

FIBO is the authoritative model of Financial Industry concepts, their definitions, and relations.



The Enterprise Data Management Council (EDMC) is the Global Association of over 200 Financial Institutions (FI) teaching

- Data Management best practices
- Development and implementation of Data Standards.



EDMC members developed the Financial Industry Business Ontology (FIBO), a business conceptual model.

More than 2,332 classes detail financial instruments, business entities, and processes. (as of release 2024/Q2)



Finance key point

You work at a Financial Institution and already embrace model-driven development, industry standards, and reference models.



Finance business stakeholder and expert with a working knowledge of Entity-Relationship and Ontology diagrams.



Data or **Application Architect** experienced in Enterprise Reference models. You may have used FIBO design patterns and definitions.



As an **Ontologist** with an in-depth understanding of the FIBO, you already use the reference ontology for your design and want to spread adaptation across your enterprise.



Introduction to author and publisher



Jurgen Ziemer has 20 years industry experience as a data architect and ontologist at leading Financial Institutions and service providers.

- Seven years as an IBM Software Group Consultant for the Banking and Financial Markets Data Warehouse (BFMDW) model at 45 banks in North America, Europe, and Asia.
- Four years implementing BFMDW at Citi and Deutsche Bank.
- Speaker at FIBO conferences



Jayzed Data Models Inc. is a US consulting company incorporated in 1999.

Jayzed holds the FIB-DM copyrights and is the assignee of US Patent 12038939





There is a chasm between semantic and conventional data management.

The EDMC specified FIBO in Ontology Web Language (OWL).

FIBO is comprehensive with detailed coverage of business entities, loans, securities, derivatives, and indicators.

Large financial institutions started implementations on RDF ("triple") stores



OWL needs highly specialized ontologists.

Many banks and investment managers don't have the expertise inhouse.

IT-departments must still support and design conventional databases.



Finance key point

FIB-DM is the bridge across the chasm.





Finance key point

The ontology transformed into a data model leverages the design for relational databases.





What is the challenge? (stories)

NY Bank needs Schema for new Security Master System; trying to leverage FIBO for Logical Data Model..

Challenge: Data Architects are not familiar with RDF/OWL and have no experience in Protégé or Topbraid Workaround: Ontologist writes SPARQL queries to extract metadata into MS-Excel spreadsheets.

CT AIM with Hedge Fund Ontology SEC Form PF assessments needs a relational platform

Challenge: Converting operational ontology of some 200 FIBO and hedge fund specific classes Workaround: Manual transcription of graphs into ERWin diagrams. Some metadata extract and import.

- Looking for tooling, Protégé and Topbraid do not export LDMs.
- ERWin and PowerDesigner have no import for RDF/OWL.
- Only two less widely used data modeling tools, Sparx Enterprise Architect and IBM Infosphere Data Architect import RDF XML.



Current tooling imports are not fit for purpose

The first FIBO versions were in Sparx EA. Sparx may be used to create ontology diagrams.



Datatype properties become classes

Class restrictions become anonymous pseudo classes

```
No import of annotation properties
```

Infosphere Data Architect aborted.

So, I encoded my custom transformation process.



Ontologis



Financial Industry Business Data Model



- Financial Industry Business Data Model of 3,074 Entities, complete definitions, annotations, and axioms (business rules).
- Data Architects leverage the full content of the Industry Standard.
- Common Language and design patterns for Semantic & Relational databases.



Finance key point

Semantic Enterprise Architecture





Finance key point

Semantic Model-Driven Development



- Midsize Financial Institution without Semantic Technologies yet, adopt FIB-DM, a compatible enterprise model.
- Large institutions use CODT to transform their inhouse ontologies into data models for downstream implementation.



Finance key point

Transformation principles & considerations for the derived data model

- 1. The model must be **practical**.
 - Overly normalized designs become too abstract for business users and developers.
- 2. The model must be **complete**.
 - We don't want to miss information from the ontology
- 3. The model has complete **documentation**. The **diagrams** depict all subject areas and design patterns.
- 4. The model maps back to its source, the ontology



Configurable Ontology to Data-model Transformation

- Source Ontology with connection parameters
- Target tool and model
- Name translation rules
- Ontology module
- Anonymous and equivalent classes
- Object properties
- Data properties
- Annotation List
- Inverse property list.

Configurable Ontology to Data Model Transformation



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Fi	le Hom Inser Draw Page Form D	ata Revit View Deve Help Quic 🔎 T 🕨
BS	• • × • £	Conceptual Data Model
	А	В
1	CONFIGURATION	
2	OPTION	VALUE
3	Source Ontology	
4	Platform	Topbraid Composer
5	File or graph	/FIBO/2018Q4/FIBO_all_llc.ttl
6	Excluded modules	none
7	Target Model	
8	Modeling Tool	PowerDesigner
9	Туре	Conceptual Data Model
10	Name	FIB-DM
11	Object Naming Rules	
12	Code	Prefix:Localname
13	Name	Uncamel Localname
14	Transformation Rules	
15	Infer Packages	Yes
16	Transform anonymous classes	No
17	Transform equivalent classes	Separate entities
18	EA Relationships	
19	Default	Relationships
20	Many-to-Many	Association
21	Parent/Child	Associative Entity
22	Configuration Anr	(+) : (
		■



From FIBO to FIB-DM, to FIBUM – how does CODT work?

The Configurable Ontology to Data-Model Transformation is basic ETL.



We extract metadata from the source ontology, transform ontology metadata into conceptual data model metadata, and load into the data modeling tool, PowerDesigner.

The extract process runs SPARQL on the ontology to get the metadata. PowerDesigner imports MS-Excel workbooks. The Transformation in between is a 2-step process using the patent-pending *Metadata Sets*.



Ontologist

The CODT Metadata Sets.

The Extract process populates the Ontology Metadata Sets for classes, object-, data properties, and annotations.



Step one transforms the ontology metadata and populates the generic ER representation. The Tool-specific metadata set is in PowerDesigner format. We serialize as MS-Excel and directly load it into the tool. Step two is a simple conversion from generic ER to PowerDesigner objects, properties, and extended attributes.



Transformation settings for Domain Ontologies

CODT, the patented, US12038939, **C**onfigurable **O**ntology to **D**ata Model **T**ransformation enables the ontologist and data architect to control the process and mapping.

To transform a domain ontology into a practical enterprise data model, we set:

- Anonymous classes do <u>not</u> transform into entities. The setting is to remove the clutter of entities that never become physical from the model. FIB-DM preserves anonymous classes used in class restrictions in the documentation.
- Names transform from OWL Camel Case to LDM English Names (capitalization and spaces). E.g. fibo-fbc-fct-fse:DepositoryInstitution becomes Depository Institution
- Object Properties transform to PD Associations and Associative Entities (<u>not</u> simple relationships). This preserves the semantically important object property hierarchy and resolves open-world properties. Domain and Range, Class Restrictions determine parent and child entities related to the association/ associative entity.





From FIBO to FIB-DM





Ontologist

Domain ontology generates a perfect CDM

Ontology graph

Conceptual Data Model





Finance key point

FIB-DM Core - a one-thousand-entity open-source model







Finance key point

A self-contained standalone data model.





Finance key point

Quick tour and validation

Expand the packages and navigate to FND Agreements – Agreements. Open the diagram.

Leaf-level packages transformed from FIBO ontologies. Higher-level packages are containers to structure the leaf-level packages.

For FIB-DM core, the rootlevel packages are:

- FND (Foundation)
- BE (Business Entities)
- FBC (Finance Business and Commerce)





Package Properties

	📴 Package Properties - Agreements (AGR) (fibo-fnd-agr-agr) 🛛 🗌	×
The Package Name is the rightmost string in the	General Definition Extended Attributes	
ontology namespace.	Name: Agreements (AGR)	=
	Code: fibo-fnd-agr-agr	=
CODT transforms the ontology prefix as theunique code of the package.	Comment: This ontology defines concepts for agreements, for use in other ontology elements Agreements as defined here are the actual agreements between parties, and this ontology is intended to be referred to in conjunction with the contracts ontology w defines the actual contracts which formalize such agreements. The concepts of agreement and contract are intended to be kept distinct in the FIBO ontologies, the provided to be reserved to be provided to be the provided to be th	hich hat is
Note: All ontology classes, properties with the prefix fibo-fnd-agr-agr become model	neither is intended to be regarded as a sub type of the other.	
objects of the Agreements package.	Stereotype:	~
	Default diagram: ன Agreements - Agreements	~ 💆
	Use parent namespace	
The URI is the Uniform Resource Identifier of the	Keywords:	
ontology. It is a traceability link to the source of	URI: https://spec.edmcouncil.org/fibo/ontology/FND/Agreements/Agreements/	
······································	More >> 🖹 🔻 OK Cancel Apply	Help



rchitect

Ontologist

Package extended attributes

The Extended Attributes tab has a list of ontology annotations.

The default transformation configuration uses the Abstract to populate the Package Comment.

Extended attributes of Data Type Text are multi-line. For example, the Copyright attribute lists the Object Management Group and EDM Council copyrights and the License attribute lists the FIBO MIT license besides Jayzed and GPL-3.0.

	Name	Data Type	Value
ŝ.	Abstract	(Text)	This ontology defines concepts for agreements, for use in other ontology elements. Agreements as defined here
1	Address for Comme	(String)	
<u>)</u>	Change Note	(Text)	The https://spec.edmcouncil.org/fibo/ontology/FND/Agreements/Agreement.rdf version of the ontology was m
8	Content Language	(String)	http://www.w3.org/standards/techs/owl#w3c_all
8	Contributer	(String)	
+	Copyright	(Text)	Copyright © 2019 Jayzed Data Models Inc.
	Depends On	(Text)	https://spec.edmcouncil.org/fibo/ontology/FND/Parties/Roles/
2	Direct Source	(Text)	
1	Editorial Note	(String)	
0	Explanatory Note	(String)	
1	File Abbreviation	(String)	fibo-fnd-agr-agr
2	Filename	(String)	Agreements.rdf
3	History Note	(String)	
4	Is Normative	(Boolean)	
5	Issued	(Date)	



Entity properties

The Name is the ontology class *Localname*, converted from Camel Case to LDM naming convention (capitalized with space between words).

The Code transforms from the ontology class *Prefix*: *Localname*.

The Comment populates from the class annotation RDFS comment and SKOS definition.

There are two particular tabs for ontology derived data models, Annotations and Lineage.

Related D	iagrams	Extended Attri	outes	Dependencies	Hrace	eability Links	Versio	on Info
General	Attributes	Data Protection	Identifiers	Mapping	Annotations	Lineage	Definition	Ru
Name:	Payment (Obligation						
<u>C</u> ode:	fibo-fnd-pa	as-psch:PaymentObl	igation					
Comment:	a legally e to the tem	nforceable duty to p ns stated in a contra	ay a sum <mark>of m</mark> ct	oney, or agree to	do something	(or not to <mark>d</mark> o sor	mething), acc	ordin
Comment:	a legally e to the tem	nforceable duty to p ns stated in a contra	ay a sum of m ct	oney, or agree to	do something	(or not to do sor	nething), acc	cordin
Comment:	a legally e to the tem	nforceable duty to p. ns stated in a contra	ay a sum of m ct	oney, or agree to	do something	(or not to do sor	nething), acc	cordin
Comment: Stereotype: Number:	a legally e to the tem	inforceable duty to p ns stated in a contra	ay a sum of m ct	oney, or agree to	do something	(or not to do sor	nething), acc	cordin
Comment: Stereotype: Number: Parent entity	a legally e to the tem	Inforceable duty to p ns stated in a contra	ay a sum of m ct ☑ <u>G</u> enerate	oney, or agree to	do something	(or not to do sor	nething), acc	cordin



Onto

Entity annotations

FIBO has extensive documentation captured in annotation properties.

The chart shows the number of classes with annotated documentation.



Related	Diagrams	Extended Attrib	outes	Dependencies	Trace	ability Links	Versio	on Inf
General	Attributes	Data Protection	Identifiers	Mapping	Annotations	Lineage	Definition	Ru
Source:	Ī							
Abbreviati	on:							
Adapted F	rom:	Barron's Dictionary of	Business and	Economics Ten	ms, Fifth Edition	2012		
Definition	Origin:							
Explanato	ny Note:							
Synonym:								
<u>U</u> sage No	te:							
	C	Deprecated						
RDFS Cor	nment:							
Defined B	y: [1						
Label:	t	payment obligation						
See Als <u>o</u> :	:	-						
Alt. La <u>b</u> el:		-						
SKOS De	finition:	a legally enforceable (duty to pay a :	sum of money, o	r agree to do so	mething (or no	t to do someti	ning),
Editorial N	ote:							
Example:	t	the <mark>duty of a bo</mark> rrower	r to repay a lo	an, a <mark>nd t</mark> he lega	l right of a lende	r to <mark>e</mark> nforce pa	ayment	
<u>N</u> ote:								
Pref <u></u> Labe	4: -							
Scope No	te:							
Dir <u>e</u> ct Sou	irce:							
Related S	pecification:							

Entity lineage

The Lineage tab captures ontology metadata of the source class. The extended attributes provide traceability into the ontology and preserve semantics beyond the entity-relationship model.

The Resource Name is class *Prefix* and *Localname*. FIB-DM uses the resource name as the entity code, but you can generate your codes in the modeling tool.

The Localname is the rightmost string in the Resource Name and URI.

The Prefix is an abbreviation of the URI defined in the ontology.

The Uniform Resource Identifier of the class is a link into the FIBO source ontology.

Restriction and Equivalent class axioms formulate OWL semantics.

	ams	Extended Attrib	butes	Dependencies	Trace	ability Links	Versi	on Info
General Attri	butes	Data Protection	Identifiers	Mapping	Annotations	Lineage	Definition	Rule
Resource Name	fibo-fno	d-agr-agr-Obligor						
Local Name:	Obligor	6						
<u>P</u> refix:	fibo-fno	d-agr-agr						
Resource Type:	owl:Cla	ass						3
<u>U</u> RI:	https:/	/spec.edmcouncil.o	rg/fibo/ontolo	gy/FND/Agreen	nents/Agreemer	nts/Obligor		
Eguivalent:								
Restriction:	fibo-fno	d-pty-fl.isPlayedBy so d-agr-agr:hasObligat	ome (fibo-fnd-; ion some fibo-	oty-pty:isAPartyT fnd-agr-agr:Com	o min O fibo-fnd- mitment	agr-agr:Agree	ment)	



Entity Restriction

Class restrictions limit the set of allowable instances. For example, the Obligor on the previous page must have an Obligation to some Commitment.

```
fibo-fnd-agr-agr:hasObligation some fibo-fnd-agr-agr:Commitment
```

Note that the ontology object property hasObligation transformed into an Associative Entity in the diagram. The transformation processes the class restriction and creates Relationships from Obligor to the associative entity *hasObligation*. Class restrictions also determine relationship cardinality. Here, the Obligor must have at least one obligation.

Class restriction can be very complex logical expressions. Even the Obligor restriction below is beyond ERM expressivity. The Obligor plays a role as a party to an agreement.

```
fibo-fnd-pty-rl:isPlayedBy some (fibo-fnd-pty-pty:isAPartyTo min 0
fibo-fnd-agr-agr:Agreement)
```

FIB-DM does not transform anonymous classes (= restrictions) into pseudo entities. However, FIB-DM preserves these business rules for the benefit of downstream physical modelers and application developers.



Entity Equivalent

Defined Classes in OWL formulate conditions for the set of members. Unlike for the Primitive Class, we don't construct (~ SQL INSERT) instances of the class. The inference engine, a.k.a. Reasoner determines the instances that match the equivalent condition. For example, the FIBO Foundation Code Set is equivalent to the LCC code set: lcc-lr:CodeSet.

That means that every instance in lcc-lr:CodeSet is also a member of fibo-fnd-arr-cd:CodeSet.

FIB-DM has entities transformed from equivalent classes. The Equivalent Lineage attribute is a hint for the physical modeler to consider an ALIAS.

Defined classes may have more complex conditions. For example, the Affiliate entity is a union of Majority Controlling Party and Controlled Company.

```
fibo-be-oac-cpty:MajorityControllingParty or fibo-be-oac-
cctl:ControlledCompany
```

The Equivalent Lineage attribute is a hint for the physical modeler to consider a VIEW.



Multiple Inheritance

An ontology class can be a subclass of more than one parent class. For example, the Central Bank is both a Bank and a Monetary Authority.

Multiple Inheritance makes sense from a business perspective, and as a conceptual model, FIB-DM keeps multiple supertypes.



However, the LDM permits only one supertype. Note that object models also allow multiple inheritances. The Logical Data Modeler can use the same techniques to resolve multiple inheritances:

- 1. The issue goes away. A logical project model derived from FIB-DM may not scope the Monetary Authority. Then the Central Bank has only one supertype, the Bank.
- 2. The Logical Modeler changes one or both subtypes into dependent relationships. In the diagram, both Bank and Monetary Authority identifiers constitute the key for the bank.





Entity Attributes

FIBO is a domain ontology defining business concepts with classes and object properties. There are only 160 data properties in the source ontology.

Hence, FIB-DM is an entity-level conceptual data model, sparsely attributed and has no keys.

The PowerDesigner CDM has Data Items. These are model objects independent of the entity. The Data Item then gets attached to the entity as an attribute. Data Items as a model object disappear when the modeler derives an LDM from the CDM.

The transformation creates Data Items from source ontology data properties. The property domain and class restrictions determine attributes on an entity.

С	urrency
Currency Name	Variable characters
Minor Unit	Variable characters
Numeric Code	Variable characters
Name	Variable characters
2	







Associations

The PowerDesigner CDM introduces the Association as a model object. Associations stand on their own, rather than depending on two entities. In the example diagram, one or more Identity Documents, such as Passport or Driver's License, identify a person. The Person can also have precisely one National ID, e.g., Social Security Number.

Association Links connect the Association to participating entities. Unlike the relationship, the Association can link to more than two entities.

The CODT process transforms object properties into associations and determines Association Links from the domain, range, and class restrictions.

Associations become Associative Entities, and the Association Links become relationships when the modeler derives an LDM from the CDM.





Associative Entities

Unfortunately, PowerDesigner CDM Associations do not support inheritance. Hierarchies of object properties are an essential OWL construct and widely used in the FIBO.

The default configuration to transform a domain ontology into an EDM, therefore, creates Associative Entities from object properties that are or have sub-properties.



Update: We changed the CODT configuration for recent FIB-DM releases to transform <u>all</u> object properties into Associative Entities.



Associations, a Star Schema?

The context diagram below shows the identifies Association and some participating entities.

Indeed, the diagram looks like a Star Schema (with a "factless" fact table in the center). While this is perfectly fine for a dimensional data model, and the model check doesn't complain, the denormalized design would not be appropriate in a logical data model.

However, as previously done for multiple inheritances, we prioritize the clarity for business users of the design over 4th Normal Form correctness.





Multi-valued association resolved.

After scoping and attribution, the logical data modeler can resolve to 4NF:

- 1. Once the modeler removes entities without attributes, the issue may disappear.
- 2. The standard 4NF resolution breaks down the *identifies* association with role-named associations (a subtype of identifies). E.g., Bank Identifier identifies Bank. The entity Lineage tab Restriction on Bank Identifier shows the class restriction.
- 3. A relationship Role can be added to stipulate the identifier. For example, a Security Identifier Type can tell the application whether to look for a Security Identifier or National Securities Identifying Number.
- 4. The Physical modeler can decide to roll-up or roll-down the identifies subtypes.





Relationships

FIB-DM uses Associations and Associative entities to model relationships between entities.

Hence, Relationship model objects are merely connecting entities to associative entities. They transform from object property domains and class restrictions.

The naming conventions for the code is "parent entity – child entity." For example: fibo-fbc-dae-dbt:Accrualfibo-fnd-rel-rel:appliesTo

Likewise, Relationship Name and Comment generate as per CODT configuration settings.

This concludes the structural overview of the model. The next tutorial introduces FIB-DM business content and design patterns.

	Entity 1	Entity 2
	Accrual	applies To
ieneral Jo	ins Cardinalities Definition	
<u>N</u> ame:	Accrual applies To	=
Code	fibo-fbc-dae-dbt-Accrual-fibo-fr	
<u>co</u> mment:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).
<u>c</u> omment:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).
<u>Co</u> mment: C <u>o</u> mment:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).
Comment: Stereotype: Entity 1:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).
Comment: Stereotype: Entity 1: Entity 2:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).
Comment: Comment: Stereotype: Entity 1: Entity 2:	A relationship to connect the a	associative entity (applies To) to the parent entity (Accrual).



Chasm between semantic and conventional FIB-DIVI is the bridge across the chasm. data management.





Finance key point

