

ON THE ROAD TO REGULATORY ONTOLOGIES

EXPRESSING REGULATIONS IN STRUCTURED NATURAL LANGUAGE

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Governance, Risk & Compliance
AN ENTERPRISE IRELAND
& IDA IRELAND INITIATIVE



OUTLINE

- 1. The team**
- 2. The idea**
- 3. Challenges in consuming regulation**
- 4. Brief overview of the approach**
 - Expressing Regulations in Structured Natural Language
- 5. Applications and benefits**

CREDITS

- **John Hall (Model Systems) & Donald Chapin (Business Semantics) for their continuous support**
- **Leona O'Brien, John Lombard, Patrick O'Sullivan, Peter O'Sullivan for their Legal subject matter expertise and their valuable contributions**
- **Tom Butler, GRCTC Principal Investigator for his valuable support**

EXPRESSING REGULATIONS IN STRUCTURED NATURAL LANGUAGE

GRCTC

THE TEAM

GRCTC, THE TEAM

- **Multidisciplinary research team**
 - Computer Science/ IS, Law, GRC, Finance
- **Academic Institutions and Industry Consortium**
 - Financial Institutions, Content Providers, Software Providers
- **Funded by Enterprise Ireland and the Irish Development Authority**
 - under the Technology Centres programme
- **Project started 20 months ago, centre established 8 months ago**

- **Note: current website is a placeholder, email for more info.**

THE IDEA

THE IDEA – FIBO & FIRO

- **Inspired by the EDM Council's Financial Industry Business Ontology, develop a Financial Industry Regulatory Ontology**
- **To capture/ axiomatize**
 - General regulatory knowledge
 - Domain-specific regulatory knowledge (AML, Capital Adequacy, etc.)

FIRO VIEW 1: A MODULARIZED ONTOLOGY

High-Level Module(s)

Regulatory “Meta-Concepts” (Entity, Action, Sanction, etc.) shared across regulations

Shared-Vocabulary describing a regulation (RegW, AML, etc.) –
Terms, definition, structural relationships between terms, etc.

Structural Modules

Obligations, prohibitions, reporting requirements, etc. from a regulation

Guidance Modules

FIRO VIEW 2: A MULTILAYERED NETWORK OF ONTOLOGIES

General purpose

Reference a general purpose Ontology, when needed: CyC, SUMO, etc.

Foundation

Reuse a set of foundational ontologies: date/time, SKOS, W3C provenance ontology, etc.

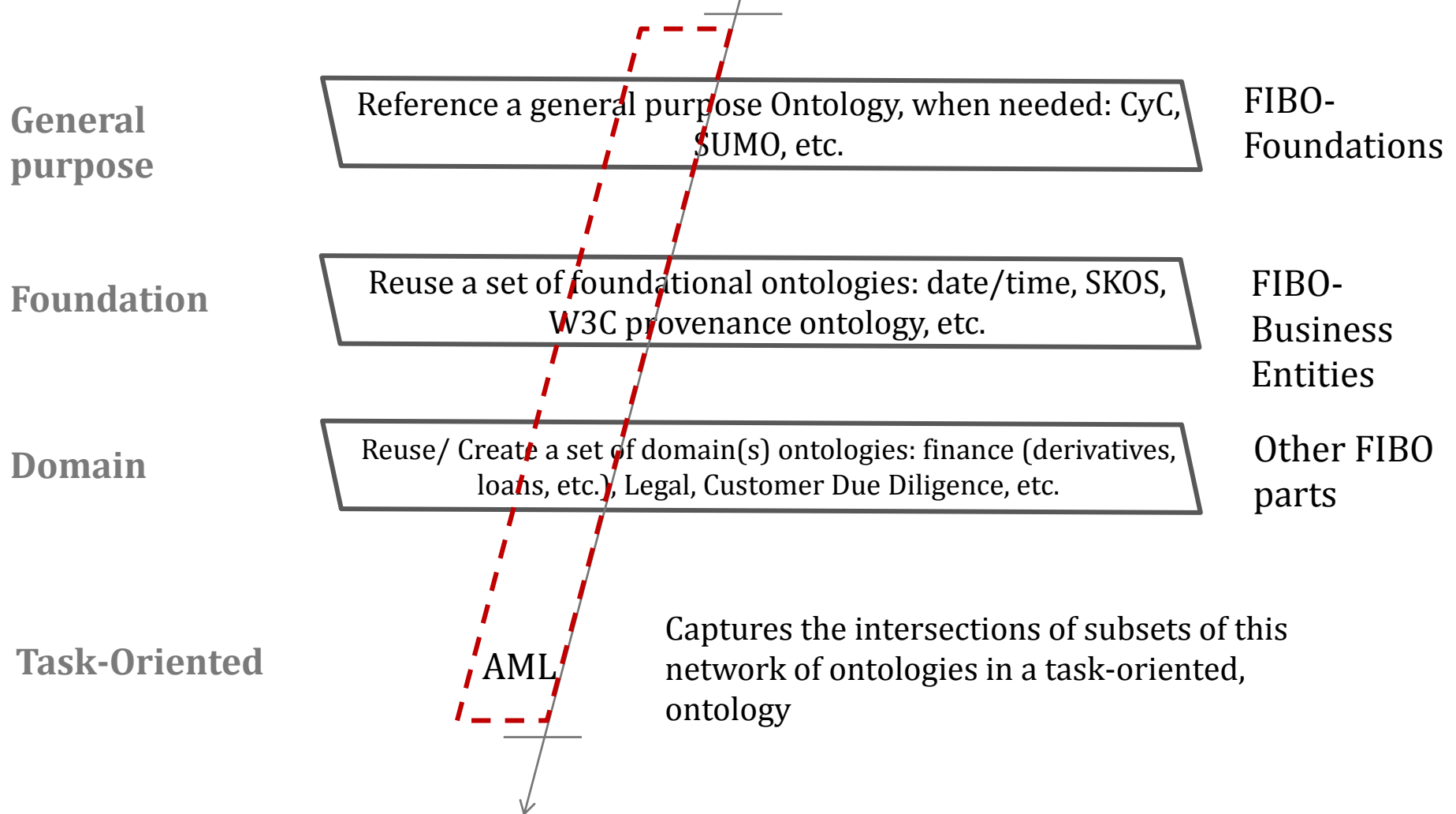
Domain

Reuse/ Create a set of domain(s) ontologies: finance (derivatives, loans, etc.), Legal, Customer Due Diligence, etc.

FIRO VIEW 2: A MULTILAYERED NETWORK OF ONTOLOGIES

General purpose	Reference a general purpose Ontology, when needed: CyC, SUMO, etc.	FIBO-Foundations
Foundation	Reuse a set of foundational ontologies: date/time, SKOS, W3C provenance ontology, etc.	FIBO-Business Entities
Domain	Reuse/ Create a set of domain(s) ontologies: finance (derivatives, loans, etc.), Legal, Customer Due Diligence, etc.	Other FIBO parts

FIRO VIEW 2: A MULTILAYERED NETWORK OF ONTOLOGIES



CHALLENGES IN CONSUMING REGULATIONS

REFERENCES TO FOLLOW AND FLESH OUT

gpo eCFR — Code of Federal R x
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- (C) Creating and retaining records.
- (D) Responding to law enforcement requests.
- (ii) Money services businesses that have automated procedures with such systems.
- (iii) A person that is a money services business solely because it is an agent for another money services business as set forth in § 1022.380(a)(3), and the money services business for which it acts as an agent. Each money services business shall remain solely responsible for development of policies, procedures, and nothing in this paragraph (d)(1) relieves any money services business from maintaining an effective anti-money laundering program.

[...] “A person that is a money services business solely because it is an agent for another money services business as set forth in § 1022.380(a)(3), and the money ...” [...]

DIFFERENT REFERENCES DESCRIBING THE SAME THING?

gpo eCFR — Code of Federal R x

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(D) Responding to law enforcement requests.

(ii) Money services businesses that have automated procedures with such systems.

(iii) A person that is a money services business solely because set forth in § 1022.380(a)(3), and the money services business for between them responsibility for development of policies, procedures (1). Each money services business shall remain solely responsible section, and nothing in this paragraph (d)(1) relieves any money maintain an effective anti-money laundering program.

[...] “A person that is a money services business solely because it is an agent for another money services business as set forth in § 1022.380(a)(3), and the money ...” [...]

gpo eCFR — Code of Federal R x

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agent to accept service of legal process with respect to compliance location within the United States for records pertaining to paragraph (b)

(3) *Agents*. A person that is a money services business solely because money services business, see § 1010.100(ff) of this chapter, is not required services business that engages in activities described in § 1010.100(ff) agent for others must register under this section. For example, a super issuer of money orders and performs no other services of a nature and money services business, is not required to register; the answer would as an agent both of a money order issuer and of a money transmitter. If supermarket corporation, in addition to acting as an agent of an issuer

[...] “A person that is a money services business solely because that person serves as an agent of another money services business, see § 1010.100(ff) of this chapter...” [...]

DEFINITION CHANGES SCOPE

Code of Federal R x GPO eCFR — Code of Federal R x
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(t) **Financial institution.** Each agent, agency, branch, or
 whether or not on a regular basis or as an organized busi

- (1) A bank (except bank credit card systems);
- (2) A broker or dealer in securities;
- (3) A money services business as defined in paragraph (ff) of this section;

(4) A telegraph company;

(5)(i) *Casino.* A casino or gambling casino that: Is duly licensed or authorized to do
 ates, whether under the laws of a State or of a Territory or Insular Possession of the U
 aming Regulatory Act or other Federal, State, or tribal law or arrangement affecting Ind
 itation, a casino operating on the assumption or under the view that no such authoriz
 eration on Indian lands); and has gross annual gaming revenue in excess of \$1 million
 adquarters and every domestic branch or place of business of the casino

[...] “*Financial institution.* Each agent, agency, branch, or office within the United States of any person doing business, whether or not on a regular basis or as an organized business concern, in one or more of the capacities listed below: ...

(4) A telegraph company
 ” [...]

DEFINITION ELEMENTS NEED TO BE DEFINED

[...] “or other unincorporated organization or group, **an Indian Tribe**” [...]

[...] “money services business must, as part of its registration, maintain a **list of its agents**” [...]

Code of Federal R x GPO eCFR — Code of Federal R x
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(mm) *Person*. An individual, a corporation, a partnership, a trust or estate, a joint stock company, a syndicate, joint venture, or other unincorporated organization or group, an Indian Tribe (as defined in the Banking Regulatory Act), and all entities cognizable as legal personalities.

Code of Federal R x GPO eCFR — Code of Federal R x
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§ 1022.380 Registration of money services businesses.

(a) *Registration requirement* —(1) *In general*. Except as provided in paragraph (a)(3) of this section relating to prepaid access and except for sellers of prepaid access as defined in § 1010.100(ff)(7) of this chapter to the extent that they are not already agents, each money services business (whether or not licensed as a money services business by any State) must register with FinCEN. Each provider of prepaid access must identify each prepaid program for which it is the provider of prepaid access. Each money services business must, as part of its registration, maintain a list of its agents as required by 31 U.S.C. 5330 and this section. This section does not apply to the United States Postal Service, to agencies of

COMPLEX SENTENCES

The screenshot shows a browser window with the address bar containing "eCFR — Code of Federal R...". The main content area displays a paragraph of text from the Code of Federal Regulations, specifically 31 CFR Chapter X. The text is annotated with red circles and grey boxes. The red circles highlight the words "obligation", "provided that", "so long as", and "may be liable". The grey boxes contain the following text: "Obligation", "assumption", "Another assumption", "Related possibility", and "Another Related possibility".

(4) The **obligation** to identify and properly and timely to report a suspicious transaction to the appropriate authorities with each money services business involved in the transaction, **provided that** no more than one report is required for each money services business involved in a particular transaction **so long as** the report is filed by the money services business (relevant facts). Whether, in **addition to** any liability on its own for failure to report, a money services business that issues the instrument or provides the money services involved in the transaction **may be liable** for the failure of another money services business

Excerpt from Money Services Businesses : Report of suspicious transactions (31 CFR Chapter X)

AMBIGUOUS SENTENCES

Each foreign-located person doing business, whether or not on a regular basis or as an organized or licensed business concern, in the United States as a money services business shall designate the name and address of a person who resides in the United States and is authorized, and has agreed, to be an agent to accept service of legal process with respect to compliance with this chapter, and shall **identify the address of the location within the United States for records pertaining to paragraph (b)(1)(iii) of this section.**

what does location refer to? the business of the agent, the agents home address or the location where the registration form has to be filed?

Excerpt from 31 CFR Chapter X - 1022.380(a)(2)

(DELIBERATE) AMBIGUOUS REGULATORY INTENT

[...] Matter of “Facts and Circumstances” [...]

[...] unless the context otherwise requires

[...] or other similar items [...]

31 CFR Chapter X subpart A § 1010.100 (ccc)

eCFR — Code of Federal R x GPO eCFR — Code of Federal R x

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day in one or more transactions.

(ii) *Facts and circumstances; Limitations.* Whether a person is a check casher as described in this section is a matter of facts and circumstances. The term “check casher” shall not include:

(A) A person that sells prepaid access in exchange for a check (as defined in the Uniform Commercial Code), monetary instrument or other instrument:

Explained sometimes But not always

SOLUTIONS?

SOLUTIONS?

Need To

- Consolidate
- Disambiguate the meaning
 - Delimit the coverage of a definition
 - Identity demarcation issues while classifying things
 - Identify Obligations and Possibilities
- Interpret
 - The regulatory intent when not accurate
 - Based on previous experience? Jurisprudence?
 - Maybe prioritize the obligations

To do this properly SMEs have a major role to play

Difficult for SMEs to master formal logic (availability, overhead, etc.) – Need an alternative way to create these ontologies

WHY NOT USE NATURAL LANGUAGE...

in a more structured way

- To consolidate references in regulations
- To clarify ambiguity in definitions and obligations
- To interpret collaboratively the regulatory intent

Benefits:

- Overcome the consumption challenges
- And "seamlessly" represent the ontology building blocks in natural language (simple, no need to learn new technical languages)

How:

- Develop a shared vocabulary and shared guidance based on the regulatory text

SEMANTICS OF BUSINESS VOCABULARY AND BUSINESS RULES (SBVR)

- **OMG Specification**
- **Business Natural Language**
 - Used in a regulatory context
- **Grounded in ISO Common Logic**
- **While capturing the interpretation in SBVR, we identify**
 - General Noun Concepts
 - Individual Noun Concepts
 - *Verb concepts*
 - **Keywords**
 - Definitional Rules and Behavioral Rules

SBVR FEATURES

General Noun Concept

credit union

Verb Concept

Definition: *is a* union *chartered under* *the* Federal Credit Union Act *or* [...]

Concept Type: general noun concept

General Concept: union

Source: 12 CFR 700.2

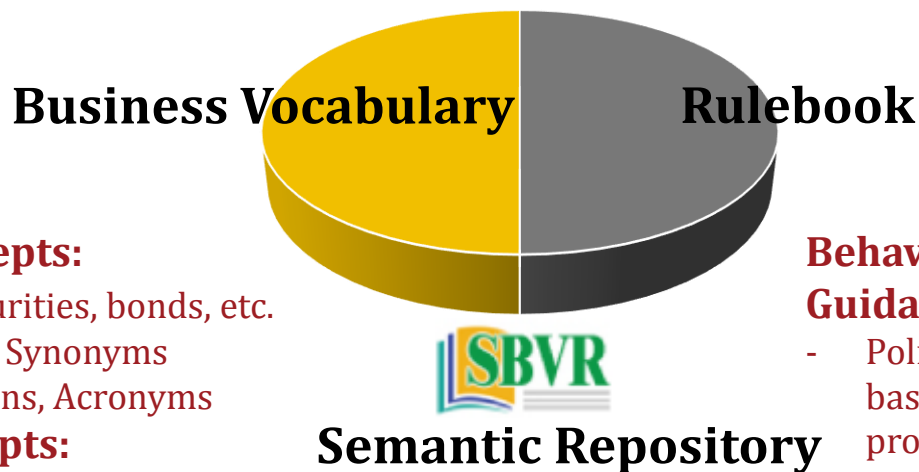
[...]

Keyword

Individual Noun Concept

List of attributes (for every SBVR vocabulary entry)

SBVR FEATURES



Noun concepts:

Car, dog, securities, bonds, etc.

- Definitions, Synonyms
- Abbreviations, Acronyms

Verb concepts:

Relationships among concepts

- General <-> Specific:
 - Securities <-> Bonds
- Composition, aggregation, etc.
- Characteristics:

Loan *has* issuingEntity

Individuals

Joseph, UCC, AIB, BoI, etc.

Structural Rules

It is necessary that each Loan has exactly one issuingEntity

Behavioural Business Guidance

- Policies and rules expressed based on obligation, possibility, prohibition, etc.
- Composed from vocabulary elements

e.g.

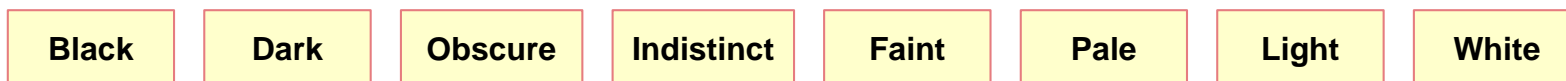
Rule: **It is possible that a Loan has more than one customer**

Rule: **It is obligatory that a customer applying for a loan has a valid ID**

SBVR FEATURES

Conventional Dictionary

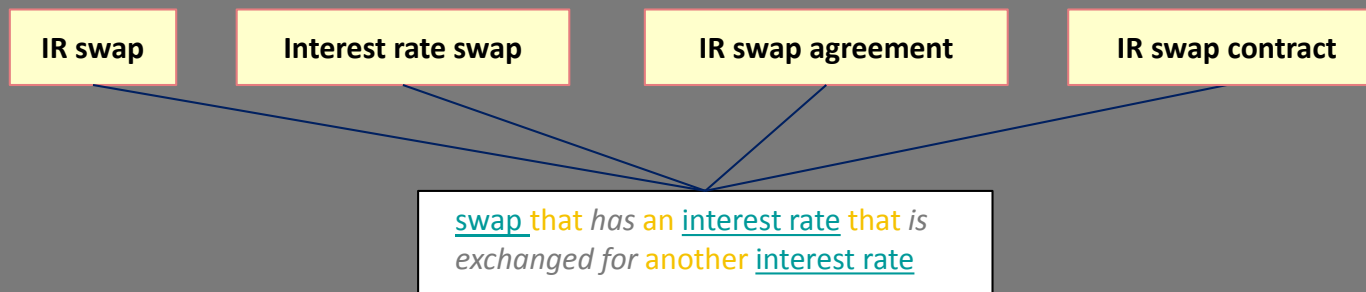
Term-based: each synonymous term has its own definition



----- Chain of approximate synonyms ----->

Terminological Dictionary (SBVR Vocabulary)

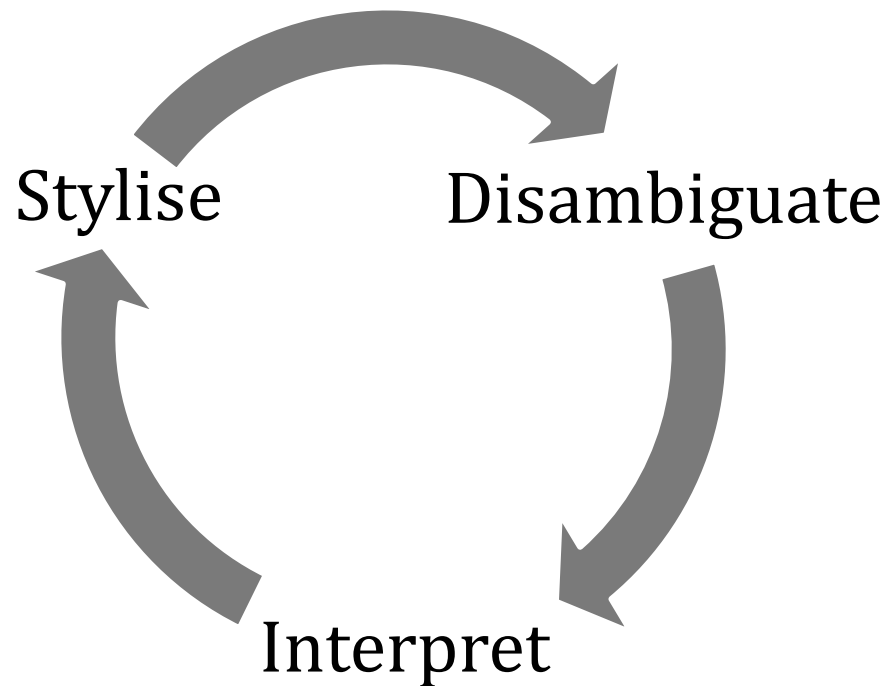
Concepts-based: synonyms share the same definition



Courtesy of J. Hall, Model Systems

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:



INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
 - indicate what element in the SBVR metamodel this term (or set of terms) corresponds to

credit union

Definition: **is a union chartered under the Federal Credit Union Act or [...]**

Concept Type: general noun concept

General Concept: union

Source: 12 CFR 700.2

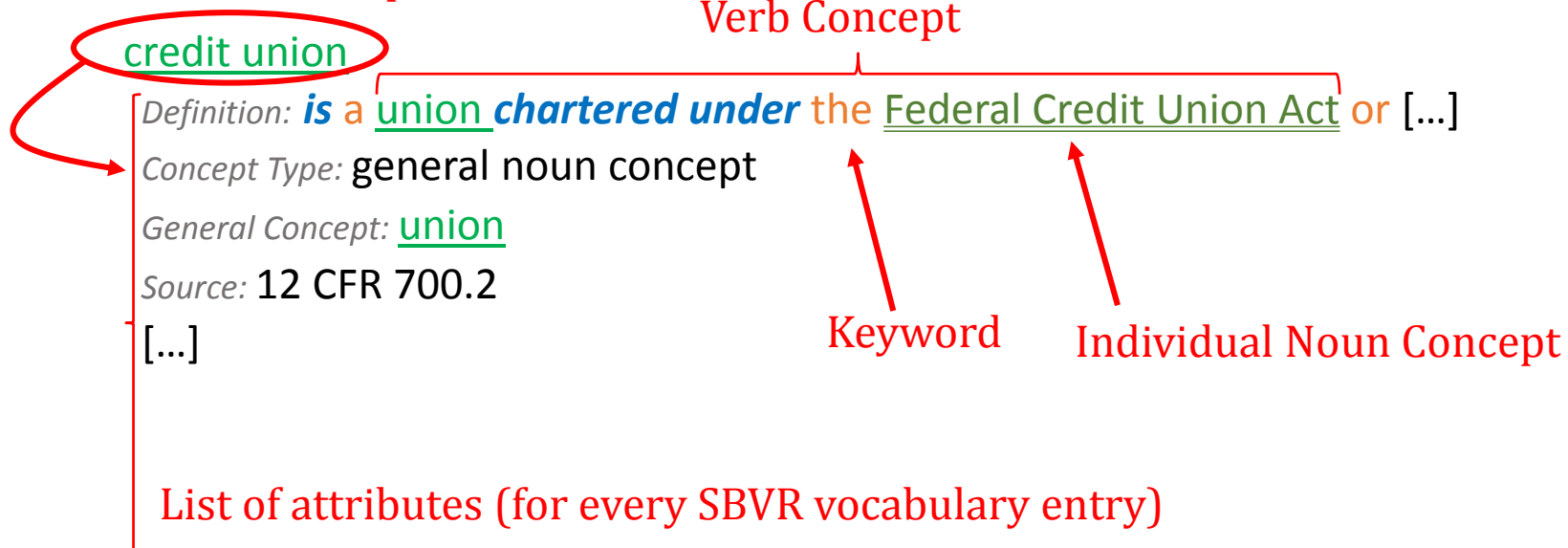
[...]

INTERPRETING REGULATIONS WITH SBVR

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General Noun Concept



INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
 - indicate to the machine what element in the SBVR metamodel this term (or set of terms) corresponds to
- **Disambiguate**
 - Consolidate references

transaction account

Definition: transaction account **includes** accounts **described** in 12 U.S.C. 461(b)(1)(C) [...]

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
 - indicate to the machine what element in the SBVR metamodel this term (or set of terms) corresponds to
- **Disambiguate**
 - Consolidate references

transaction account

Definition: transaction account **includes** accounts **described** in 12 U.S.C. 461(b)(1)(C) [...]



transaction account

Definition: transaction account **includes** deposit accounts **or** accounts **on which** the depositor **or** account holder **can make** withdrawals **by** negotiable **or** transferable instrument, payment orders of withdrawal, telephone transfers, **or** [...]

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Define terms from the text itself or find appropriate definitions

seller of prepaid access

Definition: [...]

Obligation: It is obligatory that a seller of prepaid access **sells** prepaid access **offered under** a prepaid program **provided** that this prepaid access **can be used** before verification of customer identification **under** § 1022.210(d)(1)(iv). [...]

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

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 - [...]
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seller of prepaid access

Definition: [...]

Obligation: It is obligatory that a seller of prepaid access **sells** prepaid access **offered under** a prepaid program **provided** that this prepaid access **can be used** before verification of customer identification **under** ~~§ 1022.210(d)(1)(iv)~~. [...]

Verification of customer identification

Definition: **is** the collection of information **about** the customer **including** name, date of birth, address, and identification number

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Define unclear terms in the definitions themselves (levels of disambiguation)

e.g.: Definition of person uses Indian Tribe but it is not clear what can or cannot be considered as an Indian Tribe

Indian Tribe

Definition: any Indian tribe, band, nation, or other **organized group** or community of Indians that (A) **is recognized as eligible by the Secretary for the special programs and services provided by the United States to Indians because of the status of these Indians**, and (B) **is recognized as possessing powers of self-government**.

Concept Type: general noun concept

General Concept: person

Source: 25 USC Chapter 29 Indian Gaming Act Regulation § 2703 (5)

<http://www.law.cornell.edu/uscode/text/25/chapter-29>

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Define unclear terms in the definitions themselves (levels of disambiguation)

e.g.: Definition of Financial Institution uses Fund (but Fund not defined in the text)

fund

Definition: Distinct pool of financial instruments *managed by* a single investment policy.

Source: FIBO Overview of CIV (Funds) <http://www.edmcouncil.org/semanticsrepository/index.html>

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Identify relationships between things represented by the terms

The List of Verb Concepts in the
shared vocabulary

person *structures* transaction

person designate *is appointed by* money services business

supporting documentation *is maintained by* money services business

agreement *designates* [one] person to register money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Identify relationships between things represented by the terms

**Carry on by repeating the
previous tasks for the verb
concepts**

person *structures* transaction

person designate *is appointed by* money services business

supporting documentation *is maintained by* money services business

agreement *designates* [one] person to register money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
- **Disambiguate**
 - [...]
 - Identify constraints on these relationships

agreement *designates* only one person *to register* money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Disambiguate**

- [...]
- Identify the action(s) on which the modality(ies) lies and
Identify these modalities

provider of prepaid access *maintains access to* transactional records

It is obligatory that each provider of prepaid access *maintains access to* transactional records *for a* period *of* five years.

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Disambiguate**

- [...]
- Identify the action(s) on which the modality(ies) lies and Identify these modalities

provider of prepaid access *maintains access to* transactional records

Modality: Obligation

Modified Verb Concept

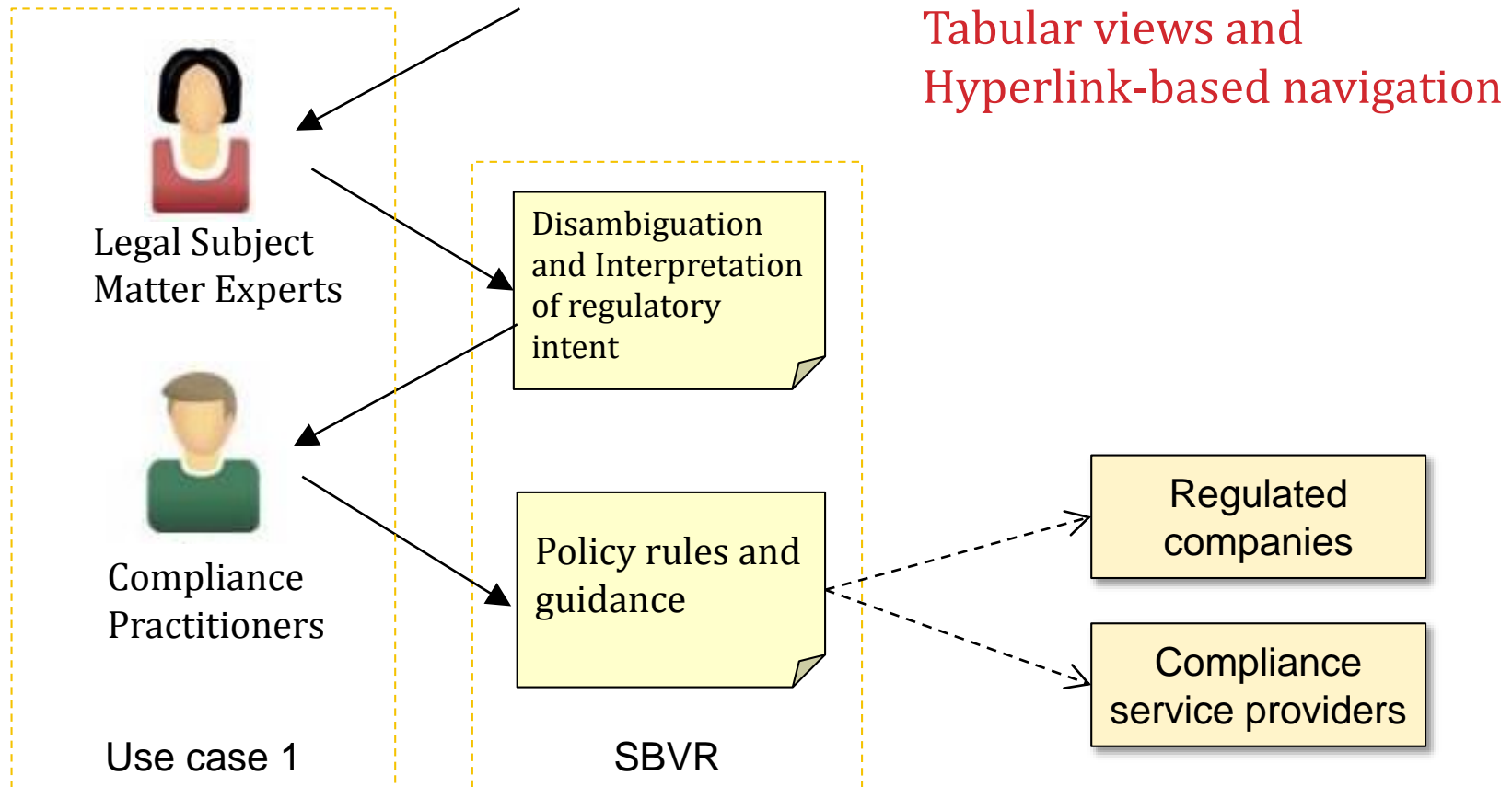
It is obligatory that each provider of prepaid access *maintains access to* transactional records *for a period of five years*.

Constraint

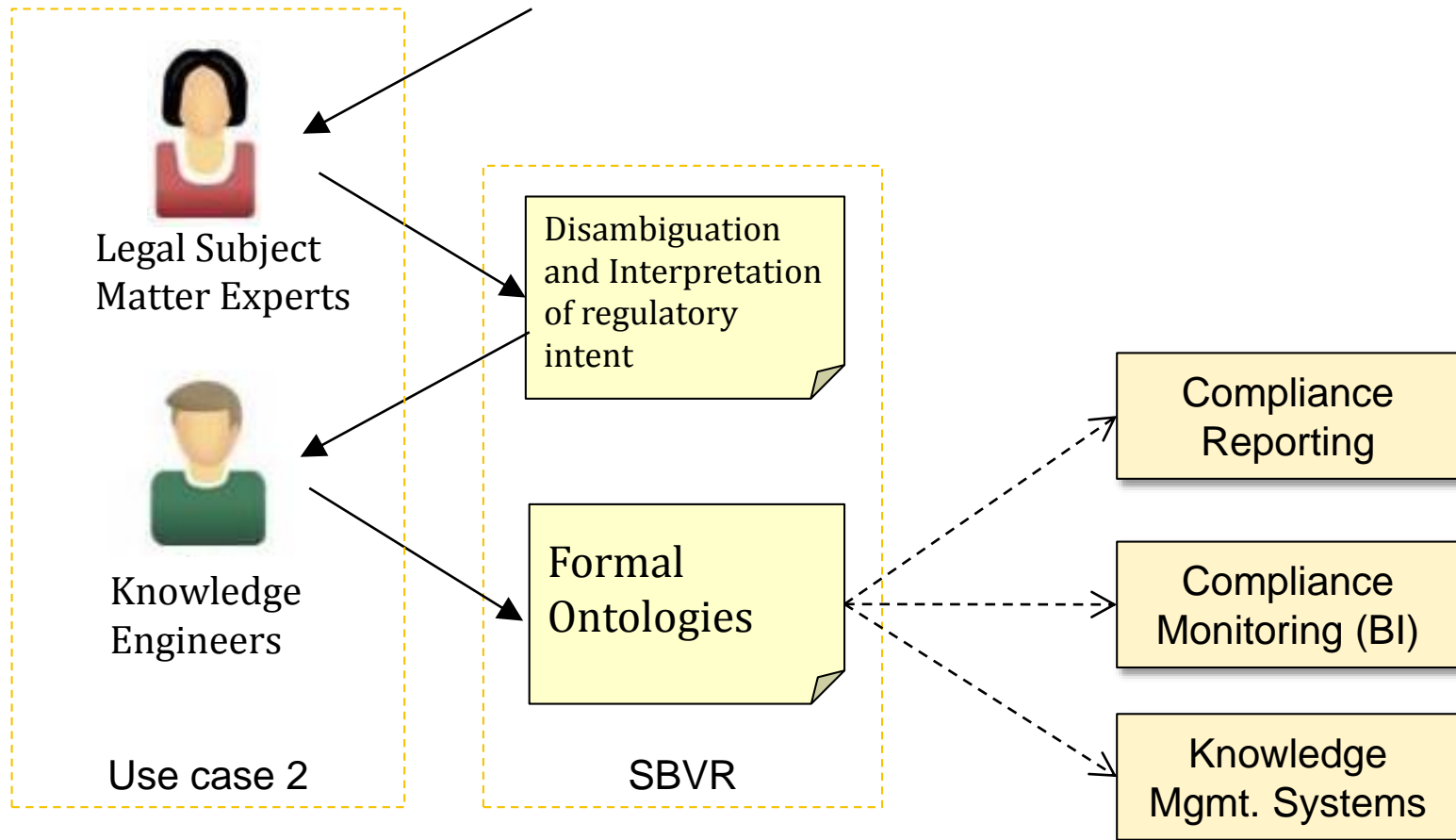
EXPRESSING REGULATIONS IN STRUCTURED NATURAL LANGUAGE

APPLICATIONS & BENEFITS

USING THE REPOSITORY TO CREATE POLICIES



USING THE REPOSITORY TO CREATE FORMAL ONTOLOGIES



USING THE REPOSITORY TO CREATE FORMAL ONTOLOGIES

currency

Definition: **is** the coin and paper money **of** a country that **is designated as legal tender** and that **circulates** and **is** customarily **used** and **accepted as a medium of exchange** **in** the country of issuance.

Concept Type: general noun concept

General Concept: legal tender

Source: 31 CFR Chapter X § 1010.100(m)

Example: the coin and paper money **of** the United States

OWL Class axioms:

- Currency
- LegalTender
- Coin
- PaperMoney
- Country
- MediumOfExchange

OWL SubClassOf

axioms:

- LegalTender /Currency
- Country
/CountryOfIssuance

OWL InstanceOf

axioms:

- UnitedStates/ Country

OWL ObjectProperty

axioms:

- HasCountryOfIssuance
(coin, country)
- HasCountryOfIssuance
(paperMoney, country)
- isDesignatedAsLegalTender(
paperMoney, LegalTender)
- isDesignatedAsLegalTender(
coin, legalTender)
- [...]

SUMMARY & CONCLUSIONS

Immediate benefits

- Remove complexity/ambiguity from regulations and resulting policies and rules
- Improve communication using a shared vocabulary
- Increase immediate understanding with underlying formal logic

Intermediate benefits

- Build controls based on the guidance expressed in SBVR → auditability and backward traceability

Ultimate goal

- Reached when SBVR vocabularies and rules are transformed into fully machine understandable models
- On-going work
 - SBVR XMI Export Validation (against the OMG's Schema)
 - Increase the automation of SBVR XMI → OWL

LAST WORDS...

**Interpreting Regulations is an
Art**

**Our approach makes it a
Science**

THANK YOU

e.abilahoud@ucc.ie

QUESTIONS?