Building an Enterprise Ontology in Less Than 90 Days

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November 18, 2015
SEMANTIC TECHNOLOGY FOR INTELLIGENCE, DEFENSE, AND SECURITY
George Mason University, Fairfax, VA

Building an Enterprise Ontology in 3 Acts

- Act 1 – Do we need to do something different?
- Act 2 – What is it about semantics that will make a difference?
- Act 3 - 6 – “How to’s” for getting this done in 90 days (or less!)
**Semantic Arts**

- Over the last 15 years, we’ve been designing and building ontologies for a number of large firms in many different industries.

- **Schneider Electric**
- **SallieMae**
- **SENTARA**
- **Investment Bank**
- **cdhs**
- **Broadridge**
- **LexisNexis**
- **P&G**

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**Dan Carey**

- Ontologist at Semantic Arts.
- Dan has 30 years of consulting experience, 25 of it designing application databases, logical and physical data models, and data strategies with major IT service firms.
- He has designed semantic technology products to assist in military human resources management, and data exchange standards using OWL and XSD.
- He holds a bachelor’s degree in Applied Physics.
Todd Schneider

- Todd has 25 years of experience as a systems engineer and ontologist, primarily in the defense industry.
- Lead several initiatives within Raytheon and their clients to integrate semantic technology with enterprise architecture.
- Early and frequent participant and contributor to the Net Centric Industry Consortium, and other Net Centric initiatives throughout the federal space.
- He holds a PhD in Mathematics.

Please introduce yourselves

- We can still tailor this presentation based on your needs and backgrounds.
  - Name
  - Organization
  - Experience with Semantic Technology
  - Experience with other information/data technologies
  - Your specific interest in this topic
Dave McComb

- Founded Semantic Arts in 2000
- Co-founded Semantic Technology conference in 2004
- Wrote Semantics in Business Systems
- Four patents in software engineering including first patent on model driven development
- Worked with dozens of large enterprises at the Enterprise Architecture and Enterprise Application level

Act 1
Do we need to do something different?
**Information Systems Cost**

- Our information systems cost 10 - 100x what they could or should cost.

**Why is that?**

- Legacy Systems?
- Vendor Lock in?
- Solving the wrong problem?
- Undue Complexity?

- Certainly a contributor
- Adds to it
- Frequently
- Getting at the root
Yeah, Where did that chaos come from?

- Root-cause analysis lead us to one of the most damaging phrases ever uttered in the Corporate world:

  “Let’s not reinvent the wheel”
Sounds innocent, helpful even

- Let’s explore how it works its way through a decision process
- Someone says “we need x feature”
- “Surely we’re not the first firm to want that. Let’s not reinvent the wheel”
- And a search begins to find a product that can be acquired that has “x”

As if...

- ...You needed a washer,
- ...And you discovered this wheel has a washer!
Before you know it

Surely they don’t...

- Implement large monolithic applications just to handle a small variation in data or function.
- Yep, they do
Examples

- Washington State - Paying employees v. paying w2 providers
- Washington State - 6 referral systems
- Washington State Labor & Industries - 23 systems with Accounts Receivable functionality

Net result

- Most large firms have thousands of major applications
- Each has its own, arbitrarily different data model
  - With thousands of tables and attributes
- Each at an arbitrary level of abstraction,
  - With an arbitrary data structure
  - With arbitrary names
- Leading to millions of distinctions to be mastered
- The implicit and explicit relationships between them are vastly complex
For Example

- SAP - Average SAP Install has 95,000 tables and well over 1 million attributes
- EPIC (Electronic Medical Record) - has 210,000 attributes

Replacing one of these systems

- Most of the time people don’t retire systems, they just build additional ones
- Let’s look at what happens when the project is to actually retire an existing application
Implementing a new system

"Data Quality Problems"
Data Quality / Data Cleanup
Integration

Those darn users

“Change Management”
Most of these projects end poorly

Cost $1 billion to date
Finding plans Allows you to search for plans, some eligibility checking, enrollment
Eligibility Verify income and calculate subsidies
User experience Healthcare.gov has adopted some of healthsherpa's UI ideas
Users enrolled 7.1 million

Initial Build: 3 guys, 3 weeks. Probably a person year since then
Same
Subsidy calculator, but doesn’t check eligibility
Initially much better, browse first, then register later

Healthcare.gov

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Further evidence that these economics are not necessary

- Pinterest — 0 - 10 billion page views/month in 2 years and 40 engineers
- Instagram — 30 million users in 2 years, from 2 engineers to 5

The Question

- Is not: “Is this approach to building and deploying systems dysfunctional?”
  - (it is.)
- The question is: “Why does this approach persist?”
How does the bad idea of adding yet another application to our architecture persist?

Because

- It's in the interest of the vendors
- It's budget-able
- It's what we know
- A credible alternative hasn't been put forward

Steam v. Electricity
We are putting forward two related ideas

1) The data-centric approach to systems implementation is the only viable way to break this pattern
And
2) The application of semantic technology and enterprise ontologies is crucial to the success of the data-centric approach

Data-Centric

- In a data-centric enterprise, the data is the main asset
- Application functionality comes and goes
- The data remains and is added to
- It does not need to be converted
In order for this to work

- There needs to be an architecture...
- ...Which replaces some of the key functions currently being performed by applications

At the architecture's heart is the data
Really a set of coordinated data repositories

Some of which are internally generated and curated and others are not

With shared meaning

This is where the enterprise ontology comes in
Other layers

Include such things as
identity management, security,
common services,
producer and consumer ontologies

What is an Enterprise Ontology?

- Definition of a common core of concepts that expose
  the hidden sameness in what people are talking about,
- That identifies some agreed-upon terms,
- And is represented in a formal notation to support
  automation.
Sounds like a Data Dictionary / Controlled Vocabulary?

- It is
- But it differs from DD/CV in that a DD/CV is primarily for human consumption (users or system designers)
- An Enterprise Ontology is meant for human consumption, plus to be used directly for system building and system integration, and operation
- It’s developed using ontological principals and analyses

Sounds Like an Enterprise Data Model?

- But if each application data model is vastly complex?

- Wouldn’t logic suggest that a model to cover them all would be far more complex than any of the individual models?
In this case...

- The logic is wrong
- It is possible to model an enterprise's information with hundreds of core concepts, plus a manageable constellation of fine-grained distinctions
- Without losing any fidelity

An Enterprise Ontology

- Can capture the fidelity of the distinctions in an enterprise
- Without succumbing to the temptation to recreate the complexity
What are the Key Difference between a traditional data model and an ontology that allow this?

- Structure
- Complexity
- Explicitness
- Flexibility
- Reusability

Structure

- It’s surprising how much the structure of a structured database contributes to its complexity
- The slightest addition, variation, or change in cardinality, seems to give rise to more tables and more attributes
Complexity

- IRS - EDM 30,000 Entities
- AT&T - have been working on an EDM for over a decade
- Most Defense Contractors - Multi-year, Multi-thousand entity efforts

Explicitness

- In traditional models, the meaning is implicit
- It lives in design documents and people's heads
- There is nothing in the "Employee Master Table" to tell you what an employee is
- Only, to tell you a few key attributes we've decided were of interest to us
- In an Ontology the meaning can be explicit
Flexibility

- The structure of a data model is rigid, and programmers rely on that rigidity.
- Many programming idioms rely on the structure of the data being recapitulated in the code.
- This means that data models are easy to re-factor before development begins, and very hard to re-factor afterward.
- This promotes a design style of adding on rather than refactoring, and at some point it is easier to create a new system than to add on.
- Ontology implementation is through a graph database that is inherently flexible.

Reuseability

- There is no extension mechanism for Data Models.
- There is no inheritance model in relational, and while some developers have developed patterns for simulating inheritance it is not widespread.
- Most modelers add additional tables and columns in order to extend a model, or create an entirely new model and application.
- Modularity, inheritance and importation are baked into Ontologies.
- As a result it is usually easier to make small extensions, without disruption.
Oliver Wendell Holmes

“I would not give a fig for the simplicity this side of complexity, but I would give my right arm for the simplicity on the other side of complexity.”

Some Evidence that Semantics Helps

- Sallie Mae
- Secretary of State (WA)
- Sentara
- Schneider-Electric
Case Study: Reducing Complexity at Sallie Mae

<table>
<thead>
<tr>
<th></th>
<th>tables</th>
<th>attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>582</td>
<td>10,230</td>
</tr>
<tr>
<td>LoanCons</td>
<td>133</td>
<td>15,295</td>
</tr>
<tr>
<td>Eagle I</td>
<td>356</td>
<td>13,538</td>
</tr>
<tr>
<td>Eagle II</td>
<td>464</td>
<td>12,502</td>
</tr>
<tr>
<td></td>
<td>1,535</td>
<td>51,565</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes</td>
<td>366</td>
</tr>
<tr>
<td>Object Properties</td>
<td>224</td>
</tr>
<tr>
<td>Datatype Properties</td>
<td>13</td>
</tr>
<tr>
<td>Individuals (Categories mostly)</td>
<td>227</td>
</tr>
<tr>
<td>Total TBox Axioms</td>
<td>1,030</td>
</tr>
</tbody>
</table>

Case Study: Reducing Complexity at WA Secretary of State

- Existing System Columns
- Domain Columns
- Tables
Case Study: EO for Sentara Healthcare

- **Enterprise Ontology**
- **Scope:** entire enterprise: healthcare, assisted living, insurance and internal systems
- **Size:** 1,276 classes/397 properties
- **Applications:**
  - We co-developed a Proof of Concept in Asthma and COPD, and the newly uncovered concepts we are finding are directly derivable from the core.
  - Currently being used as basis for semantic enterprise search. More than adequate coverage.
  - Flexible way to manage Physicians data across multiple sources

Case Study: Schneider Electric

- **Existing product catalog systems has about 700 tables and 7000 attributes in total**
- **To date the new system has populated 46 classes and used 36 properties.**
- **We expect this to slightly more than double, to include the full scope**
Act 2

What is it about semantics that will make a difference?

Semantic Technology

- Semantics - Pertaining to the study of meaning
- Semantic Technology - software and methods that rely on representing meaning, especially those that are based on the Semantic Web stack as standardized by the W3C
- However, information systems don’t understand ‘meaning’; they interpret symbols.
  - OWL and ontologies built using it provide a way to better control how they interpret the symbols.
Blub Paradox

How can they get any thing done without x?

What is all that crap?

Blub

Low Programming Language Power Continuum

High

Developers and Semantics

- Most enterprise developers have come from either Relational, Object-Oriented or JSON-style document backgrounds
- When building ontologies, they tend to build them to resemble what they are used to
- Then they wonder why it doesn’t do X as well as their approach of choice
- And what’s all this “inference” and “open world” stuff, anyway?
What Differentiates Ontology?

- All information representation is reduced to a single data structure: the “triple”

By convention

- The three parts of a triple are called...
Useful Global Identifiers

- All systems create identifiers for the many things they need to identify and distinguish
- The typical approach is to create a primary key on a table

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>007</td>
<td>Bond, James</td>
</tr>
<tr>
<td>002</td>
<td>Fairbanks, Bill</td>
</tr>
</tbody>
</table>

There are problems with this approach

- These numbers only mean anything in the context of:
  - This database
  - This table
  - This column
- They embed context and hide usage
This is one reason existing systems are complex

- If you want to get information from multiple different tables
- You have to write a query that 'joins' the tables
  ```sql
  ... WHERE SecretAgent.ID = Gadgets.Assignee And SecretAgent.ID = FemmeFatale.Foe
  ```

A human has to know all the (implicit) metadata to construct this join for each use.

This only works between tables in the same database.
We need context-independent identifiers

• GUIDs
  • May be globally unique, but not globally resolvable
  • Nor are they easily interpretable
    • What do you do when someone sends you a message with this in it?
      • (21EC2020-3AEA-1069-A2DD-0B002B30309D)

W3C’s Semantic Technology Stack
Finesses this with the “URI”

• Uniform Resource Identifier
  • Analogous to the URLs we type into our browsers
  • Each part in a triple is identified by a URI

namespace       fragment
http://cusip.com + /reg#
(domain name) (path) (id)
http://cusip.com/reg#02209S103
W3C's Semantic Technology Stack
Finesses this with the “URI”

- This identifier is truly global
- It means the same thing, regardless of the database or document it is part of

```
cusip:02209S103 = http://cusip.com/reg#02209S103
```

- The metadata has been made explicit
- In turn, this yields information that can be “joined” without relying on humans or additional (implicit) knowledge of the metadata

Using URIs (similar to URLs) as identifiers

- Gives us truly global unique IDs
- That can be looked up, if needed

```
http://isbn10.isbn.org/books#1558609172
```

This is the key to “self-assembling structures”
Let’s Visualize this Process

- Let’s say we the following triples were harvested from completely different sources
- CUSIP: Identifier for a Financial Securities

CUSIP: Identifier for a Financial Securities

CUSIP: 02209S103

cusip:filedBy

cusip:02209S

cusip:name

"Altria"

cusip:02209S

foaf:name

"Phillip Morris"

cusip:underwrittenBy

cusip:123456

Tinker toys
Accommodates change in place

- A semantic system can evolve in place
- Example: Tasks → Projects → Backlogs → Assignments → Expenses

Of course these graphs can get more complex than you could represent with Tinker Toys
Relation of Metadata to Data

- Metadata is also represented as triples
- It is made explicit
- It can be queried

Including Metadata

- Metadata is the data that defines your current systems

[Diagram with RDF triples:

:Employee :subClassOf :Person

:Employee :type :Class

:_dave :type :Employee]
Triples from RDB

- One of the most common sources for triples is from existing relational databases

Making Assertions, Traditionally

- In a traditional system, we make assertions by putting data in tables

Person 1 is named John

<table>
<thead>
<tr>
<th>PersonId</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John</td>
</tr>
</tbody>
</table>
Making Assertions, Traditionally

- Including relationships

John is the parent of Dave.

<table>
<thead>
<tr>
<th>PersonId</th>
<th>Name</th>
<th>ParentOf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Dave</td>
<td>3</td>
</tr>
</tbody>
</table>

Where do triples come from?

- Triples can come from existing systems

McComb:1 `br:parentOf` McComb:2

<table>
<thead>
<tr>
<th>PersonId</th>
<th>Name</th>
<th>ParentOf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Dave</td>
<td>3</td>
</tr>
</tbody>
</table>
Where do triples come from?

Databases

Where do triples come from?

Documents
Where do triples come from?

- Text
  
  Birth notice: John and Naomi McComb gave birth to a son on November 18, 19xx named David Walter McComb.

- Web pages

XML and HTML

```xml
<vcard style="background-color: F9C; width: 360px; height:..."
  <fn>
    <given-name>Doug</given-name>
    <family-name>Mahugh</family-name>
  </fn>
  <street-address>One Microsoft Way</street-address>
  <locality>redmond</locality>
  <region>WA</region>
  <postal-code>98052</postal-code>
  <email>mailto:dm%61h%75%67h@m%69%63%71</email>
  <tel>
    <value>+1-425-882-8080</value>
  </tel>
</vcard>
```
Where do triples come from?

- Social Media

Where do triples come from?

- The Web
DBpedia

270 million triples

Triple as Common Denominator
Inferring new information from existing

- Ontologies also provide a means for inferring new information from existing information.

The most important new information we infer is class membership.
And because class membership is just another triple

- The same instance can be in many classes simultaneously.

Description Logics

- Description Logics give a way of define the membership criteria for classes.
- This means that computer systems can do a lot of the classification that we currently have humans do.
- And that makes the rules transparent.
  (Current approaches bury meaning in code and specifications.)
Modularity

- The way that modularity works with ontologies is very cool

        Upper Ontology
           ↑                      ↓
          ↑                        ↓
     Enterprise Ontology      Application Ontology
     ↓                        ↓
    Application Ontology

Importing Ontologies

- Because they have no structure (beyond triples), it is very easy to extend and reuse ontologies

     Person Ontology
     ↓
  Doctors Ontology

     A doctors ontology could import a Person ontology and use that as its starting point (people have dates of birth, and addresses and the like)
Importing Ontologies

- Because they have no structure (beyond triples), it is very easy to extend and reuse ontologies.

A hospital ontology could not only import and use the doctor ontology, it could create a superclass of doctor, called provider which also might include organizations. It can superclass another class without the other class or ontology being aware.

Versus Relational

- In relational paradigms, there is no real concept of extending a model.
- At best, developers copy one schema for a starting point and change it from there.
Versus Object-Oriented

- In object-oriented approaches, you can extend a common model through inheritance.
- But there is no mechanism to create new classes (even superclasses) in descendent models.
- Further, with semantic technology, the order in which the ontology extensions are created is not important. You can create the sub-ontology first and unify it with another later.

Review: Characteristics of Semantics that Make it Uniquely Suited to Role as EO
Value of a Triplestore / Graph DB

- In general, the main advantage of a Graph DB over a Relational DB lies in its flexibility, and the ability to evolve in place.
- We're going to go over three specific examples of how that manifests itself.

Global / Resolvable identifiers

- In a relational system, all IDs are contextual; you need to know the DB, the table and the column to use the identifier.
- In a triplestore, all identifiers are URIs. They are globally unique and resolvable.

Once we assign a URI to an individual or concept, it means exactly the same thing, no matter what database or repository it is in.

What this means is that “joins” are done automatically for you by the system.
The relationship of Schema to Data

- In a relational system, a table must exist before you can put data in it.
- In a graph DB, you can create data and later associate it with newly created classes.

For example, in a triplestore, you could start with people and medical treatments, and later create the idea of a patient, without having to redo any of the data you’ve already committed.

What this means is that you can start simple and add as you need.

Instances can belong to many classes

- In a relational system, a row exists in only one table.
- In a graph DB, you can create data and later associate it with newly created classes.

For example, in a triplestore, you could have an instance (a URI) that represents a person, who is both a patient and a provider. In a relational system, you create two records and then have to have another way to determine that they are the same.

What this means is a great reduction in redundancy.
The Relationship of Applications and Schema

- In a relational system, schemas are built to the needs of applications. They are owned by the application.
- In a triplestore, the schema is a shared resource. Many applications cooperate around the same model.

Traditionally, every application has its own data model. This is what drives the cost of integration so high. In a semantic system, we share as much modeling as we can, running the integration costs down.

What this means is that data integration is almost a bi-product of building semantically.

Our Quest

- Find the stability
- The enduring business themes
One aspect

- Things that are generally well agreed upon

Person

Account

Semantic Primes
Abstract until everyone agrees

Credit Default Swap

Obligation

Core

- We’re looking for a core that is stable
- Not unchanging
- Just rooted
- In such a way that we can let the things around it change at their natural rate
An Analogy: Pace Layering

Stuff
Space
Skin
Systems
Structure
Site

An Analogy: Pace Layering

Stuff
Aesthetics
Space
Navigation & Search
Skin
Capability
Systems
Formal Taxonomy
Structure
Enterprise Arch
Site
Enterprise Ontology
Our Position

- A Core Enterprise Ontology:
  - Is Necessary - in order to provide some sort of framework and stability to the rest of your information systems efforts
  - Should be Understandable - the value expands greatly when it is well understood and used
  - Can be Elegant - there are typically a few hundred concepts that cover most information system activity
  - Can be Flexible - the model should be able to evolve in place and be extended by some groups without impacting all

At the end of the EO process

- You will have a model that is 1% as complex as your current models
- And that seems to gain as much as it loses in fidelity in use
Example of how a simple ontology isn't lossy

Act 3
6 “how to’s” for getting this done in 90 days or less
Getting Started

- Most companies don’t want to “boil the ocean” with an Enterprise Data Modeling effort
- They believe (correctly) that this could take 1-2 years, with questionable payoff
- We’re going to suggest some techniques for doing this in a much more streamlined fashion
- You could complete this in 3 months
- If you also do it agilely, you could begin using it in 1

Six techniques / methods for getting your EO complete in 90 days

1. Separate your artifacts by purpose
2. Use gist
3. Model the real world
4. Economize expression
5. Postulate the solution, don’t extract it
6. Use inference to check for errors
1) separate your artifacts by purpose

- Taxonomy / Ontology Assessment
- Became Knowledge Artifact Assessment

Purpose-Driven

- The assessment of an artifact turned out to be very contextual
- And the main context is “what is the intended purpose for this knowledge artifact?”
- Some characteristics of a taxonomy (for example MECE (Mutually Exclusive/Completely Exhaustive)) are very important for some purposes, and get in the way for others
For each Knowledge Artifact

- Evaluate as suitable for:
  - Categorization Scheme
  - Navigational Search
  - Textual Search
  - System Building
  - Systems Integration
  - Analytics / BI
  - Harvesting Info

We’ve discovered

- These purposes have wildly different definitions of “goodness”
- An artifact for textual search wants to have many, many synonyms for every term
  - (One of our clients said they had on average 29 synonyms for every term)
- By contrast, having lots of synonyms tends to confuse things during integration and system-building
Modularity to the rescue

- In the 2nd Act, we mentioned the power of modularity
- Now we can begin to harness that modularity
- Rather than either throw away all the excessive synonyms
  - Or load up on them
  - It’s not an either/or question
- Have the core, and modularly extend it with the synonyms
- If you don’t need the synonyms; only get the core
  - If you do get them, organize them around the core

What we’ve found

- Many classes are merely taxonomic differences
  - It doesn’t add anything to make them classes
  - And it interferes with the elegance of the model
- Moving them to modules that can be under separate governance speeds development and eases maintenance
Fractal Modeling

- Move most of your taxonomies out of the class structure
- Separation of governance
- Simplification of the model

Move Minor Distinctions to Taxonomies

- We’re tempted to put everything we know into our ontologies
- Many distinctions are best “pushed” to taxonomies
- Where mere mortals can debate and rearrange them
- Without destabilizing the ontology
**Special Individuals**

- Most ontologies have a small number of "special" individuals/instances.
- For example, the only semantic distinction between accounts payable and accounts receivable is who "you" are (your firm typically).
- Sooner or later, this becomes a definition based on an instance or several instances.
- Other special instances include those that participate in definitions that cannot be formally defined practically and have to be accepted.
- ("male" and "female", or "exempt" and "non-exempt", for instance)

**Classes and Taxonomic Instances**

- Strive to be more like GeoNames than Snomed.

<table>
<thead>
<tr>
<th></th>
<th>GeoNames</th>
<th>Snomed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts</td>
<td>10 million geographical names</td>
<td>Presumably millions</td>
</tr>
<tr>
<td>Classes</td>
<td>19</td>
<td>303,035</td>
</tr>
<tr>
<td>Properties</td>
<td>33</td>
<td>152</td>
</tr>
<tr>
<td>Taxonomic Categories</td>
<td>645 “feature codes”</td>
<td>In classes</td>
</tr>
</tbody>
</table>
Separation of Concerns

- Meaning (OWL) vs Structure (RDF Shapes)
- If you're trying to answer the question “which properties go on this class” by looking at the ontology, you’ve collapsed these two ideas
- The ontology should be the province of coining new terms, establishing meaning and providing the rules for inference

RDF Shape Example

```xml
<ProductRef> {
    rdf:type (spo:ProductReference)
    , gist:identifiedBy @<ProductID>
    , spo:describedBy @<ProductReferenceDescription> ?
    , gist:memberOf (@<ProductRange> | @<ProductSubRange>
| @<NewProductRange>) *
    , gist:categorizedBy @<ProductOrComponentType> *
    , gist:categorizedBy @<ProductFunction> *
    , gist:conformsTo @<Standard> *
    , gist:specifiedBy (@<SpecEntry> | @<TabularSpecEntry>)?
}
```
2) Use gist

http://semanticarts.com/gist

Introducing gist

- An upper enterprise ontology containing a minimal set of concepts required by most businesses.

- Copyright Semantic Arts, Inc.
  Rights to use are conveyed under the Creative Commons Attribution-ShareAlike 3.0 license.

- Current version at http://ontologies.semanticarts.com/gist/gist.owl

- Consists of a core plus several “subgists.”
Get gist from our web site

(www.semanticarts.com/gist)

gist Attribution

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About half the EO classes were derived from gist.

We evolved gist and our methodology.

Discover and Build → Evaluate & Debug Cycle

Refactor
Current Projects

- Most classes derived from gist, without even trying

What is gist?

- Fewest concepts
- Broadly agreed on, across industries
- That cover most, of most, enterprises
- Least ambiguity
- Stable, ten years old (used in about a dozen major projects)
- Evolving (we keep refining it)
Abstract?

- Many people think that to cover an entire enterprise with a few hundred concepts, they'd have to be pretty abstract.
- And some upper ontologies are quite abstract.
- One, for instance, has a high-level distinction between “endurants” and “perdurants” (things v. events).
- We think of these as “abstract abstractions”.

Concrete Abstractions

- We're trying to work at the level of “concrete abstractions”.
- Classes where the members are easily grasped, if slightly abstract.
- Person is a concrete abstraction.
- We can create an instance of Person, and as we learn more about the person, we may decide (by assertion or inference) that they are also more specific types of persons (Doctors, Brokers, Adults, etc.)
gist - Major Families of Classes

<table>
<thead>
<tr>
<th>Major Families of Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UnitOfMeasure</td>
</tr>
<tr>
<td>Magnitude</td>
</tr>
<tr>
<td>Other (Collections, Concept, Language)</td>
</tr>
</tbody>
</table>

- Time
- Place
- Landmark
- Person
- Organization
- Staff
- Documents
- Agreements
- Events
- Intention

Learning gist

- Manageable number of concepts
Modular

- As of 7.x, gist is very modular
- Understanding how the modules fit together adds a bit of conceptual baggage
- However, each module now is so simple as to be almost self-explanatory

Gist is made of 18 modules

Opening this one will import all (through transitive closure)
Address

- We treat address as a first-class object (not an attribute of a person or company)
- And the use of that address by a Person or Organization as essentially a communication preference
- This one change makes the chaos of addresses in most enterprises manageable
3) Model the real world

- It's very easy to fall into the trap of modeling the concepts you find in the application
  - (or in people's heads, which often came from an application)
- Many of them are ok
- But the only way to know which is which, is to try to get as close to the real world as you can.
  - It will shine a light on which are contrived
- Some examples: PIMS, Tabulars, Sections, most junction records., legs, and most booleans

Stay away from abstract abstractions

- Person and Agent are both abstractions
- But pretty much everyone (other than foaf) agrees on what a person is
- But agent...
  - In many cases it is Person or Organization
  - But sometimes machine
  - Or program
  - Or animal
- The real meaning is in the property (the agent on "wasBittenBy" is Animal, whereas the agent on "durablePowerOfAttorney" is Person.)
4) Economize expression

- It’s tempting to put everything you know plus everything you learn in the ontology
- “you might need it”
- These things clutter up the result
- And confuse the use
- Many are unlikely to be widely agreed upon
In an Enterprise Ontology

- Less is more
- Don’t get paid by the pound
- Remember what happened with lines of code?

Reducing Cognitive Load

- # of things you must know to be competent with the ontology
- # of things you must be in agreement with in order to commit to the ontology
- # of concepts shared
Economizing Properties

- Typical large enterprises have millions of properties (attributes/columns) in their legacy systems
- This is mostly a product of arbitrary design decisions
- We need to be vigilant
- Properties (with a few very narrow exceptions) cannot be formally defined; we must learn them all
- Our target is to get to a few hundred

The Ontology Sketch

[Diagram showing the Sentara Healthcare Enterprise Ontology: Concise Overview]
Overall Shape of the Ontology

BBC Programmes Ontology sketch
5) Postulate the solution, don’t extract it

- Over the last several years we have been moving from a “discovery model” to a “postulate model” for ontology development

**Discovery Methodology**

- Author OWL
- View in ontology editor
- Interview
- Run inference to check consistency
- Debug cycle
- Inferencing/Consistency
- Interview/Model cycle
Postulate Methodology

Then check existing systems

- Find the correlates
- And look for the things not postulated
- How do they relate?
**Mapping**

- One of the better ways to check for coverage

<table>
<thead>
<tr>
<th>Physician Data Elements</th>
<th>Subject</th>
<th>Impacts</th>
<th>Description</th>
<th>Data Source</th>
<th>Coverage %</th>
<th>statuses</th>
<th>More Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name (First Name)</td>
<td>Yes</td>
<td>80</td>
<td>Family Name</td>
<td>Medical Record</td>
<td>[80]</td>
<td>[80]</td>
<td>[80]</td>
</tr>
<tr>
<td>Name (Last Name)</td>
<td>Yes</td>
<td>80</td>
<td>Family Name</td>
<td>Medical Record</td>
<td>[80]</td>
<td>[80]</td>
<td>[80]</td>
</tr>
<tr>
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<td>Yes</td>
<td>80</td>
<td>Address</td>
<td>Medical Record</td>
<td>[80]</td>
<td>[80]</td>
<td>[80]</td>
</tr>
<tr>
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<td>100</td>
<td>SSN</td>
<td>Medical Record</td>
<td>[100]</td>
<td>[100]</td>
<td>[100]</td>
</tr>
<tr>
<td>Provider ID</td>
<td>Yes</td>
<td>80</td>
<td>ID</td>
<td>Medical Record</td>
<td>[80]</td>
<td>[80]</td>
<td>[80]</td>
</tr>
</tbody>
</table>

Many attributes collapsed

- We found 10 attributes for identity (SSN, Provider DB ID, etc) are all covered by gist:identifiedBy
Mapping added a bit to the ontology

- As you’d imagine, the act of crossing all those t’s and dotting all those i’s lead to a few extensions to the model.
- But not much, and nothing that really changed the shape of the model.
- And this is what we would hope: even as we add additional data sources, internal or external, we expect them to be extensions to the existing structure.

Profile

Global IDs

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6) Use inference to check for errors

- Use the power of semantics to help find errors
- And hidden similarities

Partial Example - Network Agreement

- Even though the agreement between physicians and insurance companies didn’t show up in the data we were provided, we know it exists
- It is an essential bit of information, which initially we will only be aware of for InsCo agreements. But eventually we may become aware of others, and this structure allows us to hold a place for them without incurring any overhead
Check it for logical consistency using Protégé or Top Braid

Agile -- Detecting Errors

- The “easy to change” aspect of agile requires a way to detect errors.
- Two of the more effective that we use are
  - High-Level Disjoints
  - ABox Unit Tests
Disjoints

- Most of the errors that a tableau reasoned will surface stem from disjointness (or negation/complement) assertions.
- No disjointness = no error checking.

High-Level Disjoints

[Diagram showing disjoint relationships between Person, GeoRegion, Comedian, City, and Chevy Chase]
**ABox Unit Tests**

- Check for things that should not arise in the course of using the ontology, and use them for unit testing

ASK {
  ?tc rdf:type sa:TimeCharge .
  ?t1 gist:universalDateTime ?start .
  ?t2 gist:universalDateTime ?end .
  FILTER(?end < ?start)
}

**Case Study**

- From discovery to postulate and test case study
Questions?

For more

http://semanticarts.com