THE BUSINESS VALUE OF SEMANTIC TECHNOLOGY
A TopConnexion Research Initiative
MILLS DAVIS

Mills Davis is TopQuadrant’s managing director for strategic development. He directs the TopConnexion program and consults with leading technology manufacturers, global 2000 corporations, and government agencies on next-wave semantic technologies and solutions.

As a researcher and industry analyst, Mills has authored more than 100 reports, whitepapers, articles, and industry studies. Previously, he directed landmark multi-company market development and R&D initiatives in the graphic communications and media industries including the Digital Roadmaps Project, and the HiFi Color Project.
BUSINESS VALUE OF SEMANTIC TECHNOLOGY

Research:

• Semantic technologies
• How semantic technologies differ from information technologies
• How semantic technologies improve efficiency, effectiveness, and business edge
• Where semantic technologies are being used today and delivering strong ROI
• Semantic technology marketplace
LONG WAVES OF INNOVATION...

What forces are driving the next wave?

Conceptual advances occur about twice a century

Industrial Revolution
Source: Norman Poire, Economist

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FUELED BY INVESTMENT CYCLES...

Next wave investment will dwarf previous cycles!

Source: Alinean, MILLS•DAVIS
SEMANTIC TECHNOLOGIES

• Semantics are shared meanings, associations, and know-how about the uses of things.

• In a computer, what has meaning is what we can represent.

• Semantic technologies represent meanings separately from data, content, or program code, using the open standards for the semantic web.
## SEMANTIC BUILDING BLOCKS

Progressing from lower to higher knowledge value

<table>
<thead>
<tr>
<th>Semantic Component</th>
<th>Instance</th>
<th>Concept</th>
<th>Relationship</th>
<th>Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Knowledge</td>
<td>Symbols, Numbers,</td>
<td>Terms, Data dictionary,</td>
<td>DTDs, Data models,</td>
<td>Ontologies, Descriptive</td>
</tr>
<tr>
<td>Representation</td>
<td>Numbers, Letterforms,</td>
<td>Glossaries, Content models,</td>
<td>Content models,</td>
<td>logics</td>
</tr>
<tr>
<td></td>
<td>Identities Data</td>
<td>Thesaurus,</td>
<td>Object models,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Relationships, Taxonomies,</td>
<td></td>
</tr>
<tr>
<td>Enabling Semantic</td>
<td>Unicode, URI</td>
<td></td>
<td>Frames</td>
<td></td>
</tr>
<tr>
<td>Web Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source: TopQuadrant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- General logic, Theory, Axiology, Value-based reasoning
- OWL-Lite OWL/S OWL-Full
- (future)
FUNCTIONS OF SEMANTIC TECHNOLOGY

Discover, manage, reason with, and utilize meanings

PORTAL

Discover, acquire, create semantic metadata (meanings)
Reason interpret, infer, and answer using semantics
Provision, present, communicate, and act using semantics

Represent, organize, integrate and interoperate meanings and resources

LEGACY SYSTEMS, DATABASES, CONTENT REPOSITORIES, INTERNET

Source: TopQuadrant
# SEMANTIC VS. INFORMATION TECHNOLOGY

## 1. How do they represent meanings?

<table>
<thead>
<tr>
<th>SEMANTIC TECHNOLOGY</th>
<th>INFORMATION TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Semantic web standards</td>
<td>• Data format; program language</td>
</tr>
<tr>
<td>• Language-neutral</td>
<td>• Language-based</td>
</tr>
<tr>
<td>• Machine interpretable</td>
<td>• Human knowledge required</td>
</tr>
<tr>
<td>• Semantic metadata</td>
<td>• Syntax/structure metadata</td>
</tr>
<tr>
<td>• External to system (shareable)</td>
<td>• Internal to system</td>
</tr>
<tr>
<td>• Knowable at run time</td>
<td>• Predefined at design time</td>
</tr>
</tbody>
</table>
2. How do they discover, acquire, access meanings?

<table>
<thead>
<tr>
<th>SEMANTIC TECHNOLOGY</th>
<th>INFORMATION TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Meaning-centered.</td>
<td>• Message, file, page, and document-centered</td>
</tr>
<tr>
<td>• Auto-recognition, information extraction, and categorization</td>
<td>• Manual, full-text &amp; statistical categorization</td>
</tr>
<tr>
<td>• Topic and concept-based search with enhanced recall and precision (relevance)</td>
<td>• Data, word, &amp; document search with limited re-call and precision</td>
</tr>
</tbody>
</table>
# Semantic vs. Information Technology

## 3. How do they manage, integrate meanings & resources?

<table>
<thead>
<tr>
<th>Semantic Technology</th>
<th>Information Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Taxonomy, ontology, knowledge base</td>
<td>• RDBMS, OODBMS, flat file.</td>
</tr>
<tr>
<td>• Knowledgebase easily modified for new concepts, relationships, properties, constraints and in-stances.</td>
<td>• Database structure difficult to modify to change /add new relationships (e.g., requires coding, reorganization)</td>
</tr>
<tr>
<td>• Integrate data, content, applications, and processes via shared ontology</td>
<td>• Integrate data, content, applications, and processes via point-to-point interfaces</td>
</tr>
</tbody>
</table>
### SEMANTIC VS. INFORMATION TECHNOLOGY

#### 4. How do they reason, infer, interpret & answer questions?

<table>
<thead>
<tr>
<th>SEMANTIC TECHNOLOGY</th>
<th>INFORMATION TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Application reasons via logic constraints, rules, axioms separate from code</td>
<td>• Application reasons via fixed algorithm that is embedded in the application code.</td>
</tr>
<tr>
<td>• Knowledge answers questions about how, why, and what-if, as well as facts</td>
<td>• Information processing provides situation awareness, e.g., what, where, when, and how much</td>
</tr>
<tr>
<td>• Machine can learn (infer new knowledge) simulate, test and adapt based on experience.</td>
<td>• Responses are preprogrammed (like instinct). Logic updated off-line (new version)</td>
</tr>
<tr>
<td></td>
<td>Program does not learn or adapt</td>
</tr>
</tbody>
</table>

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5. How do they provision, present, communicate & act using semantics?

<table>
<thead>
<tr>
<th>SEMANTIC TECHNOLOGY</th>
<th>INFORMATION TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Auto-discover, provision, semantic web services</td>
<td>• Manually discover and implement data and application connections &amp; interfaces</td>
</tr>
<tr>
<td>• Ontology-linked composite applications give 360-view of relevant data in context.</td>
<td>• Human search to find data &amp; information and then put it into useful context for</td>
</tr>
<tr>
<td>• Auto-generate text, documents, graphics, drawings &amp; dialogs from knowledgebase.</td>
<td>decisions</td>
</tr>
<tr>
<td>• Auto-personalize, customize, version (e.g. languages, different media)</td>
<td>• Computers as “electronic pencils” for humans to author and develop content, visuals,</td>
</tr>
<tr>
<td>• Autonomics: systems with self-knowledge can self-configure, self-optimize, self-</td>
<td>and media formats</td>
</tr>
<tr>
<td>protect, self-heal, and self-manage.</td>
<td></td>
</tr>
<tr>
<td>• Services &amp; products that know, learn, &amp; reason as humans do</td>
<td></td>
</tr>
</tbody>
</table>
A representative list of around 50 companies. Vendor compliance with semantic web standards varies.

<table>
<thead>
<tr>
<th>Autonomy</th>
<th>Enigmatec</th>
<th>Merant</th>
<th>Profium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captiva</td>
<td>Entrieva</td>
<td>Metamatrix</td>
<td>Protogé</td>
</tr>
<tr>
<td>Celcorp</td>
<td>Factiva</td>
<td>MioSoft</td>
<td>SAP</td>
</tr>
<tr>
<td>ClearForest</td>
<td>FAST</td>
<td>Modulant</td>
<td>SchemaLogic</td>
</tr>
<tr>
<td>Cogito</td>
<td>Grand Central</td>
<td>Network Inference</td>
<td>Semagix</td>
</tr>
<tr>
<td>CognIT</td>
<td>H5 Technology</td>
<td>NuTech</td>
<td>Stratify</td>
</tr>
<tr>
<td>Connecterra</td>
<td>HP</td>
<td>OntologyWorks</td>
<td>Sybase</td>
</tr>
<tr>
<td>Contivo</td>
<td>IBM</td>
<td>Ontoprise</td>
<td>Triple Hop</td>
</tr>
<tr>
<td>Convera</td>
<td>Intellidimension</td>
<td>Open Cyc</td>
<td>Tucana</td>
</tr>
<tr>
<td>Copernic</td>
<td>Interwoven</td>
<td>Oracle</td>
<td>Unicorn</td>
</tr>
<tr>
<td>Digital Harbor</td>
<td>Inxight</td>
<td>PeopleSoft</td>
<td>Verity</td>
</tr>
<tr>
<td>Empolis</td>
<td>KFI</td>
<td>Pinnacor</td>
<td>Vignette</td>
</tr>
<tr>
<td>Endeca</td>
<td>L&amp;C</td>
<td>Primus</td>
<td>Vitria</td>
</tr>
</tbody>
</table>
WHERE DO SEMANTIC TECHNOLOGIES APPLY?

Source: TopQuadrant
EVERYWHERE YOU LOOK ...
WHAT DO CASE EXAMPLES SHOW?

Semantic technologies drive core measures of business performance.

**EFFICIENCY**

*Cost savings*
Doing the same job faster, cheaper, or with fewer resources than it was done before.

**EFFECTIVENESS**

*Return on assets*
Doing a better job than the one you did before, making other resources more productive, increasing their return on assets and attainment of mission.

**EDGE**

*Return on investment*
Changing some aspect of what the business does, resulting in growth, new value capture, mitigation of business risk, or other strategic advantage.
**WHAT DO CASE EXAMPLES SHOW?**

*Gains in efficiency, effectiveness, and edge.*

<table>
<thead>
<tr>
<th>EFFICIENCY</th>
<th>EFFECTIVENESS</th>
<th>EDGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 20-80% less labor hours</td>
<td>• 50-500% quality gain</td>
<td>• 2-30X revenue growth</td>
</tr>
<tr>
<td>• 20-90% less cycle time</td>
<td>• 2-50X productivity gain</td>
<td>• 20-80% reduction in total cost of ownership</td>
</tr>
<tr>
<td>• 30-60% less inventory levels</td>
<td>• 2-10X greater number or complexity of concurrent projects, product releases, &amp; units of work handled</td>
<td>• 3-12 month positive return on investment</td>
</tr>
<tr>
<td>• 20-75% less operating cost</td>
<td>• 2-25X increased return on assets.</td>
<td>• 3-300X positive ROI over 3-years</td>
</tr>
</tbody>
</table>
WHAT DO CASE EXAMPLES SHOW?

Gains in lifecycle value and return on investment

**Development Stage**

**Discovery**
- Diagnose problem
- Envision solution
- Map ontology
- Make business case

**Solution Delivery**
- Design semantic apps
- Build business ontology
- Connect resources
- Integrate & test
- Deploy

**Operation & Support**
- Use, operate solution
- Monitor, measure performance
- Maintain & support

**Growth**
- Analyze new needs
- Add capabilities
- Upgrade solution
- Optimize performance

**Lifecycle Activities**

**Semantic Technology Benefits**

- Explicit business case
- Knowledge needs modeled
- Interrelated data, system sources
- Value of legacy preserved
- Make, buy, rent, share options
- Flexible, federated architecture
- Less time/cost to prototype

- Business ontology speeds data, process integration
- Composite applications give total picture, unified UI
- Capital outlay reduced
- Less time/cost to solution
- Faster time-to-market
- Faster return on investment
- Reduced development risk

- Faster, better decision-making
- Cycle time, productivity improved
- Higher service levels
- Improved quality & reliability
- Less training and support
- Simplified maintenance
- Reduced operating cost
- Reduced total cost of ownership
- Faster time to enhance
- Greater agility, flexibility
- Less capital re-investment
- Real-time optimization
- Faster time to deploy
- Reduced development risk
- Enhanced ROI

Source: TopQuadrant
The true test of whether semantic technologies deliver business value is if the benefits exceed the cost and risks.

Our preliminary research documents 2–10 times improvements in key measures of performance across the solution lifecycle.

Given the compelling nature of the business value proposition, we expect the market for semantic technologies to develop rapidly.
SEMANTIC & INFORMATION TECHNOLOGIES

Market growth to 2010

2003
- Software $234B
- Hardware $396B
- Services $455B

CAGR 4-6%

2010
- Software $337B
- Hardware $450B
- Services $620B

CAGR = 60-70%

Sources: IDC, Gartner, Meta Group, VSS, McKinsey, TopQuadrant

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Our projection of horizontal markets for semantic technologies is based on analysis of twelve studies by IT analysts and vendors. These examined: knowledge management access, infrastructure, and ontology-based solutions; enterprise & commercial publishing; enterprise-class applications such as ERP, CRM, BI, PLM, help desks, and portals; web services, grid computing, and pervasive computing (e.g. RFID); and the largest category, integration software and services. Ratios of services, to software, to hardware revenues are assumed to be much the same as for IT.
A CALL TO ACTION

For businesses and government agencies:

• Research shows semantic technologies have compelling business benefits.

• Lifecycle value is already being proven with operational solutions, not just in R&D.

• No need to wait. Take steps to prove the value of semantic technologies for your enterprise in as few as 100-days.
CALL TO ACTION

For semantic technology solution providers:

• Semantic technology is ready to “cross the chasm” to mainstream adoption.

• Semantic solution, services & software markets will grow rapidly, topping $60B by 2010.

• To win, focus on mainstream markets. Help educate and sell business value and ROI in ways that mainstream enterprises can understand.
CALL TO ACTION

For members of the investment community:

• Semantic technologies are building blocks of the next mega-wave of economic development, “distributed intelligence.”

• Markets for semantic technologies are poised for a period of sustained rapid growth.

• Now is the time for semantic technology investments to strengthen portfolios.
CALL TO ACTION

For businesses and government agencies that want to jump-start their organization to harness the benefits of semantic technologies...

TopConnexion provides an affordable (fixed cost) knowledge service that provides:

• Research — proving the business and technical value of semantic solutions through case studies, technology assessment, market studies.

• Publications and events — educating key decision-makers, and making the case for semantic solutions.

• Tools — to envision solutions, plan projects, pick sources

• Expertise — best-of-the-best talent on call.