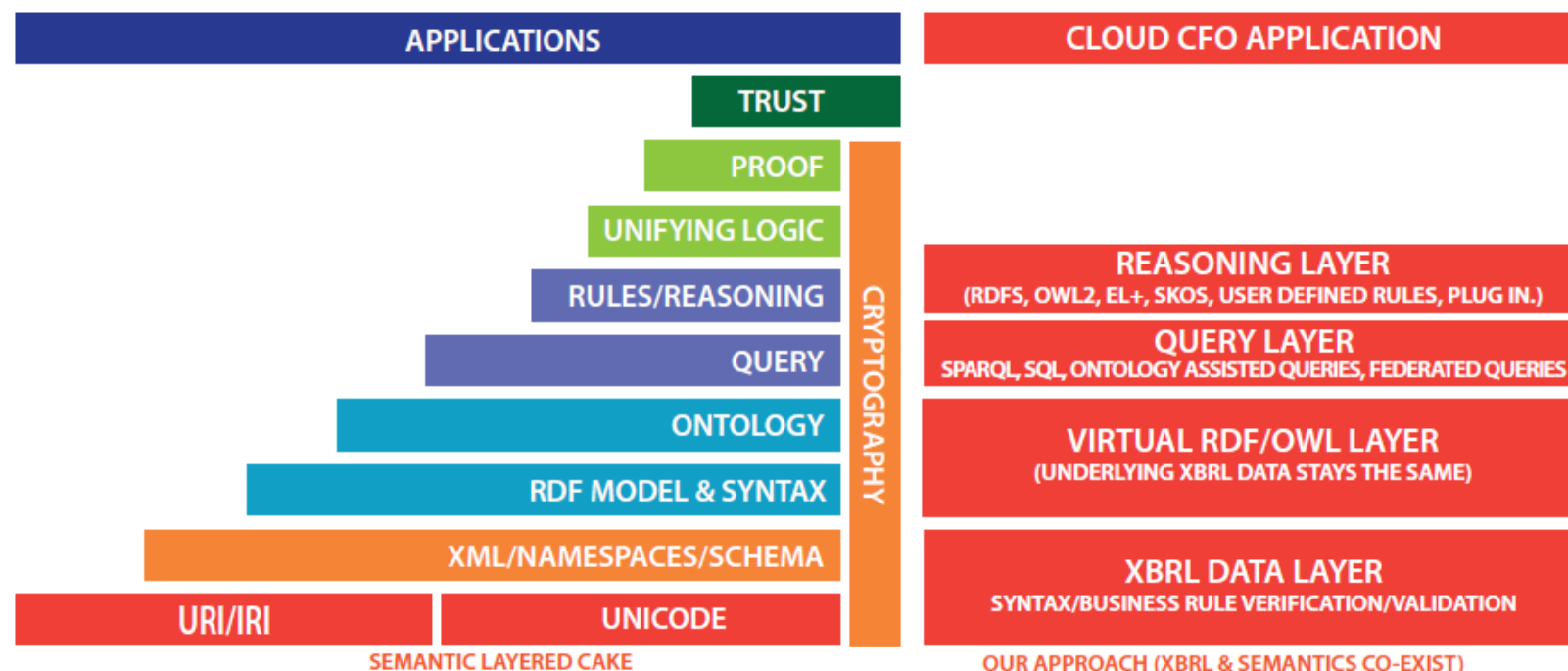
# SEMANTIC WEB ?



Semantic Web - Essentially a **knowledge graph** comprising **classes/concepts** and the **relationships** between them. It models the domain of interest.

# OUR APPROACH

XBRL & SEMANTIC WEB COULD CO-EXIST



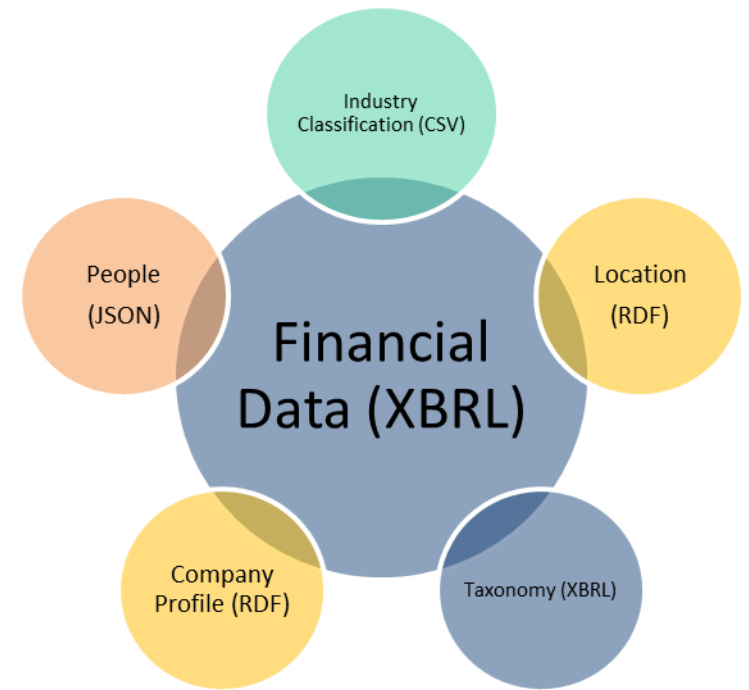
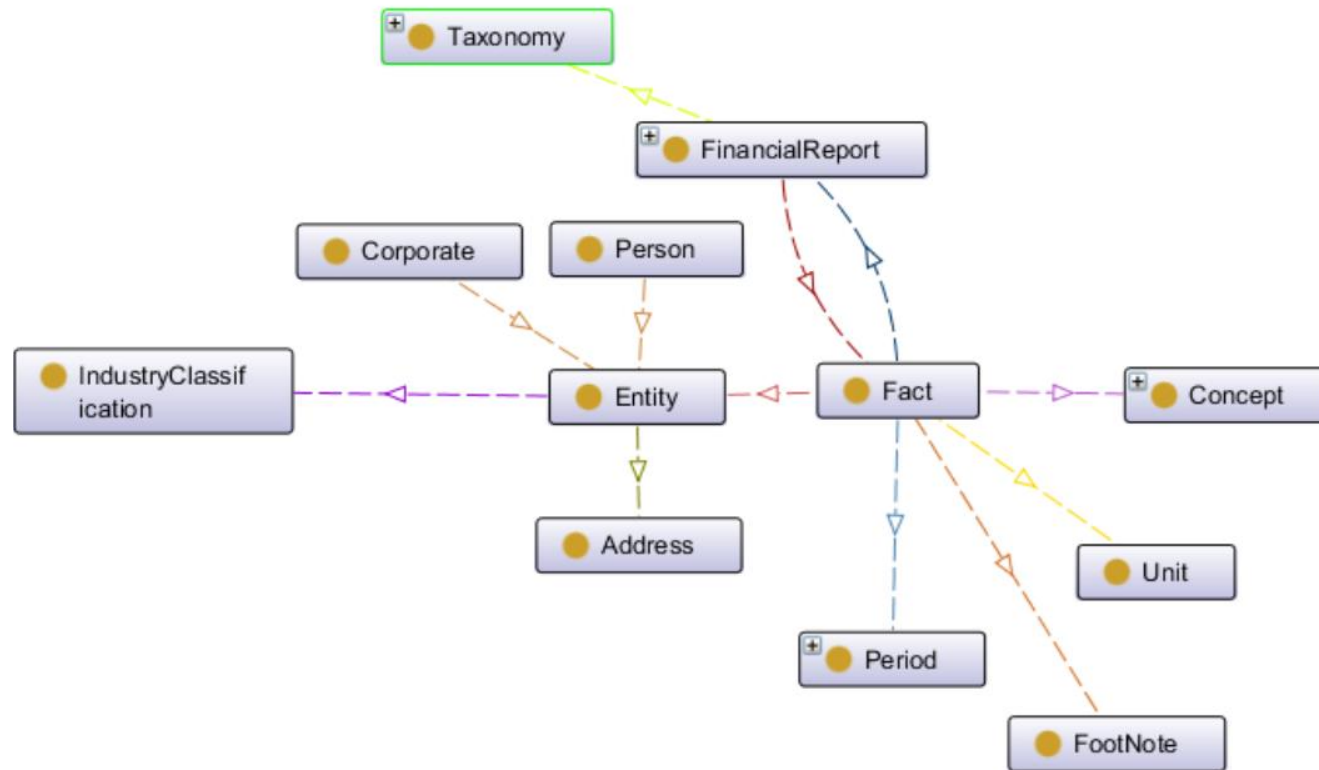
**Separation Of Concerns:** Keep XML-based XBRL to do what it does best syntactic verification. Allowing Semantic layer on top to focus on queries and more advanced use-cases. Unfortunately Syntactic validation is not enough to guarantee correctness of information contained in XBRL. There Are other subjective accounting nuances to deal with



# OUR APPROACH - COMMENTS

- Do not use XBRL to achieve semantic aspirations (XBRL is for annotation and validation ).
- Do not use Semantic Web for Syntax validation.
- Avoid transferring XML limitations into Semantic Model.
- Semantic Model is not for presenting a report.

# OUR MODEL

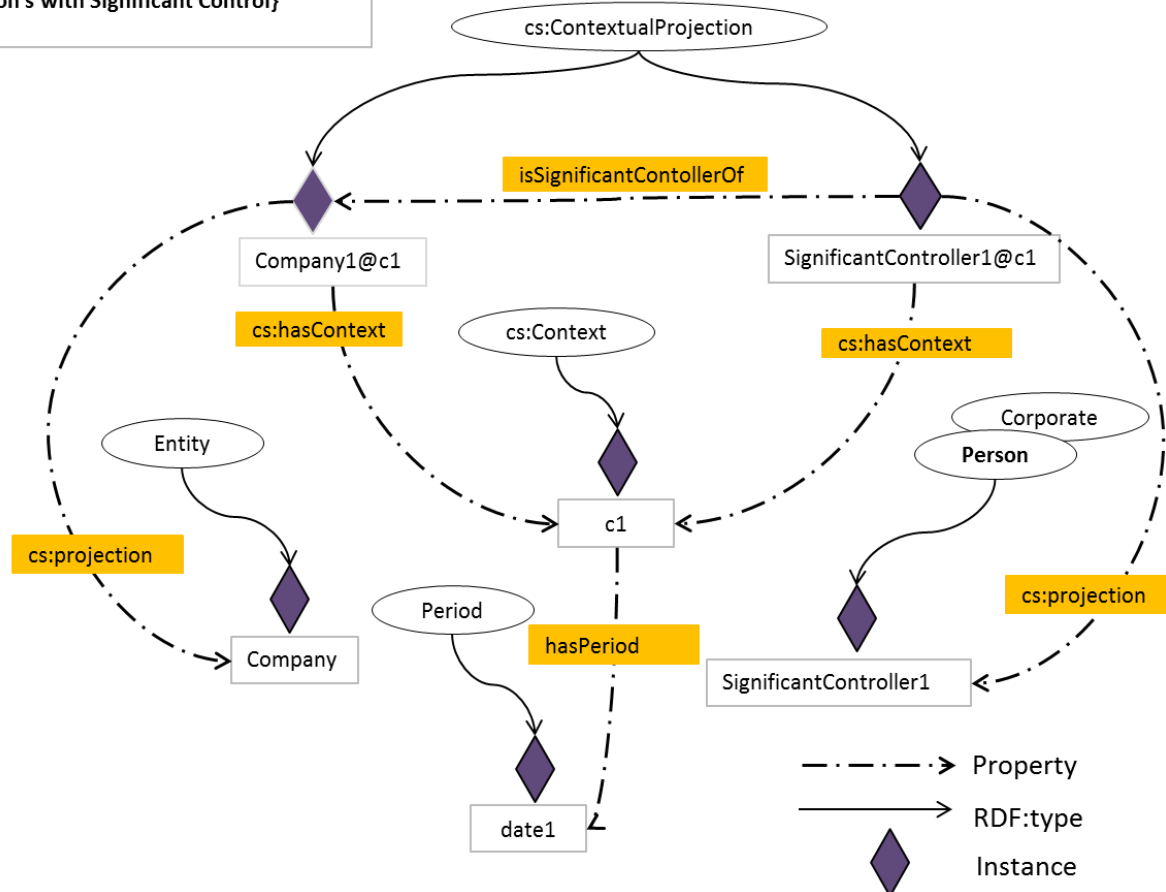


Integrated Data Sources

**A query-driven model:** A seemingly simple and intuitive model base on queries and data integration requirement. Typical modelling approach for no-sql systems e.g. Cassandra. Its work-in-progress until it supports most use-cases adequately.

# OUR MODEL – LIBERTY TO IMPLEMENT PROVEN DESIGN PATTERNS

Context Slices Design Pattern  
{Person's with Significant Control}



This example highlights the Flexibility to implement design patterns that answer specific questions or use-cases.

## Context Slices Ontology Design Pattern:

- Modelling 'A company has persons of significant contribution.'
- Its easy to duplicate entities when individuals control multiple companies. This pattern tries to avoid that.
- Answers the question E.g. What facts hold in context C1

# QUERIES

- ‘Basic’ queries of XBRL data – data points become easily accessible.
- Federated queries connecting external store (gov.uk).
- **Benchmarking:** Find companies in the same industry as mine, with similar facts(assets/profit...) and are in same location (district, region..) as mine.
- **Acquisition Targets:**  
“**Private companies** are more likely to become acquisition targets if they are **large, fast growing, and have high profitability, high leverage, and low liquidity**” - Forbes



# SAMPLE QUERY- SPARQL 101 QUERY

[HTTPS://DEVSEM.SYNAPSEINFORMATION.COM/JOSEKI/](https://devsem.synapseinformation.com/joseki/)

```
prefix ex: <http://ccfo-test.com/>
prefix cd: <http://business.data.gov.uk/id/company/>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
select ?financialreport ?fact ?value ?label ?period ?entity
where {
    ?financialreport ex:hasFacts ?fact.
    ?fact ex:hasValue ?value.
    ?fact rdfs:label ?label.
    ?fact ex:hasPeriod ?period.
    ?fact ex:hasEntity ?entity.
} limit 3
```

or type this 😊

- An Expressive Query Language – SPARQL – pattern matching.
- Expressive Queries are just the beginning
- Support Inference and Use of **CONSTRUCT** to reorganize model to meet specific needs...etc.

# SAMPLE QUERY- SPARQL 101 OUTPUT

```
{
  "head": {
    "vars": [ "financialreport" , "fact" , "value" , "label" , "period" , "entity" ]
  },
  "results": {
    "bindings": [
      {
        "financialreport": { "type": "uri" , "value": "http://ccfo-test.com/2E3EFBD9E2880EDDE0530100007F2701" } ,
        "fact": { "type": "uri" , "value": "http://ccfo-test.com/9E2880_AddressLine1_783" } ,
        "value": { "type": "literal" , "value": "24 Cornwall Road" } ,
        "label": { "type": "literal" , "value": "Addressline1" } ,
        "period": { "type": "uri" , "value": "http://ccfo-test.com/period_01-MAY-14_30-APR-15" } ,
        "entity": { "type": "uri" , "value": "http://business.data.gov.uk/id/company/07214946" }
      },
      {
        "financialreport": { "type": "uri" , "value": "http://ccfo-test.com/2E3EFBD9BD3E0EDDE0530100007F2701" } ,
        "fact": { "type": "uri" , "value": "http://ccfo-test.com/9BD3E0_CalledUpShareCapital_388" } ,
        "value": { "type": "literal" , "value": "465390" } ,
        "label": { "type": "literal" , "value": "CalledUpShareCapital" } ,
        "period": { "type": "uri" , "value": "http://ccfo-test.com/instant_30-APR-15" } ,
        "entity": { "type": "uri" , "value": "http://business.data.gov.uk/id/company/03178363" }
      },
      {
        "financialreport": { "type": "uri" , "value": "http://ccfo-test.com/2E3EFBD9C8510EDDE0530100007F2701" } ,
        "fact": { "type": "uri" , "value": "http://ccfo-test.com/9C8510_RelatedPartyTransactionExemptionBeingClaimed_530" } ,
        "value": { "type": "literal" , "value": "false" } ,
        "label": { "type": "literal" , "value": "RelatedPartyTransactionExemptionBeingClaimed" } ,
        "period": { "type": "uri" , "value": "http://ccfo-test.com/period_01-MAY-14_30-APR-15" } ,
        "entity": { "type": "uri" , "value": "http://business.data.gov.uk/id/company/04723469" }
      }
    ]
  }
}
```

# QUERY - INTEGRATION TO EXTERNAL DATA

```
PREFIX ORACLE_SEM_FS_NS:<http://oracle.com/semtech#SERVICE_JPDWN=T,timeout=15,dop=4,INF_ONLY,ORDERED,ALLOW_DUP=T>
prefix ex: <http://ccfo-test.com/>
prefix cd: <http://business.data.gov.uk/id/company/>
prefix terms: <http://business.data.gov.uk/companies/def/terms/>
prefix postcode: <http://data.ordnancesurvey.co.uk/ontology/postcode/>
prefix rov: <http://www.w3.org/ns/regorg#>
prefix gov: <http://business.data.gov.uk/id/company/>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>

select ?financialreport ?fact ?value ?label ?period ?entity ?sic ?postcode ?district

where {
    ?financialreport ex:hasFacts ?fact.
    ?fact ex:hasValue ?value.
    ?fact rdfs:label ?label.
    ?fact ex:hasPeriod ?period.
    ?fact ex:hasEntity ?entity.
    SERVICE <http://business.data.gov.uk/companies/query> {
        ?entity rov:orgActivity ?sic;
            terms:registeredAddress ?address.
        ?address postcode:postcode ?postcode.
        ?postcode postcode:district ?district.
    }
} limit 3
```



sparql federated query.txt

Federated Query: connecting our [internal store](#) to gov.uk public sparql endpoint. Providing Industry, District, Postcode  
<http://business.data.gov.uk/companies/query>

# QUERY - INTEGRATION TO EXTERNAL DATA

```
{
  "head": {
    "vars": [ "financialreport" , "fact" , "value" , "label" , "period" , "entity" , "sic" , "siclabel" , "postcode" , "district" , "districtlabel" ]
  },
  "results": {
    "bindings": [
      {
        "financialreport": { "type": "uri" , "value": "http://ccfo-test.com/2E3EFBD9E2880EDDE0530100007F2701" } ,
        "fact": { "type": "uri" , "value": "http://ccfo-test.com/9E2880_AddressLine1_783" } ,
        "value": { "type": "literal" , "value": "24 Cornwall Road" } ,
        "label": { "type": "literal" , "value": "AddressLine1" } ,
        "period": { "type": "uri" , "value": "http://ccfo-test.com/period_01-MAY-14_30-APR-15" } ,
        "entity": { "type": "uri" , "value": "http://business.data.gov.uk/id/company/07214946" } ,
        "sic": { "type": "uri" , "value": "http://business.data.gov.uk/companies/def/sic-2007/74909" } ,
        "siclabel": { "type": "literal" , "xml:lang": "en" , "value": "Other professional, scientific and technical activities (not including environmental consultancy or quantity surveying) n.e.c." } ,
        "postcode": { "type": "uri" , "value": "http://data.ordnancesurvey.co.uk/id/postcodeunit/DT11RX" } ,
        "district": { "type": "uri" , "value": "http://data.ordnancesurvey.co.uk/id/7000000000014539" } ,
        "districtlabel": { "type": "literal" , "value": "West Dorset" }
      },
      {
        "financialreport": { "type": "uri" , "value": "http://ccfo-test.com/2E3EFBD9BD3E0EDDE0530100007F2701" } ,
        "fact": { "type": "uri" , "value": "http://ccfo-test.com/9BD3E0_CalledUpShareCapital_388" } ,
        "value": { "type": "literal" , "value": "465390" } ,
        "label": { "type": "literal" , "value": "CalledUpShareCapital" } ,
        "period": { "type": "uri" , "value": "http://ccfo-test.com/instant_30-APR-15" } ,
        "entity": { "type": "uri" , "value": "http://business.data.gov.uk/id/company/03178363" } ,
        "sic": { "type": "uri" , "value": "http://business.data.gov.uk/companies/def/sic-2007/70229" } ,
        "siclabel": { "type": "literal" , "xml:lang": "en" , "value": "Management consultancy activities (other than financial management)" } ,
        "postcode": { "type": "uri" , "value": "http://data.ordnancesurvey.co.uk/id/postcodeunit/M34EB" } ,
        "district": { "type": "uri" , "value": "http://data.ordnancesurvey.co.uk/id/7000000000018821" } ,
        "districtlabel": { "type": "literal" , "value": "Manchester" }
      }
    ]
  }
}
```

**Output:** Internal data joined with External Data hosted by gov.uk. Providing Industry, District, Postcode data



```
...
'prefix terms: <http://business.data.gov.uk/companies/def/terms/>
prefix postcode: <http://data.ordnancesurvey.co.uk/ontology/postcode/>
prefix rov: <http://www.w3.org/ns/regorg#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix gov: <http://business.data.gov.uk/id/company/>
prefix ex: <http://ccfo-test.com/>
prefix skos: <http://www.w3.org/2004/02/skos/core#>
prefix cat: <http://business.data.gov.uk/companies/def/company-category/>
```

```
Select ?company ?legalname ?financialreport ?sic ?orgtype ?district
where {
    ?company a    ex:LowLiquidityCompany,ex:FastGrowingCompany,
                ex:HighProfitableCompany,ex:HighLeverageCompany;
                ex:submits ?financialreport.
```

```
SERVICE <http://business.data.gov.uk/companies/query> {

    ?company rov:orgActivity ?sic;
              rov:orgType   cat:private-limited-company;
              rov:orgType   ?orgtype;
              rov:legalName ?legalname;
              terms:registeredAddress ?address.
    ?sic skos:prefLabel "Other information technology..."@en.

    ?address postcode:postcode ?postcode.
    ?postcode postcode:district ?d.
    ?d skos:prefLabel "Birmingham"@en.
}
```

### • Acquisition Targets:

“Private companies are more likely to become acquisition targets if they are **large, fast growing** and have **high profitability, high leverage, and low liquidity**” - forbes

# CHALLENGES & FUTURE WORK

- User-friendly click-through query interface.
- General Availability of basic Model + Data as linked data service.
- Private models for client's internal use... **Collaboration with businesses that need such solution.** ('internalising XBRL')

## Challenges

- Dealing with subjective accounting principles that can make reports uncomparable.
- Dealing with incomplete/inconsistent tagging.

# USER INTERFACE

SEQUOIA Prototype V2.xlsm - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer

SQL QUERY

Table QUERY: SEQUOIA QUERY

A7 = A Catered Affair Limited

COMPANY_NAME	REG_NO	POST_CODE	FOUNDING PLACE
1ST CLEAR FLOW LIMITED	3959	SS7 5LA	London
28 HR Limited	4635	SS9 2UJ	London
9 Grace Road Limited	4385	SS7 5LA	London
A B MANAGEMENT 2000 LIMITED	3818	SS9 2UJ	London
A Buchanan Contractors Limited	2910		
A Catered Affair Limited	3772		
A D PROPERTIES LTD	576		
A E CHEER LIMITED	679		
A G EDGEcombe PROPERTIES LIMITED	514		
A J SMITH & SON(BENFLEET)LIMITED	482		
A M CLARK LIMITED	234		
A M KANE LIMITED	4439		
A W FOLKES HAULAGE LIMITED	4629		
A. LETTON PERCIVAL & CO LIMITED	2187		
A.A.C. (SOUTHERN) LTD	4127		
A.S.G. FABRICATIONS LIMITED	4465		
ABBEY LIFT TRUCKS HANDLING LIMITED	4447		
ABC DRUG STORES LIMITED	2825		
ACD46 LIMITED	3457		
ACROATICS LIMITED	4397		
ADELANTE SOFTWARE LTD	4450		
ADVANCED TELECOM SERVICES (UK) LIM	4325		
ALAN AULD ASSOCIATES LIMITED	2422900	UNE 17	Essex
ALAN REED LIMITED	3878953	65 Woodbridge Road	Essex

Query (and Sync) complete! 75 seconds consumed.

Ready

SEQUOIA COMPANY INDUSTRY DIRECTOR

1.0

SEARCH

GO

Data Tree View

- COMPANY
  - COMPANY
  - REG\_NO
  - ADDRESS
  - REGION
  - POST\_CODE
  - FOUNDING PLACE
- INDUSTRY
  - SIC\_CODE
  - SIC\_DESCRIPTION
- DIRECTOR
  - DIRECTOR\_NAME
  - COMPANY\_NAME
  - AGE
  - COUNTRY OF RESIDENCE
- ASSET
  - COMPANY\_NAME
  - REG\_NO
  - FACT\_VALUE

Walk Through Data

- View COMPANY [639 COMPANY(s)]
- Add Filter
- is located in
  - View Location [7]
  - Add Filter
- founded in
  - is a Continent
    - View Country [248 Country(s)]
    - Add Filter
  - is a Country
    - is a City
      - with Industry
        - is founding place of Company
        - is current Address of Company
        - is place of registration of Company
        - is birth place of Director (Staff)
- belongs to Industry
- has Staff
- has Agent
- is listed on Stock Exchange
  - View Industry [1624 Industry(s)]
  - Add Filter
- is forecasted to Grow
- has Financial Information
- is Bankrupt
- has Companies
  - belongs to country

# THANK YOU

Stephan Reiff-Marganeic (srm13@le.ac.uk)

Brian Donnelly (briandonnelly@synapseinformation.com)



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