Semantics in the Financial Industry: the Financial Industry Business Ontology

Ontolog Forum
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Network of Financial Exposures

Financial exposure to counterparty
Network of Financial Exposures

Some of these are looking a little shaky…
Network of Financial Exposures

Where does that leave the survivors?
Motivation: The Need for a Conceptual Model
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Common ontology

Shared business meanings
Motivation: The Need for a Conceptual Model

Common ontology

Shared business meanings

Validated by business
Motivation: The Need for a Conceptual Model

Common ontology

Shared business meanings

Validated by business

Expressed logically
Model Positioning

Conceptual Model

Realise

Logical Model (PIM)

Implement

Physical Model (PSM)
Model Positioning

Conceptual Model

Realise

Logical Model (PIM)

Implement

Physical Model (PSM)

Business

The Language Interface

Technology
This is not a more abstract model of the solution...

- Conceptual Ontology
- Logical Data Model (PIM)
- Physical Data Model (PSM)

Realise
Implement
This is not a more abstract model of the solution...

It’s a concrete model of the problem!

Conceptual Ontology

Realise

Logical Data Model (PIM)

Implement

Physical Data Model (PSM)

Business

The Language Interface

Technology
Starting Point: Dimensions of a Model
Dimensions of a Model

For what

By what

Of what

\[ \forall x \exists y (P(f(x)) \rightarrow \neg(P(x) \rightarrow Q(f(y), x, z))) \]

e.g. First Order Logic

e.g. Business domain (business process etc.)

e.g. Messaging Level
Dimensions of a Model

MODEL

Model Formalism

\[ \forall x \exists y (P(f(x)) \rightarrow \neg(P(x) \rightarrow Q(f(y), x, z))) \]

e.g. First Order Logic

By what

Of what

Application

Layer

For what

Model Theoretic Relation

(grounding)

e.g. Messaging Level

e.g. Business domain

(business process etc.)
Dimensions of a Model

• 1. Model Formalism:
  • How are the things in the model modeled?

• 2. Model Semiotics
  • What are things in the model, a model of?

• 3. Model purpose (application):
  • How does the model relate to development of solutions?
The power of an information management paradigm depends upon the intelligence and expressive power of its underlying conceptual model or schema.

* Ontology Spectrum courtesy of Dr. Leo Obrst, The Mitre Corporation
## Development Lifecycle for Data

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<thead>
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<th>Data</th>
<th>Function</th>
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Introducing FIBO

• FIBO is a collaborative effort among industry practitioners, semantic technology experts and information scientists to standardize the language used to precisely define the terms, conditions, and characteristics of financial instruments; the legal and relationship structure of business entities; the content and time dimensions of market data; and the legal obligations and process aspects of corporate actions.

FIBO is being released as a series of standards under the technical governance of the Object Management Group (OMG). FIBO is based on the legal structures and obligations contained within the myriad of contracts that form the foundation of the financial industry. We have constructed this content into both a business conceptual and fully operational ontology that formally models the reality of how the financial industry operates.

• The EDM Council is the author and steward of the Financial Industry Business Ontology (FIBO).
FIBO: An Ontology for Finance

Upper Ontology

FIBO Foundations: High level abstractions

FIBO Contract Ontologies
- Securities (Debt, Equities)
- Derivatives
- Loans, Mortgage Loans
- Funds
- Rights and Warrants

FIBO Pricing and Analytics (time-sensitive concepts)
- Pricing, Yields, Analytics per instrument class

FIBO Process
- Corporate Actions, Securities Issuance and Securitization

Future FIBO: Portfolios, Positions etc.
- Concepts relating to individual institutions, reporting requirements etc.
The Two ontological Questions

• For each kind of “Thing” in the ontology (each class):
  • What kind of thing is this?
  • What distinguishes it from other things?
Defining a Kind of Thing

• We start with some kind of thing
Defining a Kind of Thing

• We ask just two questions about this kind of thing:
  • What kind of thing is it?
  • What distinguishes it from other things?
What kind of thing is it?

- Animal
  - Vertebrate
    - Bird
    - Waterfowl
  - Invertebrate
    - Mammal
    - Fish
  - Some kind of thing
What distinguishes it from other things?

- Animal
  - Vertebrate
    - Bird
    - Waterfowl
      - Some kind of thing
        - Walks like a duck
        - Swims like a duck
        - Quacks like a duck
  - Invertebrate
    - Mammal
    - Fish
It’s a Duck!

- Animal
  - Vertebrate
    - Bird
      - Waterfowl
    - Mammal
    - Invertebrate
      - Fish

- Walks like a duck
- Swims like a duck
- Quacks like a duck
Where does this lead?

• Taxonomy of kinds of contract
• Taxonomy of kinds of Rights
  • Rights, Obligations are similar and reciprocal concepts
  • Note that these don’t necessarily correspond to data
• Semantics of accounting concepts
  • Equity, Debt in relation to assets, liabilities
  • Cashflows etc.
• Semantics of countries, math, legal etc.
Example
Ontology Types

• OWL may be used for ontology based applications
• OWL embodies formal first order logic and as such is usable for conceptual ontology
• These are separate model types
  • Same formalism but different lifecycle positioning
  • Distinct ontological commitments
• Use separate namespace
Approaches to Meaning

Rosetta Stone

Mayan Language
Approaches to Meaning

- Existence of already-understood terms enabled translation
- Semantics grounded in existing sources
Approaches to Meaning

- Rosetta Stone
  - Existence of already-understood terms enabled translation
  - Semantics grounded in existing sources

- Mayan Language
  - No existing common language to enable translation
  - Translation was possible only from internal consistency of concepts
Rosetta Stone: Semantic Networks

- Directed Graph
- The meaning at each node is a product of its connections to other nodes
- Semantically grounded at certain points in the graph
Semantic Grounding for Businesses

What are the basic experiences or constructs relevant to business?

- Monetary: profit / loss, assets / liabilities, equity
- Law and Jurisdiction
- Government, regulatory environment
- Contracts, agreements, commitments
- Products and Services
- Other e.g. geopolitical, logistics
Where does this lead?

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• Semantics of countries, math, legal etc.
Mayan: Internal Consistency

- Graph has logical relations between elements
- These correspond to the relations between things in reality
- Automated reasoning checks the “deductive closure” of the graph for consistency and completeness
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Isomorphic Semantics

• The more detailed logic there is in the application ontology, the more confident we can be that it reflects only one set of things and their relation in reality
  • Like Jabberwocky
  • Or a crossword solution

• This allows for stand-alone ontologies to do very powerful processing of knowledge in an application

• This is not incompatible with the techniques described for conceptual ontology modelling – IFF it is done right!

• However, some techniques which are appropriate for stand-alone operational ontologies would not be compatible with a conceptual enterprise ontology

• Decide whether to have application and conceptual ontologies in separate namespaces, or satisfy both sets of requirements in one namespace
Application vs. Reference Ontology

**Application Ontology**
- Built to support a particular application (use case)
- Reused rather than define terms
- Skeleton structure to support application
- Terms defined refine or create new concepts directly or through new classes based on inference

**Reference Ontology**
- Intended as an authoritative source
- True to the limits of what is known
- Used by others
The Semiotic Triangle (Peirce)

Concepts

- Signs
- Real World Objects
Concepts

Musical Instrument

{Symbolizes}

Any device capable of tuneful, melodious, harmonious sounds

Musical Instrument

Concept

(Intension)

(Extension)

Diagram: Jim Odell
Extension as a Happening

Intension

Concept

Extension
A Semiotic Rhombus

Concepts

Intensions

Extensions

Signs

Real World Objects
Styles and Approaches to Ontology

• Semantics:
  • Isomorphic versus foundational

• Practical
  • Term-derived versus concept-derived

• Of these:
  • Which is appropriate to a reference ontology?
  • Which is appropriate to an operational ontology
  • Intermediate “Logical” ontology – reusable but data focused
Conceptual and Physical Ontologies

Business Conceptual Ontology (CIM)

Extract and Optimise

Application Ontology (PSM)

The Language Interface

Business

Technology
OWL Datatypes – a Strange Thing

- Business Conceptual Ontology (CIM)
- Application Ontology (PSM)
- Platform specific matter

Extract and Optimise

The Language Interface

Business

Technology
Ontology and Data

- **Conceptual or Reference ontology**
  - Intensional definitions of things in the domain of discourse

- **Pragmatic or Application ontology**
  - Directly relates to data about things in the world
Ontology and Data

• Conceptual ontology: What are the facts (truth makers) that make something mean what it means?
  • Typically social constructs and the like
    • the legal capacity to take and disburse funds
    • Commitments, rights etc.
  • Real world grounding of meaning is usually not found in data
    • Except when it is
    • Hardly any datatypes – only when the computational representation IS the reality

• Pragmatic Ontology: the data signatures that indicate something exists in the world
  • Available data or data derived by reasoning
    • e.g. a banking license
    • Terms of a contractual commitment
  • Use computational datatypes (design decision) to represent ontological things
    • E.g. text / string for Name
Methodology Summary

• OWL as a means of representing FOL
• FOL as a means of setting out intensions
  • In FIBO, Intension is meaning
  • A statement does not require an extent in order to have meaning in this sense
    • Lies have meaning
    • Credit defaults, force majeure etc. have meaning
• There are no made-up “possible worlds” as a workaround
• Intensions are extended as needed
  • Once, many times or never
  • Corresponds to use case in an application
• Extensions are “intended” (i.e. concepts formed) by the organization or the data it uses
Conceptual Modeling Principles

• Concepts not words
• Faceted Classification
• Archetypical concepts
• Semantic grounding
• Find the right “real thing”
• Things in the world versus data surrogates
• Identify the concepts the business uses (not the ontologically perfect)
• Abstraction
• Information is also a kind of real thing
• Processes and events are a kind of real thing
• Social constructs (commitments, capabilities) are real and foundational
• Re-use vetted concepts from communities of practice
• Use and maintain the conceptual ontology through business usage
Ontological Perfection

• The aim of conceptual ontology is not to come up with an ontologically perfect model of the problem domain, but to understand what are the concepts which the business has in its phenomenal world (see discussion in next section) and make these explicit by means of intensional definitions of those concepts.
Ontology Reuse

- Semantic Abstractions
  - Inevitable by-product of the “What kind of Thing is this?” question
  - Examples: Contract, Credit, Asset etc.
  - Leads to...

- Mid Level Ontologies
  - Domain independent concepts
  - Reusable Semantics from other domains

- Aim to identify and re-use available academic work on conceptual abstractions where these exist
Positioning FIBO

• Developed according to conceptual reference ontology principles
  • Foundational semantics – concepts grounded in semantic primitives
  • Intensional definition of concepts (plus written definitions)
  • Real things e.g. social constructs, not data signatures
  • Upper ontology (Sowa KR Lattice Layer 1)
  • Reuse of REA, concepts from DOLCE etc.

• Standardized as a set of OWL ontologies for broad reuse
  • Data focus (signatures not social constructs)
  • Removal of upper ontology
  • Only surface parts of e.g. REA
  • More internal logic (isomorphic) and less abstraction / foundation

• These distinctions are being documented as part of the standard
FIBO: Status; Dependencies

Key
- Depends on
- Alignment / preparation
- OMG Complete

Upper Ontology
- FIBO Foundations: High level abstractions
- FIBO Business Entities
- Indices and Indicators
- FIBO: Status; Dependencies

Reference Ontologies
- Loans
  - Loans Common
  - Mortgage Loans
  - Other Loans
- Structured Finance
- Corporate Actions
- Money Markets
- Bonds
- Debt Securities Common
- Equities
- CIV (Funds)
- Rights and Warrants
- OTC Derivatives
- Derivatives common
- Derivatives Temporal
- Funds Temporal
- Equity and Debt Pricing / Analytics

Temporal
- Process
  - Securities Issuance
  - Debt Issuance
  - MBS Issuance
- Loans Phases and Status

Process
- Upper Ontology
- Common Debt
- Other foundational concepts
- Process
Questions?