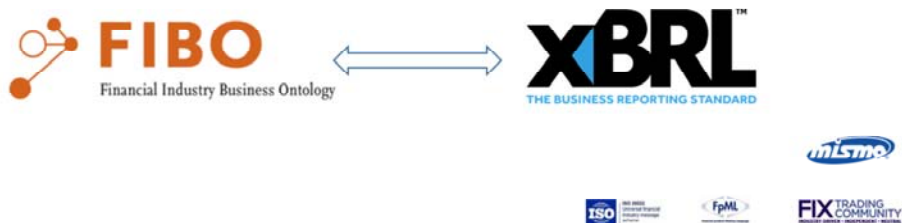# FIBO relationship to other Financial Industry Standards

The XBRL Bank Call Report (FFIEC 031) in FIBO

Jurgen Ziemer

Ontologist at Jayzed Data Models Inc.

Welcome!

FIBO is key to better Data Management.
And so are Industry Standards like ISO20020 FpML, FIX, Mismo.

Getting started with FIBO and integrating industry standards can be a challenge.

This presentation shows how to integrate the XBRL industry standard.

Leveraging FIBO includes "Proof & Trust" and "Managing Complexity" use cases.
For the business side, Finance Officers & Regulators Proof and Trust in the data is critical.
Proof & trust are the upper layers of the semantic web.
- How the data was derived
- On which data
- By whom

For program managers and architects the goals is to better manage complexity.

The slides have a heading of
Key points (finance)
Explanation
Details
Roughly corresponding to the roles.

Complexity overwhelms Conventional Data Management.

Hundreds of people mapping between numerous heterogeneous systems, languages, components…

Consolidated Life New York offices, 1960. (Jack Lemon in Billy Wilder's "The Apartment", MGM)

Finance key point

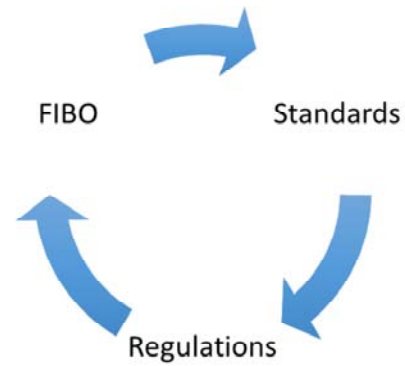http://finregont.com http://bankontology.com © Jayzed Data Models Inc. 2017

Has anybody seen this picture?

A typical 1960 open-plan office.

I saw this 15 years ago on my first Basel 2 assignment. Saw this literally again with CCAR. EDMC helps to manage complexity DCAM and FIBO can reduce the complexity.

The bright future!

Industry standards and compliance are excellent drivers for FIBO implementation.
Because they have good definitions and clean data.

Semantic compliance with FIBO reduces data management complexity.
Because data, mapping, lineage – everything is a triple.

Onboarding industry standards, compliance forms and reports into FIBO is an easy 2-step process.

Source → 1 Extract → Ontology Staging → 2 Transform Load → FIBO
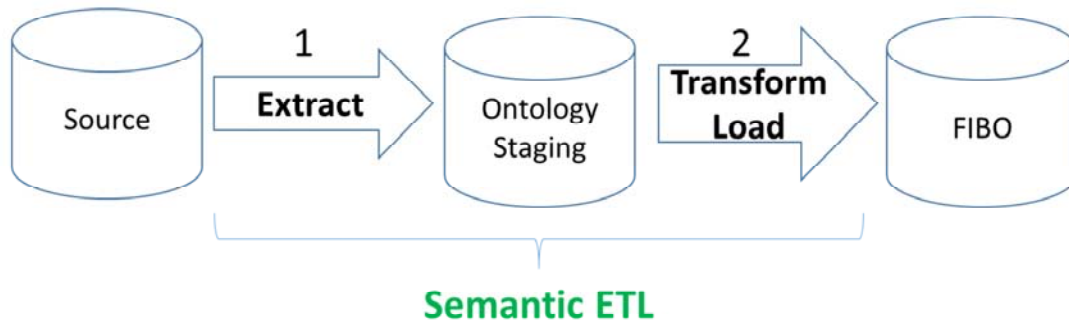
Semantic ETL

The XBRL and Call Report ontology are Open Source. (same MIT-license as FIBO)

Finance key point   http://finregont.com http://bankontology.com © Jayzed Data Models Inc. 2017

We have done Extract, Transform and Load in conventional IT.
The semantic data migration model is no different.
**The critical point** is that the Staging Area is in Ontology Web Language.
Thus uniform Semantic rules address the critical business **transformation** rules.
Step 1: Extract the XBRL into Ontology Staging
Step2: Transform Staging and load into FIBO
Not just for XBRL. **This applies to all data sources**: database, messages, files

Extract the industry standard XBRL regulatory report FFIEC 031 into Ontology Staging.
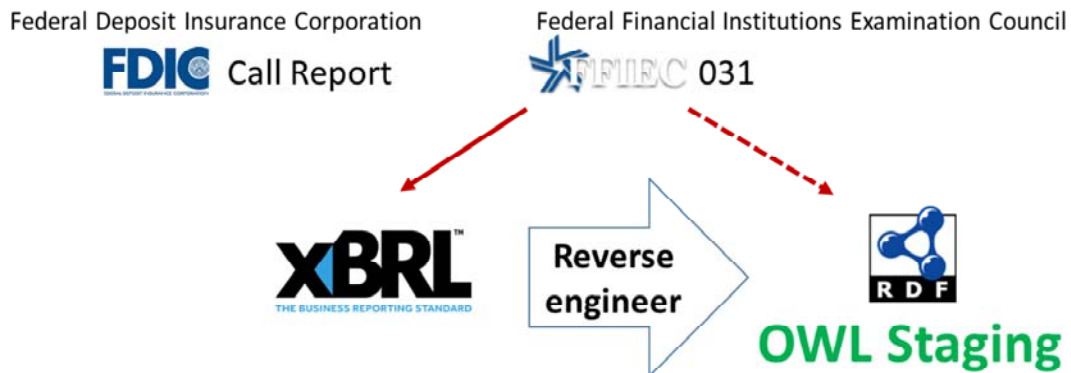
US banks must file quarterly Consolidated Report of Condition and Income. A.k.a. Call or RC report.
- The Federal Deposit Insurance Corporation is author and auditor.
- The Federal Financial Institution Examination Council is an interagency body serving FDIC, Federal Reserve and other agencies. FFIEC prescribes standards and forms, processes filings and disseminates reports to the public.

The Call report format is XBRL.

We reverse engineer the XBRL schema into Ontology classes.

XBRL is the global standard to exchange business reports.

eXtensible Business Reporting Language

XML/XSD

XBRL Ontology is a complete 1-to-1 representation of the XBRL schema

RDF/OWL

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The Open Source XBRL Ontology is a complete 1-to-1 representation of the XBRL schema.
Every element in the XBRL schema is represented in the ontology.
All XBRL files have a corresponding ontology.

XBRL separates reporting items from presentation, calculation and edit checks.

Xlink is a W3C extension to XML that provides methods for creating links between documents

linkbase utilizes Xlink with a framework to define roles and relations of instance items for presentation, calculation, and edit checks.

instance defines the basic reporting items with their meta-data, context units, datatypes and format.

Benefit: We only have to load instance data into the ontology, independent of the report structure.

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We on boarded other proprietary XML: United States Code, Code of Federal Regulations, Investment Adviser Act forms ADV and PF (Private Fund). That meant understanding and navigating the report structure.

With XBRL based sources, we won't be impacted with structural changes.
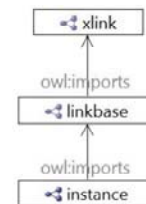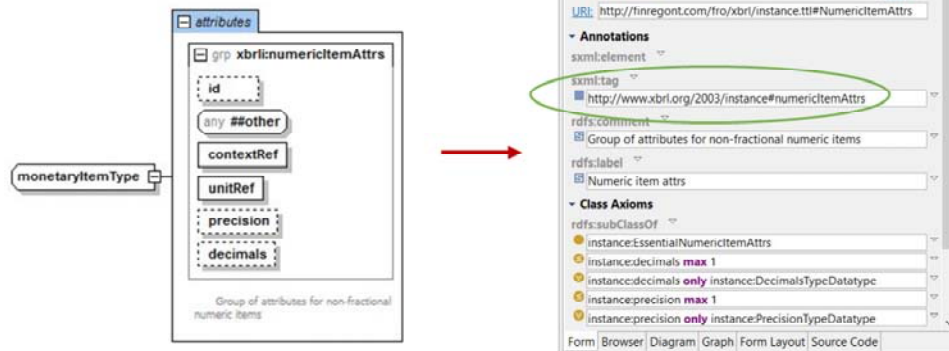
The XBRL ontology has all extensions, some 40 files for Solvency. But for the Call Report we only need the 3 base modules.

We use TopQuadrant's Topbraid Composer as the ontology development environment. But the approach, methodology and architecture is independent of the tooling.

The diagram shows the XSD schema for Monetary Items with its attributes for Precision and number of Decimals.

The reverse engineered OWL class has restrictions that reflect the XSD cardinality. (optional).

The sxml:tag point to the original XSD definition.

The XBRL instance import processing a Monetary Item will find the tag, locate the OQL class and create a resource.

Likewise, the export will write an XML record with S value.

XBRL is not specific to Financial Services.

The taxonomy differentiates Bank Call Report from Insurance Solvency.

Thus, we map taxonomies to FIBO – not the XBRL framework.

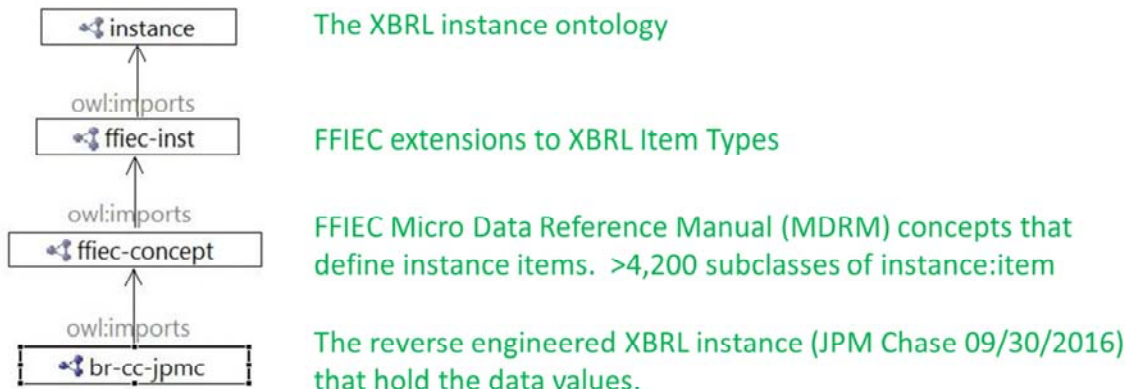FFIEC provides schema and Bank call reports

The taxonomy download is a ZIP with all required files.
The individual institution report is available in PDF, SDF (open with Excel), and XBRL.

The Bank ontology has an OWL version of the FFIEC taxonomy

instance — The XBRL instance ontology

owl:imports

ffiec-inst — FFIEC extensions to XBRL Item Types

owl:imports

ffiec-concept — FFIEC Micro Data Reference Manual (MDRM) concepts that define instance items. >4,200 subclasses of instance:item

owl:imports

br-cc-jpmc — The reverse engineered XBRL instance (JPM Chase 09/30/2016) that hold the data values.

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The instance file is just a header and some 2000 lines of lines like this.
This also makes it very easy to generate XBRL filing out of FIBO. Just put the values in lines following the syntax.

A query on the populated ontology matches the FFIEC individual institution download.

Institution Name JPMORGAN CHASE
BANK, NATIONAL ASSOCIATION
City COLUMBUS
State OH
Zip Code 43240
Call Report Date 9/30/2016

FFIEC download.

Short_Definition	Value
Reporting date	20160930
FDIC certificate number	628
Legal title of bank	JPMorgan Chase Bank, National Association
City	Columbus
State abbreviation	OH
Zip code	43240

Ontology query results

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The left is a copy of the PDF page.
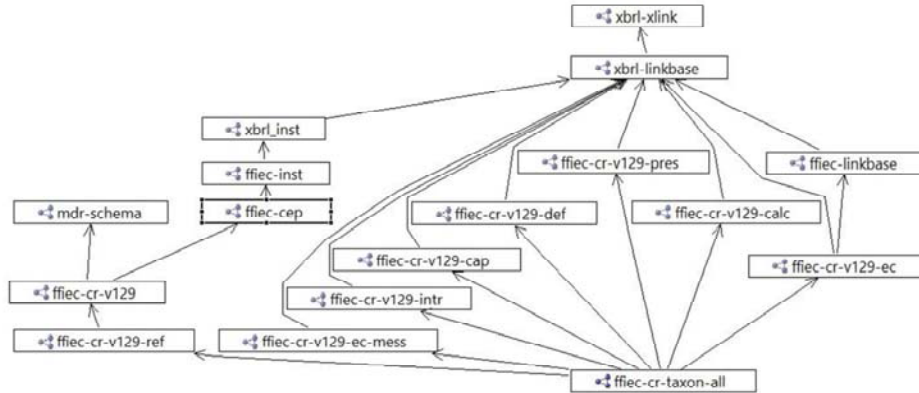
The taxonomy files are needed to query and report out of OWL staging.
We only require ffiec-cep (concepts) for data import.

We validate the import reproducing the FFIEC report in SPARQL, the ontology query language

```
SELECT  ?Call_Date ?Bank_RSSD_Identifier ?MDRM ?Value ?S
hort_Definition ?Call_Schedule ?Line_Number
WHERE {
    ?end_date_inst a instance:ContextPeriodType .
    ?end_date_inst instance:instant ?instant .
    BIND (xsd:string(?instant) as ?Call_Date) .
    ?ident a instance:ContextEntityType-identifier .
    ?ident composite:child ?ident_node .
    ?ident_node sxml:text ?Bank_RSSD_Identifier .
…
    BIND ( fn:substring (?lb_label_loc, 4) AS ?MDRM) .
    ?lb_loc ffiec-w3-xlink:label-loc ?lb_label_loc .
    ?ffiec_concept rdfs:label ?MDRM .
    ?ffiec_concept rdfs:subClassOf* instance:ItemAttrs .
    ?concept_inst a ?ffiec_concept .
    ?concept_inst composite:child ?text_node .
    ?text_node sxml:text ?Value .
}
ORDER BY ?Call_Schedule ?Line_Number
```

Similar to SQL, the SELECT specifies the result set columns

The WHERE clause joins the triplets.

ORDER BY provides the sorting.

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The biggest challenge for SQL folks is that the SELECT doesn't separate with comma.

The FFIEC excel (SDF on top) and SPARQL result set.

The complete query and also a SELECT * is on the website.

Transform XBRL staging data and load into FIBO classes.
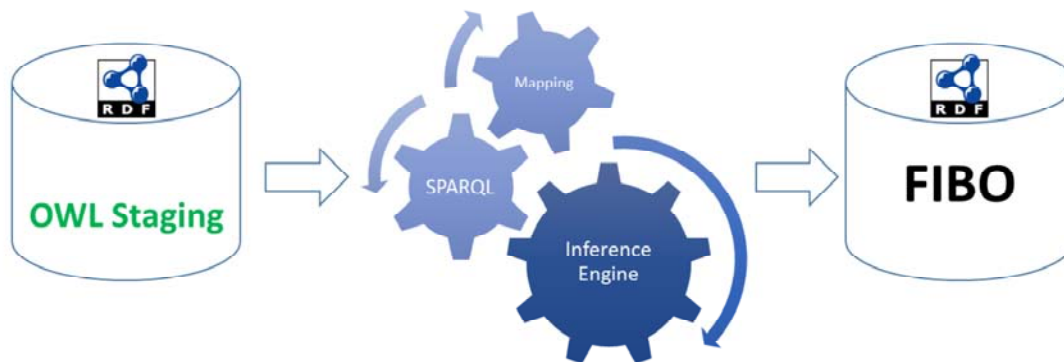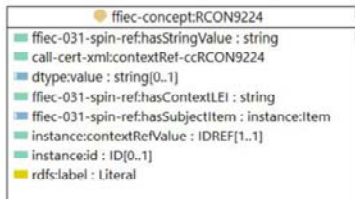
Step 2 defines the complex business logic. It is an OWL to OWL ontology transformation. The inference engine (reasoner) examines the mapping and executes SPARQL constructs to move the data.
All within the ontology – all semantic web technology.

We graphically map FFIEC XBRL MDRM into FIBO classes.

OWL Staging

ffiec-concept:RCON9224
- ffiec-031-spin-ref:hasStringValue : string
- call-cert-xml:contextRef-ccRCON9224
- dtype:value : string[0..1]
- ffiec-031-spin-ref:hasContextLEI : string
- ffiec-031-spin-ref:hasSubjectItem : instance:Item
- instance:contextRefValue : IDREF[1..1]
- instance:id : ID[0..1]
- rdfs:label : Literal

build URI

FIBO

fibo-be-le-lei:LegalEntityIdentifier
- fibo-fnd-aap-agt:identifies : [1..1] (exactly 1 fibo-be-le-lp:LegalEntity)
- fibo-fnd-rel-rel:appliesTo
- fibo-fnd-rel-rel:characterizes
- fibo-fnd-rel-rel:classifies
- fibo-fnd-rel-rel:defines
- fibo-fnd-rel-rel:denotes
- fibo-fnd-rel-rel:hasUniqueIdentifier : text[0..1]
- fibo-fnd-rel-rel:isMemberOf : (exactly 1 fibo-fnd-arr-id:IdentificationScheme)
- fibo-fnd-rel-rel:refersTo
- fibo-fnd-rel-rel:represents
- fibo-fnd-utl-alx:hasArgument : fibo-fnd-rel-rel:Reference
- fibo-fnd-utl-alx:hasExpression : fibo-fnd-utl-alx:Expression
- fibo-fnd-utl-alx:hasOperand : fibo-fnd-rel-rel:Referent
- rdfs:label : Literal

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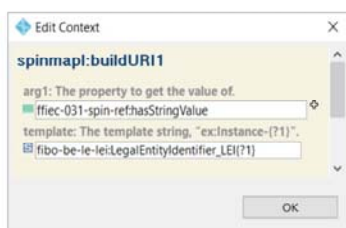RCON9224 is the MDRM element for the Legal Entity Identifier.
We map the element to FIBO LegalEntityIdentifier class.
We also map the value to the FIBO data property.
The inference engine will
1. Construct an instance of LegalEntityIdentifier
2. Construct a data property, UniqueIdentifier

The Legal Entity ID provides the URI local name

The argument is the value of the Legal Entity Identifier in reporting item RSSD9017.

The template builds the URI as
FIBO-prefix : FIBO-class _ "LEI" argument

http://www.omg.org/spec/EDMC-FIBO/BE/LegalEntities/LEIEntities/LegalEntityIdentifier_LEI_7H6GLXDRUGQFU57RNE97
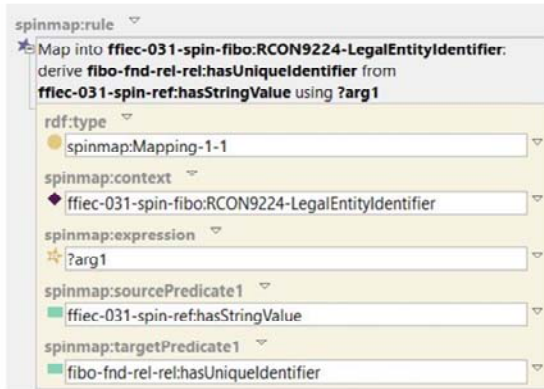
We anchor our target URIs around the LEI. FIBO Corporation, Depository Institution, Address and MonetaryAmount URSs are also based in LEI.

The data property mapping assigns the MDRM value to the FIBO unique identifier.

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SPARQL rules specify complex data transformations.

The hasSourceInstance object property provides data lineage. For every FIBO instance, we have a link to its original instance in the Call Report.
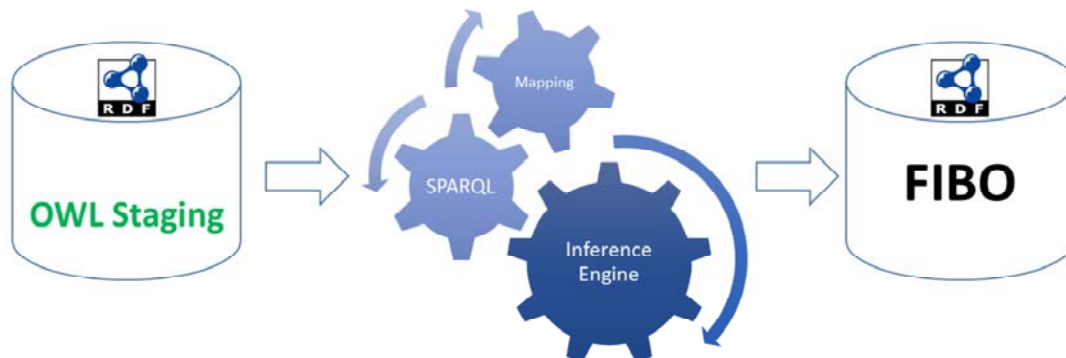
```
spin:rule  ▽
★    # Set the FIBO instance source to THIS
     CONSTRUCT {
         ?targetLEI fro-ref:hasSourceInstance ?this .
     }
     WHERE {
         BIND (spinmap:targetResource(?this, ffiec-031-spin-fibo:RCON9224-LegalEntityIdentifier) AS ?targetLEI) .
     }
```

The BIND function uses the mapping context to determine the FIBO target instance

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We run the inference engine out of Topbraid. It take quite a while because in development we include the full FIBO ontology.

The Legal Entity Identifier class has a new instance

The source instance points to the original FFIEC instance.

A SPARQL rule has populated the link to the FIBO Corporation instance.

The unique identifier shows the correct LEI.

FIBO has a detailed taxonomy of Organization (48 subclasses) and Financial Service Provider (46 subclasses). Unfortunately, they are all primitive classes.
We must assert that our FFIEC import is a Stock Corporation and Depository Institution.

It would be better to have more Defined Classes. The inference engine rather than the mapping architect should determine the type of bank.

The resource graph shows populated FIBO instances and their relationships.
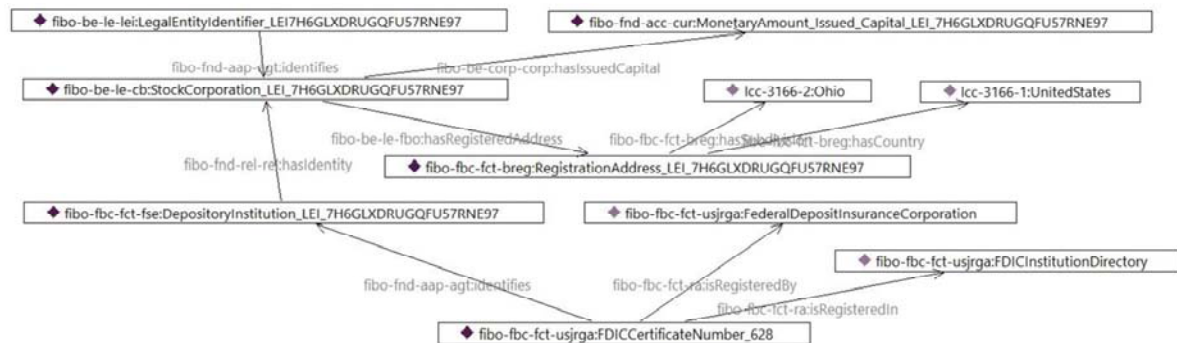
- FIBO differentiate between the Agent (Stock Corporation) and the Role (Depository Institution) it plays. The two are connected via the hasIdentity object property.
- The LegalEntityIdentifier identifies the Corporation
- The Corporation has a registered Address.
- Address links to state and country, already in FIBO
- FIBO stores Capital (and others) as Monetary Amount. The number plus semantics, like currency and date.
- The Depository Institution (not the corporation!) has an FDIC Certificate number. We use this number to create the URI.
- The certificate ties up to FDIC and FDIC directory, already in FIBO.

Nice design. But FIBO need more support for Accounts and Balances!

The data query traverses the joins and shows data properties

```
SELECT ?institution ?lei ?country_name
?state_name  ?issued_capital ?fdic_certificate
?regulator ?registration_directory
WHERE {
   ?corporation fibo-fnd-aap-agt:hasName
          ?institution .
   ?corporation
          fibo-be-le-fbo:hasRegisteredAddress
          ?registered_address .
....
   ?institution_directory rdfs:label
   ?registration_directory .
}
```

institution_name	JPMorgan Chase Bank, National Association
lei	7H6GLXDRUGQFU57RNE97
country_name	United States
state_name	Ohio
issued_capital	$176,083,000,000
fdic_certificate	628
regulator	FDIC
registration_directory	FDIC Institution Directory

The full query is on the website.

The mapping query lists source to target class.

Mapping is in triples.

This is the great value ontology provides for data management. Besides class mapping we can also dive down to query property mappings and rules.

The lineage graph connects FIBO to Call Report instances via the hasSourceInstance property

Again, the value that ontology adds to data management. **Data Lineage is inherent**

The lineage query results trace the FIBO instance back to its XBRL source record.

[fibo_class]	fibo_inst	call_cert_inst	ffiec_class	xml_tag
fibo-be-le-cb: StockCorporation	fibo-be-le-cb: StockCorporation_LEI_7H6G LXDRUGQFU57RNE97	<file:///BankOntology/data/Call_ Cert628_093016.xml#r-2169>	ffiec-concept:RSSD9017	http://www.ffiec.gov/xbrl/call/co ncepts#RSSD9017
fibo-be-le-lei: LegalEntityIdentifier	fibo-be-le-lei: LegalEntityIdentifier_LEI7H6 GLXDRUGQFU57RNE97	<file:///BankOntology/data/Call_ Cert628_093016.xml#r-1084>	ffiec-concept:RCON9224	http://www.ffiec.gov/xbrl/call/co ncepts#RCON9224
fibo-fbc-fct-fse: DepositoryInstitution	fibo-fbc-fct-fse: DepositoryInstitution_LEI_7 H6GLXDRUGQFU57RNE97	<file:///BankOntology/data/Call_ Cert628_093016.xml#r-2169>	ffiec-concept:RSSD9017	http://www.ffiec.gov/xbrl/call/co ncepts#RSSD9017
fibo-fbc-fct-usjrga: FDICCertificateNumber	fibo-fbc-fct-usjrga: FDICCertificateNumber_628	<file:///BankOntology/data/Call_ Cert628_093016.xml#r-642>	ffiec-concept:RSSD9050	http://www.ffiec.gov/xbrl/call/co ncepts#RSSD9050

FIBO   Ontology Staging   XBRL Source

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The reverse – populate the Call Report out of FIBO.

FIBO → Semantic ETL → OWL Staging → Export → FFIEC 031 Call Report

The complex transformation and business rules are defined OWL-to-OWL, within the ontology. The export, conversion from OWL to XBRL is just mechanical, tooling.

Map FIBO into FFIEC 031 staging classes.
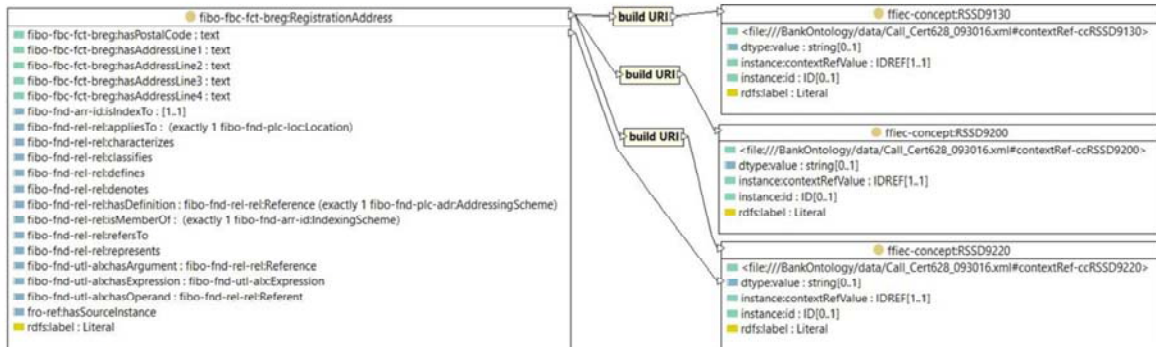
Our example, the FIBO registration address maps to 3 FFIEC MDRMs.

RSSD9130 – city
RSSD9200 – state
RSSD9220 – zip code

The mapping is a reversal of the Staging to FIBO mapping context.

Unfortunately there is no "reverse mapping" ETL button.

We have to specify
- How to build (match) the Staging URI
- Transform FIBO formats into FFIEC formats.
- The UPDATE operation is still a challenge.

The Staging to FIBO mapping context query, provides our to-do list.

The XBRL import assigns system generated URIs. We must match the correct instance URI in order to update. Or should we just create a completely new instance ontology?

The answer also depends on, whether we look at a single institution filing every 3 months or a consolidator / regulator holding multiple institutions in OWL Staging. .

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We would also examine the other changed resources.

Export the staging into FFIEC compliant XBRL.
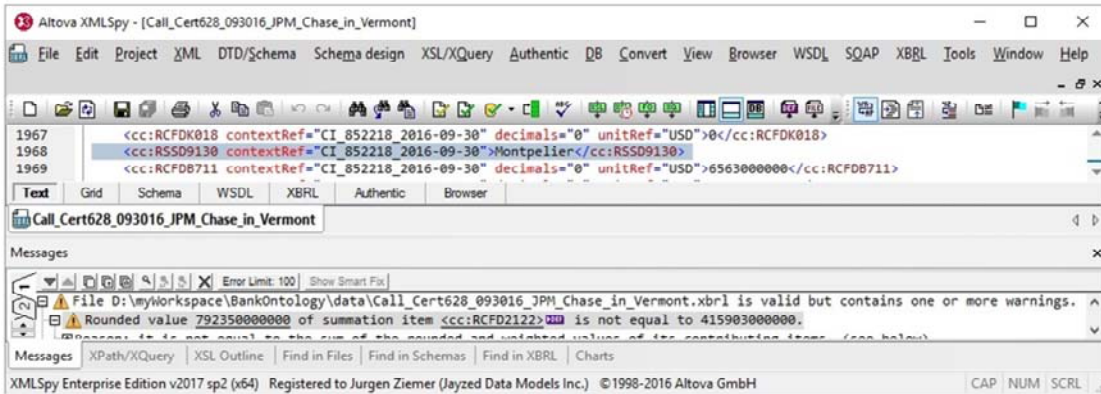
Line 1968 shows the updated city. The XBRL is valid.

We use XMLSpy as an XBRL tool. Topbraid only accepts XML files, so we have to modify the header and save as XML and XBRL.

We export the modified staging OWL into XML.

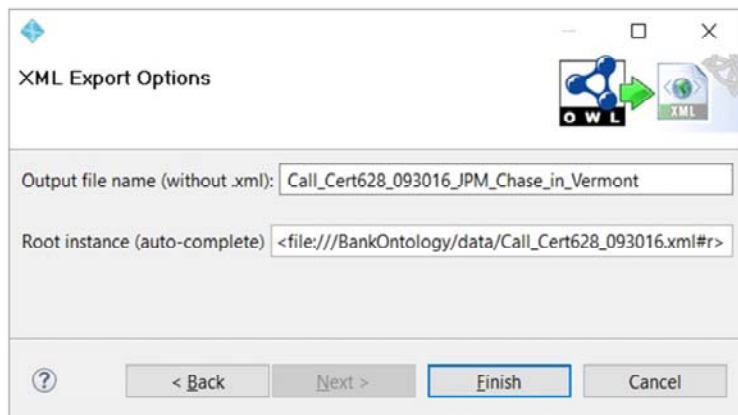We invoke the export dialog for the staging OWL file.

The root instance "#r" will export all semantic XML triples.

XML Export Options

Output file name (without .xml): Call_Cert628_093016_JPM_Chase_in_Vermont

Root instance (auto-complete): <file:///BankOntology/data/Call_Cert628_093016.xml#r>

< Back   Next >   Finish   Cancel

Architecture details

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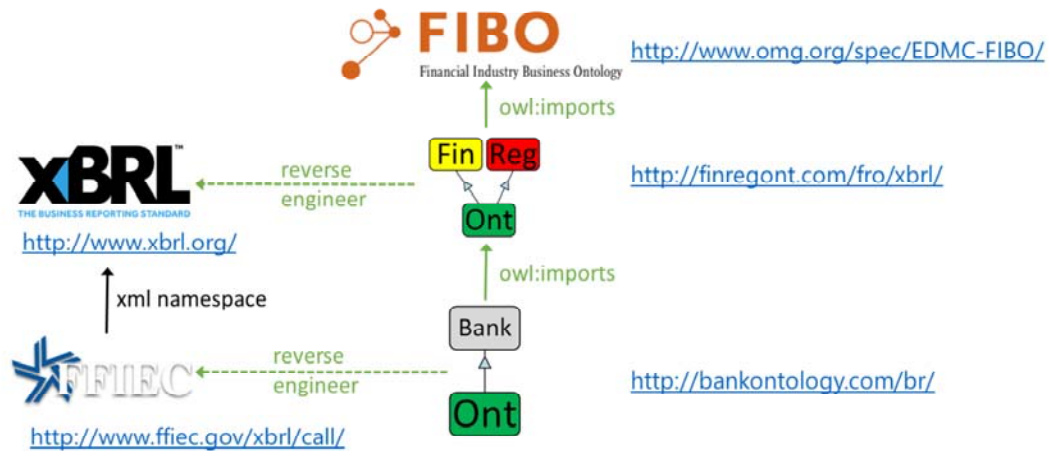
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The JPMC and some other bank XBRL files are on the bankontology.com website in the data directory. You are welcome to test with your filing software.

Namespaces and imports

You can follow the links to the base namespaces.

The FFIEC Call Report imports XBRL.

As the upper/core ontology FIBO is on top of the owl imports.

Financial Regulation Ontology has entities common for Banks, Funds, Hedge funds and Insurance. So it is the domain to hold the XBRL ontology. FinRegOnt imports FIBO and a Legal Ontology.

Bank Ontology holds the reverse engineered FFIEC taxonomy. It imports the XBRL classes from FinRegOnt.

To try it out, just create a "My Bank" set of ontologies, importing the bank ontology.

Hundreds of people mapping between numerous heterogeneous systems, languages, components...

Consolidated Life New York offices, 1960. (Jack Lemon in Billy Wilder's "The Apartment")

Finance key point

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To recap:
We started in the bleak 1960s.
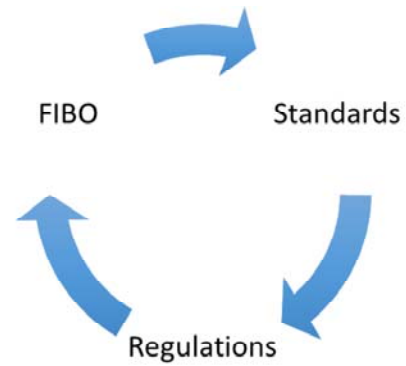
In the bright future everything is a triple.
- Standards and Regulations drive FIBO.
- FIBO makes compliance data management less complex.
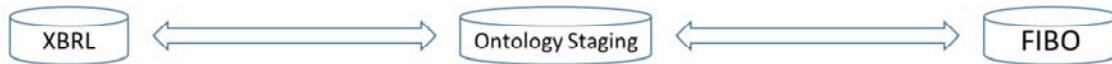
Lessons learned:

FIBO has good support for compliance. We can load XBRL data into FIBO and generate the Call Report out of FIBO.

XBRL import and transformations are slow.

FIBO is too assertive. Have more defined classes!

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XBRL, Staging FIBO - two simple steps in either direction.

The appendix has links to the ontologies, documentation and tutorials.

References

1. Tutorial : http://finregont.com/financial-regulation-ontology-tutorial/
   Chapter one has an into to OWL, FIBO, and the Legal reference ontology. There is also a getting started with Protégé section.
   Chapter two shows XML source import in depth for Code of Federal Regulations and United States Code.
2. XBRL Ontology: http://finregont.com/xbrl/
   Includes links to the ontology files and documentation.
3. Bank ontology: http://bankontology.com/ontology-directory-files-prefixes/
4. XBRL consortium, US website: https://xbrl.us/
5. FFIEC taxonomy and data download: https://cdr.ffiec.gov/public/Default.aspx
6. Topbraid Composer website:
   http://www.topquadrant.com/tools/IDE-topbraid-composer-maestro-edition/

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