OntologySummit2009 Communiqué: Toward Ontology-based Standards (1TTS)

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  - this version has been edited by SteveRay / 2009.05.15 (1WK5)

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Summit Resolution and Endorsement Statement (1WK8)

Each annual Ontology Summit initiative makes a statement appropriate to each Summits theme as part of our general advocacy designed to bring ontology science and engineering into the mainstream. The goal of this Ontology Summit 2009 is to articulate the power of synergizing the ontology and standards communities in the form of a communique in which a number of challenges are laid out. The joint communities of ontologists and standards developers represented at this year's summit hereby endorse the application of ontology science and engineering to standards. Some good examples of this kind of approach are illustrated by the following list of concrete, near-term projects. (1WK9)

- A harmonized ontology of units and dimensions (1WKA)
- Ontologizing product structure and properties (1WKB)
- Re-engineering Open Application Group specifications with UN/CEFACT CCTS (1WKC)
- Geospatial Catalog Mediation (1WKD)
- Financial industry semantics - developments and potential applications (1WKE)
- Ontology Across Building, Emergency, and Energy Standards - with Open Floor Plan Display demonstration (1WKF)
- I-Ring (Realtime Interoperability Network Grid) for Process Industry standards (1WKG)
- Connecting ISO/IEC 11179 to data sets (1WKH)
- Providing data sets and associated metadata for public use (1WKI)

These projects promise to demonstrate the advantages gained by incorporating ontology approaches when developing and applying a standard. Benefits include: (1WKJ)

- Improved quality (1WKK)
- Easier implementation (1WKL)
- Improved conformance checking (1WKM)
- Improved integration and interoperability (1WKN)
- Increased precision and rigor (1WKO)
- Improved search and discovery (1WKP)
- Reuse of standards (1WKQ)
- Reduced ambiguity and misinterpretation (1WKR)
- Easier management of standards and applications (1WKS)

We also offer the following suggestions as priority research areas that should be addressed by the ontology and standards communities sooner rather than later: (1WKT)

Issues that should be considered (1WKU)

One issue of primary importance is the development of business models for bringing ontologies into standards. We propose that ontologies be made freely available to the user community via ontology repositories and registries. (1WKV)

Other important issues, such as governance, have been addressed in earlier Ontology Summits. (1WKW)

Priority Research and Development Areas (1WKX)

We have identified the following challenges for the ontology community: (1WKY)

a) Development of ontologies, particularly in the following areas that arise from the need to integrate overlapping standards: - Business entities - Financial - Organization (1WKZ)

b) Identification of tools for evaluating, analyzing, selecting, and comparing ontologies. An additional emphasis is to be placed on tools for ontology presentation for subject matter experts in the domains for the relevant standards. (1WL0)

c) Articulation of the business case for demonstrating the benefit of using ontologies with standards. (1WL1)

Recommended Roadmap Elements (1WL2)

We encourage the development of registries of standards and ontologies to facilitate communication between the two communities. For this purpose, we can use the following template for description: (1WL3)

- Identification of the relevant standards bodies (1WL4)
- Issues (1WL5)
- Use cases (1WL6)
- Demonstration of benefits/impacts (1WL7)
- Basic concepts (1WL8)
- Existing ontologies (1WL9)

In particular, the following domains will be of interest for identifying and developing ontologies: (1WLA)

- engineering mathematics (1WLB)
- mereotopology (1WLC)
- geometry (1WLD)
- time (1WLE)
- process (1WLF)

Supporting Material (1WLG)

Goal of Summit (1WLH)

This summit addresses the intersection of two active communities, namely the technical standards world, and the community of ontology and semantic technologies. This intersection is long overdue because each has much to offer the other. Ontologies represent the best efforts of the technical community to unambiguously capture the definitions and interrelationships of concepts in a variety of domains. Standards - specifically information standards - are intended to provide unambiguous specifications of information, for the purpose of error-free access and exchange. If the standards community is indeed serious about specifying such information unambiguously to the best of its ability, then the use of ontologies as the vehicle for such specifications is the logical choice. (1WLI)

Conversely, the standards world can provide a large market for the industrial use of ontologies, since ontologies are explicitly focused on the precise representation of information. This will be a boost to worldwide recognition of the utility and power of ontological models. (1WLJ)

The goal of this Ontology Summit 2009 is to articulate the power of synergizing these two communities in the form of a communique in which a number of concrete challenges can be laid out. These challenges could serve as a roadmap that will galvanize both communities and bring this promising technical area to the attention of others. The challenges chosen were debated and decided upon during electronic discussions and at this Ontology Summit Symposium. (1WLK)

Synopsis of Standards Requirements (1WLL)

Standards are agreements across particular communities of interest, to achieve mutual benefit, based on the best available knowledge and technology. The community of interest may be global, sectoral, regional, national or even company or project specific, noting that the broader the community, the greater the benefits that can be achieved from exploiting common solutions, but also the challenges in achieving consensus. (1WLM)

Ontologies have the potential to facilitate both the creation and exploitation of standards. There are tens of thousands of existing traditional standards which effectively define the characteristics of products and their permitted values, tolerances and relationships. Even without ontologies, there is a challenge to represent such standards in a form where the established agreements can be exploited in an electronic environment, either singly or integrated into a consistent body of knowledge. For example, there are hundreds of standards related to fasteners - bolts, screws, rivets and other types, with their dimensions, materials and other characteristics. These are being brought together through application of dictionary standards like ISO 13584 and 22745. There are standards which define simple lists of permitted values for properties, such as country codes and currency codes. Information models have been created for physical products, buildings, factories and geographical entities. These standards provide an existing body of knowledge that provides a rich source of material which could potentially be exploited using ontological tools to capture all or selected parts of the content and the related implicit knowledge. (1WLN)

There appear to be opportunities for using ontology tools to validate and integrate existing and new information models, to support the identification of common concepts between standards, and to simplify the presentation of suites of standards to end users. (1WLO)

A further challenge would be exploit ontological tools and principles to improve the performance and quality of the development of new standards. Key capabilities would seem to be the ability to support rules and constraints in unambiguous computer-interpretable form, and to provide unambiguous definitions and identification for ontological components to facilitate reuse - possibly across multiple industry sectors. Clear guidelines and training would be needed to support such developments. (1WLP)

Major challenges will undoubtedly include the need to support ontological representations through multiple generations of information technology over periods exceeding the life of the products to which the ontologies apply. Careful configuration management will need to be applied to ensure that previous versions of an ontology remain available for reference. We also require a way to publish authoritative and agreed ontologies - this may need a step change in the policies and business models of standards bodies to exploit the new capability. (1WLQ)

Widespread deployment of ontological techniques in support of standards will require the availability of efficient and reliable toolsets that will scale into industrial applications. (1WLR)

It must always be remembered that the development and implementation of standards is voluntary, unless mandated by legal or commercial constraints, so the benefit case is fundamental to the success of the standard. In considering the application of ontology to existing standards, there must be a clear additional benefit from the extra work required. (1WLS)

Synopsis of Ontology Capabilities (1WLT)

Ontologies allow the explicit specification of the multiple possible meanings of concepts so that people can recognize commonalities and differences in the semantics of the concepts that they use. (1WLU)

Ontologies can be used to improve the quality of standards, leading to more robust implementations of the standards and the semantic integration of multiple standards. The axiomatization of formal ontologies can also support automatic conformance-checking. (1WLV)

There are several roles that ontologies can play to support the development, analysis, and extension of information standards in industrial domains. (1WLW)

1. Design ontologies that formalize concepts within existing standards In this approach, standards serve as the requirements documents for ontologies, so that we can evaluate the correctness of an ontology with respect to the standard. (1WLX)

2. Ontological analysis of existing standards (i.e. identify potential problems and semantic ambiguities) and the subsequent use of ontologies to reengineer existing standards. Examples of such analysis includes the OntoClean methodology. (1WLY)

3. Using existing ontologies to support the integration of existing standards. This may lead to the identification of new ontologies that serve as mediators between the ontologies associated with each standard. (1WLZ)

4. Identification of ontologies that we should be designing to lay the foundations for emerging standards that are are currently under development. (1WM0)

Descriptions of Example Projects (1WM1)

A harmonized ontology of units and dimensions (1WM2)

Measurement units and dimensions (or dimensionality) are essential for the meaningful communication of measurements, design specifications, scientific data, medical data, environmental data and regulations, and many commercial transactions. Confusion over measurement units can lead to disasters such as the demise of the Mars Climate Observer satellite. An ontology of measurement units and dimensions would have wide utility in many IT standards. (1WM3)

Measurement units include meters, feet, inches, etc. all of which have the dimension of "length", i.e., length is the "property" of which "meter" is the quantum. In the metric (S.I.) system the base dimensions (units) are: mass (kg) length (meter), time (second), current (Ampere), amount of substance (mole), luminous intensity (candela), and temperature (Kelvin). Derived (or composite) dimensions are constructed by multiplying or dividing the dimensions when multiplying or dividing the corresponding quantities. Hence speed has dimension of length / time. In practice the various base dimensions may have exponents of -3 to +3. Thus the space of derived dimensions has size of 7 to the 7th power - approx. 800K possible dimensions. For each dimension there are often serveral alternative measurement units - thus the space of all possible measurement units is huge. (1WM4)

Thus is it is clear that one will need to specify a framework for constructing derived dimensions / units from base dimensions and units. It will also be important to construct canonical URIs to reference the various measurement units and dimensions. Furthermore, the ontology should be linked to standard representations (names, abbreviations) for the various measurement units / dimensions, e.g., meters, m, joules, etc. The UnitsML effort at NIST is one such effort. (1WM5)

There are some anomalies which need to be addressed, mostly notably having to do with the measurement of concentrations. In the S.I. system concentrations are to be recorded as moles / cubic meter, or more commonly, as moles / Liter, i.e., molarity. However, we often see concentration measurements expressed as ratios, e.g., percent solutions or parts per million. However, such concentration ratios may either be mass ratios, mole ratios, volume ratios (for solutions), or partial pressure ratios (for gases). Although all of these concentration ratios appear to be dimensionless, they are not comparable, and conversions among them (or to/from molarity) are both material dependent and state dependent, e.g., temperature and pressure. (1WM6)

Another anomaly concerns the dimensionality of work (energy) and torque, both of which have units of Newton * meters. In the case of work, we are computing the dot product of the force vector and the direction of travel. In the case of torque are computing the cross product of force and distance. (1WM7)

We envision an ontology which would specify (at least) the various base dimensions and units of the SI (metric) system, the various metric scale factors (nano-, micro-, milli-, kilo-, ...), the rules for constructing various derived units, and the designations of the most common derived units such as joules, watts, ... Initially, we envision only recording a small number of non-metric base units, e.g., inch, foot, pound, and some of the more popular derived units, e.g, quart, cup. (1WM8)

Ideally, we should work with international standards organizations such as ISO and BIPM which deal with measurement units and their representation. However, as a practical matter it seems plausible to commence work jointly with U.S. NIST (National Institute of Standards and Technology) who have already begun a UnitsML project. Some organization(s) such as NIST, ISO, BIPM, ... will eventually have to maintain a server for the units/dimensions ontology. NIST has great expertise in measurement and measurement units. Another advantage of working with NIST is that it would circumvent the problems of licensing fees for ISO standards. (1WM9)

Finally, we note the existence of prior efforts at units ontologies, notably the early work of Tom Gruber, et al., "An Ontology for Engineering Mathematics", in 1994. This should facilitate the development of a comprehensive units ontology. (1WMA)

Details here (1WMB)

Ontologizing product structure and properties (1WMC)

- To enable enterprise integration based on inter-related data exchange, ontology and service specifications (1WMD)
- To enable the selective harvesting of ISO 10303 (aka STEP) standards into ontologies and other widespread modelling languages via OMG Model Driven Architecture ™ approach (1WME)
  - ISO TC184 SC4 STEP community has been creating data exchange information models for 20 years – lots of knowledge, lessons learned and capability there (1WMF)
  - With possibility of ISO STEP harvesting improvements made in OMG and W3C back

  - into its standards (1WMG)
  - May lead ISO STEP to adopt OMG & W3C technology. (1WMH)

Details here. (1WMI)

Re-engineering Open Application Group specifications with UN/CEFACT CCTS (1WMJ)

- The Open Applications Group builds and publishes a business process interoperability standard for enterprise business processes. This standard is a horizontal standard but also focuses on Automotive, Aerospace and Defense, High Tech, Chemical, Steel and general discrete manufacturing industries. It has recently also expanded it's support for process manufacturing as well. (1WMK)
- This diverse community requires a standard that is rigorous as possible and therefore the Open Applications Group is embarking on a project to re-work the OAGIS standard using the UN/CEFACT CCTS 3.0 methodology. (1WML)

Details here. (1WMM)

Geospatial Catalog Mediation (1WMN)

- The proposed OGC project would leverage a standards ontologies registry-repository to create and manage mappings between discovery-level models for geospatial information and earth observation resources. Some of these ontologies have been created informally, some have not yet been created for relevant standards. The two use cases would involve first the creation / discovery / management / annotation of ontology artifacts (schema and domain level), and then their data-level use in federated catalogs / knowledgebases for cross-community queries and broad "findability". There is both a general knowledge aspect, and aspects specific to geospatiotemporal observational parameters (feature of interest, phenomenon, measurand, sensor process model, etc.) (1WP1)

Details here. (1WMO)

Financial industry semantics - developments and potential applications (1WOX)

- Standardization of industry terms at the semantics level (1WMQ)
  - Work is under way with the EDM Council to create a financial industry semantics model covering securities terms and definitions. This is based initially on the content of the existing standards, with ongoing reviews of the content by business experts across the industry. (1WMR)
  - To support this, the ontology editor has defined a framework in which to derive local semantics by specialization of existing terms e.g. for geographical, math, legal and other common terms. A key requirement for this work is a better reuse of cross-industry ontology standards, or establishing the ontologies of data standards in these areas. (1WMS)
- Enterprise Tools for traceability between financial business and technical models (1WMT)
  - There is an important need to develop tools to enable "synchronization" between work on such things as data models and software classes and the Ontology. In practical terms, how do we take refinement of the ontology and reflect that in data/class structures, and vice-versa? (1WMU)
  - There is work ongoing in this area by the SIIA/FISD as well as important ground work from the European Central Bank. (1WMV)

Details here. (1WMW)

Ontology Across Building, Emergency, and Energy Standards - with OpenFloorPlanDisplay demonstration (1WOW)

- The project plan is to build an ontology for spatial representation and correlated temporal representation to facilitate common understanding for interoperability to support specific defined services to support the integration of emergency and energy standards. (1WP2)

Details here (1WMY)

I-Ring (Realtime Interoperability Network Grid) for Process Industry standards (1WMZ)

- The Process Industry iRING is providing a data integration and exchange environment for large capital projects. It supports the integration of applications within and between organizations such as equipment suppliers, Engineering, Procurement, and Construction companies, and the owners and operators of facilities. The iRING implements ISO 15926 in a Reference Data Library as the common language for exchange and integration. Applications have a Facade that maps the application to ISO 15926, thus enabling exchange and integration across applications and organizations. One piece of current work is the development of tools to assist in the mapping of the application ontologies to ISO 15926. (1WP3)

Details here. (1WN0)

Connecting ISO/IEC 11179 to data sets (1WN1)

- ISO/IEC 11179-3 Edition 3 is expected to provide a standard metamodel for (among other things) defining the semantics of Data Elements in terms of formally defined concepts, as defined by formal ontologies. The connection between Data Elements and the actual data is however beyond the scope of 11179. Realization of the "Data Web" will require closing of this gap, to connect datasets with ontologies which define their semantics. A complete solution will need to address an array of dataset forms including XBRL, SDMX, domain-specific XML schemas and "microformats", and relational and non-relational DBMSs. Some of this may be supported by OMG CWM and/or forthcoming IMM standards, but a broader framework is called for. (1WP4)

Details here. (1WN2)

Providing data sets and associated metadata for public use (1WN3)

- Provision of data sets and associated metadata for public use will require use of ontologies not only for defining the semantics of individual data elements (see above project, "Connecting ISO/IEC 11179 to data sets"), but also for organizing assembled data sets for search and navigation (i.e., information architecture). The listed use cases illustrate the common need for a framework supporting this type of facility. (1WOU)
- Use cases: (1WN5)
    - data.gov (OMB) (1WN6)
    - the ontology for the National Map (USGS) (1WN7)
    - Sensor Standards Harmonization WG (NIST) (1WN8)
    - Geospatial Catalog Mediation (proposed above) (1WN9)

Details here. (1WYH)

This Communiqué was reviewed, collaboratively edited, finalized and adopted by individuals present at the Ontology Summit 2009. (1WNA)

Endorsed by: (1WNB)

The above Communiqué has been endorsed by the individuals listed below. Please note that these people made their endorsements as individuals and not as representatives of the organizations they are affiliated with. (1WNC)

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