Hedge Fund Regulation Ontology

Prototype v1.0 – Filing the US Investor Adviser Act (IAA)

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I. Introduction

The regulatory regime for Hedge Funds has tightened worldwide. European countries implemented the Alternative Investment Manager Directive. The Dodd Frank Act brought Hedge Funds under supervision or the Securities & Exchange Commission as Investment Advisers. Form PF (private fund) requires volumes of heterogeneous data. Conventional compliance architecture is entangled in numerous systems, transformations, and mappings. Neither the business nor regulators have trust and proof that the code accurately implements the logic of the rules, and that reported numbers accurately trace back to their data sources.

This document proposes a Semantic Web approach to regulatory compliance. Core is the Ontology Web Language (OWL). A W3C standard proven scalability, handling complexity in Bio and Medical field. The core value proposition is that Everything is a Triple. Data, schema, mapping, transformations, rules, ... everything is stored a uniform cells of subject-predicate-object.

The Hedge Fund Regulation (HFR) ontology is based on two industry standards:

- **FIBO** Financial Industry Business Ontology for funds, clients, securities, derivatives, positions etc.
- **LKIF** Legal Knowledge Interchange Format for SEC rules, forms, submissions and responses.

The introduction continues with Uses Case for Regulators and Compliance Managers and a non-technical primer on OWL. We present structure and content of the two reference ontologies and show how HFR integrates and extends them. The prototype details how the ontology computes a fund’s IAA filing requirements. (Code of Federal Regulations, title 17 vol3).

We conclude with an outlook of the next HFR releases and application in other financial areas.
Use Case

The Securities and Exchange Commission (SEC) provides the investors with Adviser data in XML. Publication in OWL on a semantic endpoint would serve the public even better and facilitate queries across other information sources. This presentation shows by example how the Legal Framework should be stored and queried in an ontology.

How to get started with a Semantic Endpoint? “Loading the Federal Regulations” explains, how to design ontology classes and how extract, transform and load data from the XML. In the future, the SEC should process IAA and PF forms via ontology alignment.

The aggregated data can be stored in an RDF database. Regulators will be able run SPARQL queries against the database. The presentation explains how

The fund manager monitors compliance and can assess the impact of changes to fund structure, investments and client base. Part I has a Finance example based ontology primer and business overview of the reference ontologies..

The fund’s compliance officer can populate forms using inference and SPARQL rules. The RDF database of the fund holds internal financial data, positions, investors, structure. Part II shows ontology inference and rules in practice.

Note: The Use “Load RDF Database” is common for both regulators and funds. That does not mean a common database instance. Funds have their own private systems and RDF store. However, the core design of the regulatory and fund version are the identical.
"The Semantic Web is an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation." – Sir Tim Berners-Lee, director of the World Wide Web Consortium (W3C)

Trust is the firm belief in the integrity, reliability as accuracy of a regulatory filing. Proof is how a statement in a regulatory filing as been derived.

What are the underlying sources of Financial Data? What are the rules and regulations applied?

In traditional approaches to regulations Business Rules are defined in spreadsheets and documents for human readers. They get mapped and encoded in programs and databases. In order to proof we elevate logic from code to schema. So that a single artifact is understood and validated by both humans and programs.

The Semantic layer build upon the foundation to fulfill requirements for proof and trust. RDF removes ambiguity from XML. Unequivocal it connects two URIs, subject and object with a predicate. RDFS and OWL define classes of RDF resources, association between classes and class restrictions. The ontology Reasoner processes the asserted facts and infers new information. All information including results and rules can be queried with SPARQL selects.

Today’s traditional web provides the basic building blocks to encode text and Uniform Resource Identifiers. XML provides machine readable syntax. Namespaces facility XML-Schema definition, XSD.
Everything is a Triple

The Resource Description Framework (RDF) uses an elementary grammar to define a cell of information.

Subject | Predicate | Object
--- | --- | ---
Black Rock Fund Advisers | manages | iShares MSCI Emerging Markets ETF

Black Rock manages the iShares MSCI Emerging Markets ETF. Both are web resources identified by a URI. The **Object Property** “manages” connects the two resources. This is similar to creating
- an association between objects. E.g. associating two Java instances.
- a Foreign Key reference between two database records.

The **Data Property** assigns a value to the subject resource. Here is the Ontology Web Language (OWL) code. The colon separates the Namespace from the resource name.

- rdfs:label - a build in RDF data property

```
:Black_Rock_Fund_Advisers
  rdf:type fo-fr:InvestmentAdviser ;
  :hasBusinessName "BLACKROCK FUND ADVISORS"^^xsd:string ;
  :hasIncorporationDate "1984-11-15T00:00:00"^^xsd:dateTime ;
  fibo-fnd-rel-rel:manages :iShares_MSCI_Emerging_Markets ETF ;
  rdfs:label "Black Rock Fund Advisers"^^xsd:string ;
```
Data is a triple

The iShares ETF legal entity of the fund is an issuer of shares. The shares are traded on the NYSE. All depicted instances may have more data properties and object properties connecting to other instances. We get a web of information called a Graph.

SPARQL, the Protocol and RDF Query Language is SQL for RDF/OWL ontologies. The ontology can be file based or an RDF database aka a Triple Store.

In order to list the exchanges, where Black Rock ETFs are traded, we traverse the graph chaining all object properties.

```
SELECT ?investmentadviser ?securitiesexchange
WHERE {
}
```
The schema is in triples

RDF Schema (RDFS) extends RDF to allow describing taxonomies of classes and properties.

OWL classes are interpreted as sets that contain individuals aka instances. The RDF object property rdf:type asserts that the individual is an instance of the class.

We can define data and object properties of the class. The RDFS property’s Domain restricts the type of the subject, Range restricts the type of the object.

The RDF-schema property subClassOf enables rich hierarchies of classes. The subPropertyOf build hierarchies of class association.

The core difference to object models is the notion of the set rather then class objects.

In Java we must explicitly assign Black Rock to be an Investment Adviser and assign it to be a Financial Service Provider. In RDFS/OWL an instance of Investment Adviser is automatically an instance of all the super classes.
Logic described in triples

RDFS provides constructs similar to UML class / object and data modeling Entity Relationship models. Modeling tools provide model transformations, import and export between OWL, ER and UML.
- Data modelers still need to derive the Physical model from the Logical Model.
- Object modelers generate code from UML
The ontology already contains schema and data expressed in triples and we can use metadata in our SPARQL queries.

```
SELECT ?investmentadviser ?managementcompany ?FS_provider ?ETF_class
WHERE {
  ?managementcompany rdf:type ?class .
  ?managementcompany rdf:type ?ETF_class .
}
```

<table>
<thead>
<tr>
<th>[investmentadviser]</th>
<th>Black_Rock_Fund_Advisers</th>
</tr>
</thead>
<tbody>
<tr>
<td>[managementcompany]</td>
<td>iShares_MSCI_Emerging_Markets_ETF</td>
</tr>
<tr>
<td>FS_provider</td>
<td>fo-fr:InvestmentAdviser</td>
</tr>
<tr>
<td>ETF_class</td>
<td>fibo-fbc-fct-fse:ManagementCompany</td>
</tr>
</tbody>
</table>
Class restrictions

A restriction describes a class of individuals based on the properties that instances of the class participate in. In other words, a restriction is a kind of class, just like a named class. Typically, we apply restrictions to narrow down the set of instances from class to subclass.

An Investment Manager is an Investment Adviser, who manages some Investment Company. In the ontology editor (Topbraid Composer) we define the existential restriction (some) on the object property. The universal restriction (only) would mean that the adviser manages nothing else but Investment Companies. We can place restrictions on Quantifiers, Cardinalities and even Values. An example of a Value restriction is a Prime Bond with hasRating only ‘AAA’.

The class hierarchy browser shows the number of direct class instances plus total of instances in the subclasses. Our example has Black Rock and Whitingham Wealth as Investment Adviser. TDAmeritrade doesn’t manage funds.
Defined Class and the Reasoner

So far, the class restrictions although more refined than database constraints still depend on the implementation to assert that Black Rock is an Investment Manager and TDAmeritrade is only an Investment Adviser. Changing Investment Manager to a **Defined Class** will have the Reasoner infer this new knowledge from existing asserted information.

We move the class restriction from rdfs:subTypeOf to owl:equivalent class. Now the Manager is defined as the intersection of all Investment Advisers and all things that manage an Investment Company.

The Reasoner tool processes class definitions and infers that a particular individual is a member of the class. The class hierarchy now shows the defined classes in blue and we see two inferred instances: Black Rock and Whitingham Wealth. Checking for class **subsumption** is a key task of the reasoner key differentiator to non-semantic technologies.

We formulate complex IAA rules as Defined Classes from class restriction building blocks. The Reasoner places the matching Funds, Advisers, Assets as inferred members of the rule. -- Semantic Regulation Compliance
An upper ontology (aka top-level ontology or foundation ontology) is an ontology which describes very general concepts that are the same across all knowledge domains. Well known core ontologies are BFO, GFO, DOLCE, SUMO and Dublin Core.

The goal of a core ontology is to provide a global and extensible model into which data originating from distinct sources can be mapped and integrated. (Doerr, Hunter, Lagoze)

The core ontology applies to a specific domain, such as biology, medical, Legal and Finance.

The Operational Ontology is an implementation of a core ontology. It is specific enough to hold source data. HFR is an operational ontology for the sub-domain of (alternative) investment management.

Reference Ontologies - levels
Reference ontologies for HFR

It is a standard practice and often mandated for Data Modelers at Financial Institutions to utilize Reference Models*. For a Semantic Web solution, integration with Industry Standards is even more important.

Hedge Fund Regulation (HFR) is an operational ontology integrating legal and financial information. http://hedgefundontology.com/

- Unfortunately neither FIBO nor LKIF utilize an upper ontology for generic concepts.

* Over 150 banks for example have licensed the IBM Banking Data Warehouse model 7.
Financial Industry Business Ontology (FIBO)

FIBO is a collaboration between the Enterprise Data Management Council (EDMC) and the Object Management Group. The EDMC leads design in collaboration with major Financial Institutions. OMG provides governance and publishes FIBO as a formal standard.

The EDM Council is a 501(c)(6) non-profit trade association founded by the financial industry to elevate the practice of data management as a business and operational priority. The Council is a leading advocate for the development and implementation of data content standards and the publication of data management best practices.7

The Object Management Group® (OMG®) is an international, open membership, not-for-profit technology standards consortium, founded in 1989. OMG standards are driven by vendors, end-users, academic institutions and government agencies. OMG Task Forces develop enterprise integration standards for a wide range of technologies and an even wider range of industries.8

FIBO™ is a business conceptual ontology standard providing a description of the structure and contractual obligations of financial instruments, legal entities, market data and financial processes. The primary application of the business conceptual ontology is for data harmonization and for the unambiguous sharing of meaning across data repositories. This common language (or Rosetta stone) for the financial industry supports business process automation and facilitates risk analysis.9
Legal Knowledge Interchange Format (LKIF)

The European project for Standardized Transparent Representations in order to Extend Legal Accessibility (Estrella, IST-2004-027655) aims to develop and validate an open, standards-based platform allowing public administrations to develop and deploy comprehensive legal knowledge management solutions, without becoming dependent on proprietary products of particular vendors.\(^5\)

LKIF is intended to model legal rules of the kind found in legislation and regulations.\(^6\)
It is the main deliverable of the ESTRELLA project. LKIF is an Upper and Core ontology. The lead architect, Rinke Hoekstra made the OWL files are available on GitHub: [https://github.com/RinkeHoekstra/lkif-core](https://github.com/RinkeHoekstra/lkif-core)

The import graph shows the major OWL files. The Jayzed approach to reference ontologies is to extend – not to change the domain standard. We did add namespace prefix “lkif” to differentiate from “fibo” and “fo-fr” (Fund Ontology – Fund Regulation).

**Core** is the base ontology module. It contains abstract and basic concepts of an Upper ontology. LKIF **Extended** adds rules and the basic concept of time modification.

**Role** is a basic concept, corresponding to role in the FIBO. **Legal Role** is a domain concept specializing Role. HFR extends the **Norm** to hold Laws and Regulations for the Investor Adviser Act. The **Action** module defines Agents and acts they perform. **Expression** models propositions, qualifications, statements and legal documents.
FIBO / LKIF statistics

The statistics show the number of elements in the two reference ontologies.

- **Class** – Together we have over 900 classes to utilize and leverage. LKIF provides over 200 classes defining legal concepts. FIBO already has 700 classes and is still growing. (see following detail slides)
- **Note the absence of Data Properties and Named Individuals in LKIF.**
  - FIBO has some operational elements, data properties and individuals for Currencies, Countries and even the 12 Federal Reserve district banks.
- **The OWL:Ontology bar shows the actual number of OWL files.**
- **The high number of symmetric and transitive properties show the high ontological commitment in LKIF.**

### Three-layer ontology design pattern proposes

- **Primitive layer consists of classes/properties forming taxonomic trees in which a single parent may be asserted.**
- **Complex layer refines the primitive layer by imposing restrictions such as necessary or necessary and sufficient conditions beyond the asserted subsumption.**
- **Application restriction layer applies highly restrictive constraints and may be used for the purposes of document validation and application interoperability.** (Dumontier, Villanueva-Rosales 8)

The ratio of Primitive to Equivalent classes show that LKIF has larger Complex layer than FIBO.
US Legal Framework instances

The diagram shows LKIF instances to define semantics of the IAA legal background. Congress enacted (actor) the 1940 Investor Adviser Act and the Dodd-Frank Act. There are two instances each: The Act and the Statute. The Statute bears the text of the Act of Law passed in congress.

The laws contain provisions that give the Security and Exchange Commission a mandate to supervise Investment Advisers. The SEC enacted a Rulemaking (IAA amended P.L. 112-90). In other words, the SEC announced the final version the regulation. The US Investment Advisers regulation bears the text of the rules (e.g. CFR-2012-title 17-vol3 part 275).
US Legal Framework Classes

The graph shows some of the LKIF and HFR classes for the instances. Solid yellow dots represent primitive classes.

- Existential ‘some’ restriction
- Universal ‘only’ restriction

Legislative Body is the class for US Congress. The Executive Body holds the SEC and other Regulators. An existential restriction ties the Legislative Body to the Act of Law. The US IIA and Dodd-Frank are acts of law. The Act of Law contains a Supervisory Mandate. A class restriction refers to the Executive Body that got the mandate. Corresponding to the Act of Law we have a class for the Rulemaking. The Regulation class anchor for rules. Part II will explain more LKIF concepts and their implementation.
II. Implementing SEC IAA rules

**Identify and review Legal Sources**
- US Congress
- Investment Advisers Act of 1940
- Dodd-Frank Act – title IV
- Hedge & Private Equity Funds
- Securities and Exchange Commission
- Code of Federal Regulations (CFR): Title 17, vol3
- Government Publishing Office
- GPO publishes and XML version of the CFR.

**Load CFR into ontology**
- Reverse engineer XML/XSD files into OWL CFR classes
- Identify and extend Legal Knowledge Interchange Format (LIKIF) ontology classes: Legal Source, Legal Document, Regulation, Statute, Code Federal of Regulations
- Map CFR to Fund Ontology and create mapping rules
- Run Reasoner to execute mapping rules. That will move the data from CFR to Fund Regulation Ontology.

**Define Fund Regulation in OWL classes and axioms.**
- Identify and extend Financial Industry Business Ontology (FIBO) classes for Fund data
- Identify and extend LKIF classes for Rules: Qualified, Normatively Qualified
- US IAA, Ex. US IAA Section 202-1-11
- Defined Ex. US IAA Section 202-1-11
- Excluded Ex US IAA Section
- Run Reasoner to compute inferences. That will classify a Fund that fulfills the rule axioms as a member of the US IAA Section 202-1-11 class

**Examine classified funds, reasons for classification and lineage to Legal source**
- Review funds classified as Mandated to file
- US IAA, Ex. US IAA Section 202-1-11 list “Whitingham Wealth”. It does not list any other excluded Funds.
- Defined Ex. US IAA Section 202-1-11 Whitingham Wealth is included in all the subclasses.
- Excluded Ex US IAA Section 202-1-11 Whitingham Wealth is not excluded.
- Traverse the Graph to browse Linage, Legal application, and Financial Information.
- Run SPARQL queries and export results.
Legal Sources

**Congress**
- The act placed mutual funds, closed-end funds, unit investment trusts, and exchange-traded funds under SEC regulation and supervision.
- The 2010 Dodd Frank Act (DOF), Title IV required most Hedge and Private Equity Funds to register with the SEC. Full text: https://www.sec.gov/about/laws/wallstreetreform-cpa.pdf

**OLRC**
- The Office of the Law Revision Counsel of the United States House of Representatives prepares and publishes the United States Code
- Cornell University has the best online reference:
  - Dodd-Frank: Title IV - Regulation of Advisers to Hedge Funds and Others https://www.law.cornell.edu/wex/dodd-frank_title_IV

**SEC**
- The Security and Exchange Commission implements the law.
- Defining form and reports, as well as electronic filing and submission methods.
- Form ADV: The application for registration with the SEC as an investment adviser. Form PF (Private Funds)

**GPO**
- The Government Publishing Office is the official source for Federal Government information
- Title 17 CFR Part 275 is available in PDF at http://www.ecfr.gov/cgi-bin/text-idx?SID=6dec71bde0cdaad16a331d63c3bd8b4f&node=17:4.0.1.22&rgn=div5
- An XML version is available for download at https://www.gpo.gov/fdsys/bulkdata/CFR/2015/title-17
- We import CFR-2012-title17-vol3-part275.xml into the OWL ontology
The GPO website provides the XSD-Schema and documentation
- CFRMergedXML.xsd
The XSD Schema is generic for all Federal Regulations. A good example of the Semantic Web Layers discussed previously. We get the machine readable syntax, but no semantics for the particular regulation.
The header contain identifying information about the document

The regulation text is structured in sections. <SECTION>
- Section number with the paragraph reference <SECTNO>
- Subject of the section <SUBJECT>
- And individual paragraphs <P>.

<SECTION>§ 275.203(m)-1</SECTION>
<SECTNO>Private fund adviser exemption.</SUBJECT>
<P>(a) <E T="03">United States investment advisers.</E> For purposes of section 203(m) of the Act (15 U.S.C. 80b-3(m)), an investment adviser with its principal office and place of business in the United States is exempt from the requirement to register under section 203 of the Act if the investment adviser:<P>
<P>(1) Acts solely as an investment adviser to one or more qualifying private funds; and<P>
<P>(2) Manages private fund assets of less than $150 million.</P>
Generating OWL classes from CFR XML

Topbraid Composer Maestro Edition11 (TBC) is our main ontology editor.

1. First we import the XSD-Schema. There are various options to customize the import. The tool creates on OWL file CFRMergedXML.ttl with classes for the XSD elements.
2. The second step is to open CFR-2012-title17-vol3-part275.xml with TCB’s “Semantic XML”. This show instances of the classes with the actual XML text fragments. Note that this is still a semantic rendition. The underlying file is still XML.
3. Finally we export the graph to create save it as OWL. This is for convenience and performance, so we don’t have to repeat the import steps.
Validating the generated OWL classes

Above, our Private Fund Exemption rule section. Below the generated OWL.
The XSD elements became classes. The XML content has been generated as instances of the schema classes.
The namespace prefix, fo-fr-cfr means Fund Ontology – Fund Regulation- Code of Federal Regulations
We define a parent class, CFRpart275 and make all generated classes subclass of it. The list to the right shows the 50 generated classes and their number of instances. We should consider this a set of dumb Staging classes rather than ontology design. The core classes are section with 44 instances and paragraph with 757 instances. Most of the other classes become data properties.
Validating SECTION § 275.203(m)-1

The TopBraid Composer Resource form shows the properties of our “Private fund adviser exemption” generated as an instance of SECTION. The import generates properties “composite:” for nested elements in the XML:

- “composite:child” is the object property generated for all XML groups and elements within the SECTION: Section number, subject, note, citation and many paragraphs.
- “composite:index” is the data property for the element position.

The paragraph in turn has a composite child for the actual text instantiated in “sxml:TextNote”.

To use the data warehousing ETL analogy, this is just an Extract of into simple Staging classes rather than ontology design. There are no semantics and it is hard and error prone to SPARQL query the data. **We need to Transform the structure into true ontology design.**
Identify and extend LKIF target

The **US Legal Framework Classes** defined the SEC as a LKIF Executive Body and Financial Regulation as an outcome of its Rulemaking. Financial Regulation class is the ontology target for our Staging Class instances.

Financial regulation is a form of regulation or supervision, which subjects financial institutions to certain requirements, restrictions and guidelines, aiming to maintain the integrity of the financial system. This may be handled by either a government or non-government organization. Financial regulation has also influenced the structure of banking sectors, by decreasing borrowing costs and increasing the variety of financial products available.

CFR documents are organized in sections. A section contains group or container tag for search and retrieval purposes.

The LKIF “contains” property specifies that some thing is contained (spatially) within some other thing. A CFR section contains paragraphs.

A collection class for CFR sections and paragraphs. This is to differentiate CFR from other regulations. E.g. the European Alternative Investment Fund Managers Directive will be a sibling to this class.

Paragraph is the atomic piece of text in the CFR document. It is not divided any further.
Modelling CFR Section and Paragraph

The Mapping Diagram shows the staging section and related classes, prefix “fo-fr-cfr”. The target “fo-fr-sec-iaa:CFR_Section” ontology class has data properties of the information relevant to HFRO. We do not need to remodel all of CFR. Lineage to the original staging records remains available.

Note that there is no object property connecting SECTION with the related classes. The “contains” semantic is only in the XML data – not the schema. The target ontology will create class restrictions to enforce semantic integrity.

- XML imports into Staging tend to be over normalized. The ontologist **denormalizes** into optimal OWL classes.
- **Relational Database** imports into Staging are often denormalized. Tables with a hundred columns that are not in 3rd, 2nd or even 1st Normal Form. The ontologist **normalizes** adding semantic to the OWL class structure.

```
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```

LKIF object property “lkif-expr:bears” connects the Section to the SEC Rulemaking.

LKIF object property “lkif-mero:contains” ties the Section to its paragraphs.

All target classes get an “sp:sourceInstance” object property. The source instance holds the URI of original CRF record. This provides end-to-end lineage and query capability.
“fo-fr-cfr:P” is the class generated for paragraphs in the XML. “fo-fr-cfr:E” is for enumerations. These are small text fragments wherever the CFR document contains a list. We also have “sxml:Node” for the actual text.

The target CFR Paragraph transforms text and enumeration text to data properties.

LKIF object property “lkif-expr:bears” connects the Section to the SEC Rulemaking.

LKIF object property “lkif-mero:contained_in” is the inverse property of “contained” and point to the section.

The rectangular box “change namespace denotes a direct class-level mapping: For every instance of “P” create an instance of CFR_Paragraph and change the URI namespace from “fo-fr-cfr” to “fo-fr-iaa-rule”. The connector from “composite:index” to “fo-fr-sec-iaa-rule:hasCompositeIndex” is a direct data property level mapping.

We will examine the Topbraid Composer “SpinMap” feature in more detail...
Links and Books

Legal Knowledge Interchange Format (LKIF), http://www.estrellaproject.org/

Financial Industry Business Ontology (FIBO)
   Enterprise Data Management Council http://www.edmcouncil.org/financialbusiness

Jayzed Data Models http://www.jayzed.com
www.fundontology.com  www.hedgefundontology.com
References

1. **Towards a core ontology for information integration**

2. **Upper ontology**

3. IBM Banking Data Warehouse – product page.

4. Three-Layer OWL Ontology Design
   Michel Dumontier, Natalia Villanueva-Rosales1 - School of Computer Science, 2Department of Biology, Carleton University, 2007

5. ESTRELLA project website: http://www.estrellaproject.org/

6. ESTRELLA Deliverable N°: 4.1 -The Legal Knowledge Interchange Format (LKIF)


10. Cornell University Law School, Legal Information Institute website: https://www.law.cornell.edu/wex


12. TopQuadrant, Reshaping Relational Data using SPINMap: http://topquadrant.com/spin/SPINMapRDBMS/