Ontology Summit 2011 Communiqué

version: 1.0.0

Making the Case for Ontology

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Editorial Remarks

About this document: *This document is the Joint Communique of the Ontology Summit 2011, the sixth annual series of events in which the international ontology community explores a given topic over a series of online meetings culminating in a face-to-face symposium held at the National Institute of Standards and Technology (NIST).*

Goal: *The goal of the 2011 Ontology Summit is to assist in making the case for the use of ontology by providing concrete application examples, success/value metrics and advocacy strategies. This communique provides tips, guidelines, and strategies for making the case for ontology to a variety of potential beneficiaries and future stakeholders.*

Intended audience: *This communique specifically targets ontology technology evangelists who already get the value but want to overcome the blank stares they get when trying to explain it to people who don't.*

About the Ontology Summit: *The 2011 Summit was organized by the Ontolog Forum, NIST, the National Center for Ontological Research (NCOR), the National Center for Biomedical Ontology (NCBO), the International Association for Ontology and its Applications (IAOA) and the National Coordination Office for Networking and Information Technology Research and Development (NCO/NITRD). To meet our goal, the Ontology Summit organized thirteen teleconferences over a period of three months -- each exploring different aspects of the challenge. The process culminated in a face-to-face meeting in Gaithersburg, Maryland on April 18-19, 2011, where this document was finalized. The Ontology Summit 2011 was co-sponsored by 64 organizations.*

Summary

Substantial numbers of people are deploying ontology-based solutions, in government, scientific, and commercial organizations. Unfortunately, the growing number of ontology technology evangelists who know the value of ontology also know the "blank stares" of people who don't. Having simple and effective ways to explain the practical value in a real-world setting is necessary as ontology technology goes mainstream.

Ontologies represent a shared understanding about concepts and relationships of a domain. They help manage and exploit information. Ontologies clarify meaning among people in the form of explicit knowledge that can be executed by software. They model processes and decision-making. And, they improve agility and flexibility while reducing costs.

Developing a good ontology requires human understanding of the domain, logic, reasoning, and clarity about the intended use. A good ontology enables automated application of logic and reasoning in ways that reduce unnecessary complexity and/or improve efficiency of solutions. More information on what ontologies are can be found in the results of a prior ontology summit[1].

This communique provides tips, guidelines, and strategies for making the case for ontology to a variety of potential beneficiaries and future stakeholders. It is targeted at people who want to explain the practical value of ontology; it will also benefit those who want to better understand it. Some of the key findings and results of this communique include the following:

Know who to target:

- Early adopters and the cutting edge,
- Anyone facing problems that a good ontology can solve.

Establish relevance:

- Focus on the value to your audience, not the technology.
- Show how and why an ontology can add value.
- Relate the benefits to your audience's situation.
- Understand what kind of problem your audience has.
- Highlight how the specific ontology-based solution you propose addresses this sort of problem.

[1]A discussion of the range of uses of the term "ontology" can be found in the Communique for Ontology Summit 2007. (http://ontolog.cim3.net/cgi-bin/wiki.pl?OntologySummit2007_Communique).

Generate excitement and instill confidence:

- Present relevant success stories of ontology in use today.
- Cite other evidence that the technology is mature (e.g. mergers and acquisitions, conferences, ontology jobs, venture funding)
- Make clear the difference between what is possible in the short, medium and long term (avoid an ontology winter).
- Be prepared to respond to past experiences your audience may have had with ontology.

Communicate clearly and listen:

- Start with concrete examples, not abstractions.
- Tailor the approach to different audiences.
- Be ready with one liners and elevator speeches.

Building the Foundation

Next, we elaborate on the foundation we built that supports the above recommendations. The primary focus of the case examples, usage framework, and value metrics is on what can be done here and now as well as in the near to medium term.

Case Examples

Case examples comprise the core foundation of our strategy. They illustrate the benefits of ontology in a real world setting. Case examples illustrate problems that ontologies can help solve. They demonstrate value propositions, risks and returns. This helps clarify who to target in making the case and for establishing relevance to those making investment decisions. Use cases generate excitement and instill confidence. Select and present examples that are relevant to the intended audience. Different audiences have different backgrounds and points of view. Think about how to explain things from these different points of view.

Ontology Usage Framework

To better communicate case examples, we created an *Ontology Usage Framework*. Key questions addressed by this framework include:

- What is the function of the ontology? (e.g. inference, specification, matching/search)
- Who are the ontology users? (e.g. knowledge worker, application user, application developers)
- What is the value that the ontology delivered? (e.g., new capabilities, user experience, performance, life cycle value.)

The Ontology Usage Framework distinguishes four main categories of ontology use case studies — *integration, decision support, semantic augmentation, and knowledge management.* Don't get too wrapped up in the categories or the framework itself, use them as a communication tool.

Ontology Value Metrics

The Ontology Summit set out a value paradigm to help those promoting the use of ontologies. For a fuller discussion see: Value Metrics, Value Models and Value Proposition Statements. Five key areas of value metrics were identified: IT efficiency, operational efficiency, business agility, business efficiency, and customer satisfaction. Metrics for ontology-based solutions are often more granular, less technically detailed, and more business case-specific than, metrics defined for software development.

Key Findings and Conclusions

Where and how are ontologies already being applied and delivering value?

The short answer is just about everywhere you look. To successfully make the case for ontology, we need first of all to be familiar with a wide variety of examples of ontology deployments and applications.. Here are a few examples.

- Provide and secure dynamic infrastructures where information of very different kinds is being combined from different sources on a large scale
- Add intelligence to the user interface to provide new capabilities and enhanced user experience
- Apply various techniques for semantic document processing and advanced analytics in fields such as law, medicine, science, defense, and intelligence
- Accelerate knowledge-intensive activities such as modeling & simulation, acquisition, design, and engineering
- Power mission-critical processes in energy, financial services, logistics, manufacturing, and transportation.
- Manage networks providing diagnostics, logistics, planning, scheduling, cyber-security, and event-driven process orchestration
- Support adaptive, autonomic, & autonomous processes such as robotics, intelligent systems, and smart infrastructure.

How do we characterize the value spectrum for ontologies?

Ontology, semantics, and knowledge technologies benefit and add value across a very broad spectrum of applications. Based on the case studies reported, we can group ontology applications into the following classes:

- **Low-hanging fruit** — Multiple knowledge-centric applications exist that have proven benefits, low risk, and real value that can be realized with off-the-shelf tools and solutions used by subject matter experts, business users, and consumers. Simple solutions to the right problem can bring great value.

- **Mainstream** — Categories of applications exist that address bigger needs and have characteristics best addressed with knowledge-centric approaches. Case examples are available that show solution patterns delivering substantial value. Multiple providers of technologies (products, services) and services have expertise in these areas. These applications often involve:
    - Discovering, connecting, integrating and interpreting information of different kinds, from multiple sources, and at varying scales
    - Aggregating, connecting and orchestrating services, applications, processes, and families of systems
    - Modeling and automating decision rules and decision-making processes
    - Methodologies that realize value from different stages of the solution life cycle.

- **Cutting edge opportunities, tough problems, and grand challenges** — In consumer, social, enterprise, and ecosystem domains important challenges exist that cannot be solved within current information technology approaches. Problem characteristics encompass issues of intelligent, user experience, understanding of language and sign system), scale, systemics, autonomics, security, dynamics, extent and depth of knowledge, and complexity of reasoning as well as time and mission criticality, etc. demand capabilities only become possible or economically feasible with the inclusion of knowledge technologies, semantics, and ontologies.

What is the most important thing to do to make the case for ontology?

Making the case for ontology means explaining how ontology creates value. To illustrate, the organizational process of defining and reaching an agreement about terminology and relationships in an ontology *improves clarity of meaning* about what is important in an organization and its computational systems. The resulting value of ontology almost always manifests as increased *flexibility and agility*. How does

improved clarity of meaning result in flexibility and agility? Improved clarity in meaning helps get everyone on the same page, which can lead to:

- *Reduced unnecessary complexity,* resulting in fewer conflicts and overlaps, and thus fewer primitives.
- *Interoperability and integration* among disparate systems and data (fewer silos) at less cost and lower development risk.
- *Reduced maintenance costs* because the model-based architecture makes it easier and faster and to adapt to changing circumstances and to add in new capabilities.

Looking ahead: What are the grand challenges?

We asked several experts to identify high-value, longer term challenges where ontologies will play a key role in the solutions. Also, we asked them to summarize the significance of these Grand Challenges, comment on the current state of the art with respect to their realization, determine gaps that hinder real-world ontology applications, and suggest actions for overcoming these gaps.

Three domains were explored, and other domains were suggested in the summit workshop. Representative grand challenge problems identified were:

- Help both the medical student and the doctor in a multitude of tasks, such as case history analysis, expert diagnosis, scenario analysis, and to be able to learn from experience.
- Facilitate effective recognition and reaction in a network-centric situation awareness environment, which consists of a symbiotic network of people and mobile communication and computing devices.
- Help people to understand and assess the consequences of multiple interacting complex disruptions to critical infrastructure and key resources.

Strategies for Making the Case

How do we put together all the materials gathered and present them in the most effective way when making the case for ontology? From our over-arching effort to identify Strategies for "making the case" for ontology two results emerged.

First, the consensus is that the message needs to be adapted in different ways to different audiences. For example, the goal in talking to a budget holder is to get the work funded. Value is key. A more technical approach is required when talking to technologists (see table).

Audience	Goal
Policy/Strategic Decision Maker	Convince them that this is the strategic direction to go. e.g. identify a poor decision that an ontology could have helped prevent.
Budget Holder / Business Decision Maker	Convince them that this is a good investment.
Technology Decision Maker (e.g. CIOs, Architects)	Convince them that this is the right concept.
Technology Implementer	Convince them that this is the right implementation approach.
Users/Consumer	Create trust, create buzz, as they will be driving the needs.
Educator	Train people with the right skills.

Table 1. Making the Case to Different Audiences

Second, we collected a set of sound bites and elevator speeches that can go into an ontology evangelist's toolkit of making the case.

Emerging Themes

Several themes emerged during the three months of discussions. Below are selected quotes that illustrate these themes; mostly taken from the collection of sound bites and elevator pitches.

Ontology is a way of clarifying meaning and reducing unnecessary complexity.

> "*Francis Ford Coppola said* 'The secret to making a good movie is getting everyone to make the same movie.' *So it is with enterprises and that's what ontologies do.*"
>
> "*An ontology is like a contract's fine print, one of those things which require a very precise technical jargon, which you might ignore in many cases, but which can save your business in critical situations.*"
>
> *"Ontologies can help you tame increasing complexity."*
>
> *"Ontology is critical for you to know the difference between what you think you know and what you really know."*

"*Ontology is the science of information in this sense: its semantic theories provide a unified account of how human thought and machine data can be united into a Web of meaning*."

Ontology is a way to improve agility and flexibility.

"*There are three main things that ontologies are good for: flexibility, flexibility and flexibility.*"

"*The real world is complex and changing, you need a solution that can cope with that complexity and adapt with the changes. That's what ontology does for you*"

"A vital problem facing every growing, changing organization is developing solutions that can adapt to new and dynamic environments, employees, technologies and market realities. … Ontology based solutions makes these assumptions explicit and accessible across the organization. … They provide a powerful framework to manage, update and evolve the high value components of responsive, agile organizations."

Ontology is a way to improve interoperability and integration.

"*Ontology enables semantic interoperability by presenting information consistently across organizations and domains and machines*"

"*Every person, organization or system has an [often tacit] ontology – the things presumed to exist in the world and how they behave. ... these ontologies pervade and underpin our deliberations, inform our decisions and guide our actions...*

Growing complexity and a need for smarter use of resources and solutions that cut across silos, means that it has become ever important to make explicit these implicit ontologies thereby easing interoperability and improving operational effectiveness.... The time is ripe to know what you know and share it with others."

Ontology is a new paradigm.

We believe that a new paradigm is emerging that will take a decade or two to become mainstream. This is illustrated by the following quotes from the summit participants.

"*Ontology does for machines what the World Wide Web did for people.*"

"*Ontology promises to be the driver for the next paradigm shift. If you think personal computing, and the Internet have been disruptive, wait and see what Ontology can bring about.*"

"Everything in IT up till now has been about technology first and business a distant second. But semantic and ontological technology are different - there are explicitly, fluidly and directly about the core of our business - which is the work of our business. No other technology has ever really been primarily about the work of business."

Summary and Conclusions

Ontology is about clarifying and representing meaning and supporting automated inference. The three most prominent value propositions to date are: (a) getting everyone to understand each other, possibly while disagreeing; (b) flexibility and agility; and interoperability and integration. Ontology technology is ready for prime time.

Fundamentally, ontology is about reaching agreements on what things mean and putting it in a machine-processible form. In an enterprise, this represents a radically different way to express meaning. The usual way is for meaning to be scattered randomly throughout the organization in people's heads, in email, in no-longer-maintained requirements documents, in conceptual models etc. In computational artifacts, a lot of meaning is in the names used to refer to things: code, variables, data base schema. Ontology both forces and enables an organization to be clear about what things mean and in doing so, gets everyone on the same page. Equally importantly, formally representing meaning enables automated inference which helps reduce unnecessary complexity, improve reliability and increase agility.

Clarifying meaning and reducing unnecessary complexity are two important vehicles for achieving interoperability and integration, which in turn, is a key vehicle for achieving flexibility. When no-one knows what anything means and so many systems are in production, you are stuck. Ontology is the key to flexibility. Ontology enables organizations of any size to do the same things more efficiently, and the ability to do entirely new things that were not possible before. The root of the benefits can almost always be traced back to using ontology as a way to clarify and agree on meaning.

It is also important to note that some key technologies offer great synergy with ontology. In particular, ontologies are especially important for databases, both relational and network based. Since ontology focuses on meaning rather than implementation details,

it can relate applications that use different storage systems and mechanisms. A wide variety of knowledge-based and semantic technologies including machine learning and natural language processing depend critically on ontology. The advantages of ontology are multiplied when used in conjunction with such technologies.

Generally, the approach in this summit has been pragmatic, emphasizing the need to "put food on the table". The case for further research also needs to be made. There are many unsolved issues.