Web 3.0 Manifesto

How Semantic Technologies in Products and Services Will Drive Breakthroughs in Capability, User Experience, Performance, and Life Cycle Value

Mills Davis
Principal Investigator
mdavis@project10x.com

Project10X
2853 Ontario Road NW #501
Washington, DC 20009 USA
1-202-667-6400
1-800-713-8049 fax
www.project10x.com

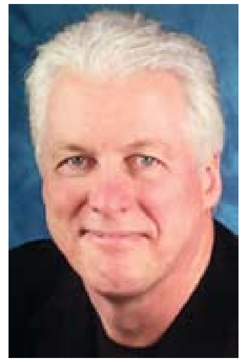


Table of Contents

About the Author

Mills Davis is Founder and Managing Director of Project10X — a research consultancy specializing in next wave semantic technologies, solutions, and business models. The firm's clients include technology manufacturers, global 2000 corporations, government agencies, and next-generation web start-ups. Mills serves as principal investigator for the Semantic Wave research program. A noted consultant and industry analyst, he has authored more than 100 reports, white papers, articles, and industry studies.

Mills is active in both government and industry-wide technology initiatives that are advancing semantic technologies. He co-chairs SemanticCommunity.net, which carries on the mission the Federal Semantic Interoperability Community of Practice (SICoP) in supporting Communities of Interest in both government and private industry. Mills is a founding member of the AIIM interoperable enterprise content management (iECM) working group, and a founding member of the National Center for Ontology Research (NCOR). Also, he serves on the advisory board of several new ventures in the semantic space.

millsdavis@project10x.com
www.project10x.com/
www.semanticexchange.com/

Web 3.0 Manifesto

How Semantic Technologies in Products and Services Will Drive Breakthroughs in Capability, User Experience, Performance, and Life Cycle Value

By Mills Davis

Overview

If you're looking to build the next "killer app," and you hate the term "Web 3.0." Get over it. This special report investigates how semantic technologies drive product and service opportunities in the next stage of the internet. You can call it whatever you want.

Internet innovation has a direction. It is towards greater bandwidth, more intense social connectedness, smarter applications and devices, and pervasive adaptability. The broad sweep of internet evolution we call the semantic wave.

The semantic wave embraces four stages of internet growth. Web 1.0, was about connecting information and getting on the net. Web 2.0 is about connecting people — putting the "I" in user interface, and the "we" into webs of social participation. The next stage, Web 3.0, is starting now. It is about representing meanings, connecting knowledge, and putting these to work in ways that make our experience of internet more relevant, useful, and enjoyable. Web 4.0 will come later. It is about connecting intelligences in a ubiquitous web where both people and things reason and communicate together.

All product and service Innovation is about new configurations of value. Value is measured as the worth or desirability (positive or negative) of something, and of how well something conforms to its concept or intension.

Value innovation in Web 3.0 has four key perspectives: user experience, social computing, smart software and things, and semantic ecosystem. These perspectives are present in any new offering. They co-evolve. In Web 3.0, these four value innovation perspectives are unified through a shift from data, information, and procedure centric computing to new patterns of computing that are knowledge centric. Key measurable dimensions of worth include capability, performance, user experience, and life cycle value.

Semantic technologies drive value in Web 3.0. This report maps 70 semantic capabilities, grouped into 16 categories, and 4 value perspectives. Individually and in combinations, semantic technologies provide value building blocks for next stage internet products and services.

Successful innovation does involve more than technology, and more than coming up with a hot new product or service. The key to successful innovation is design, engineering and delivery of new configurations of value that address all aspects of the business concept. However, winning business concepts in the next stage internet will leverage semantic technologies.

What is the Semantic Wave?

The semantic wave is a tidal wave of four stages of internet growth. The first stage, *Web 1.0,* was about connecting information and getting on the net. *Web 2.0* is about connecting people — putting the "I" in user interface, and the "we" into Webs of social participation. The next stage, *Web 3.0,* is starting now. It is about representing meanings, connecting knowledge, and putting these to work in ways that make our experience of internet more relevant, useful, and enjoyable. *Web 4.0* will come later. It is about connecting intelligences in a ubiquitous Web where both people and things reason and communicate together.

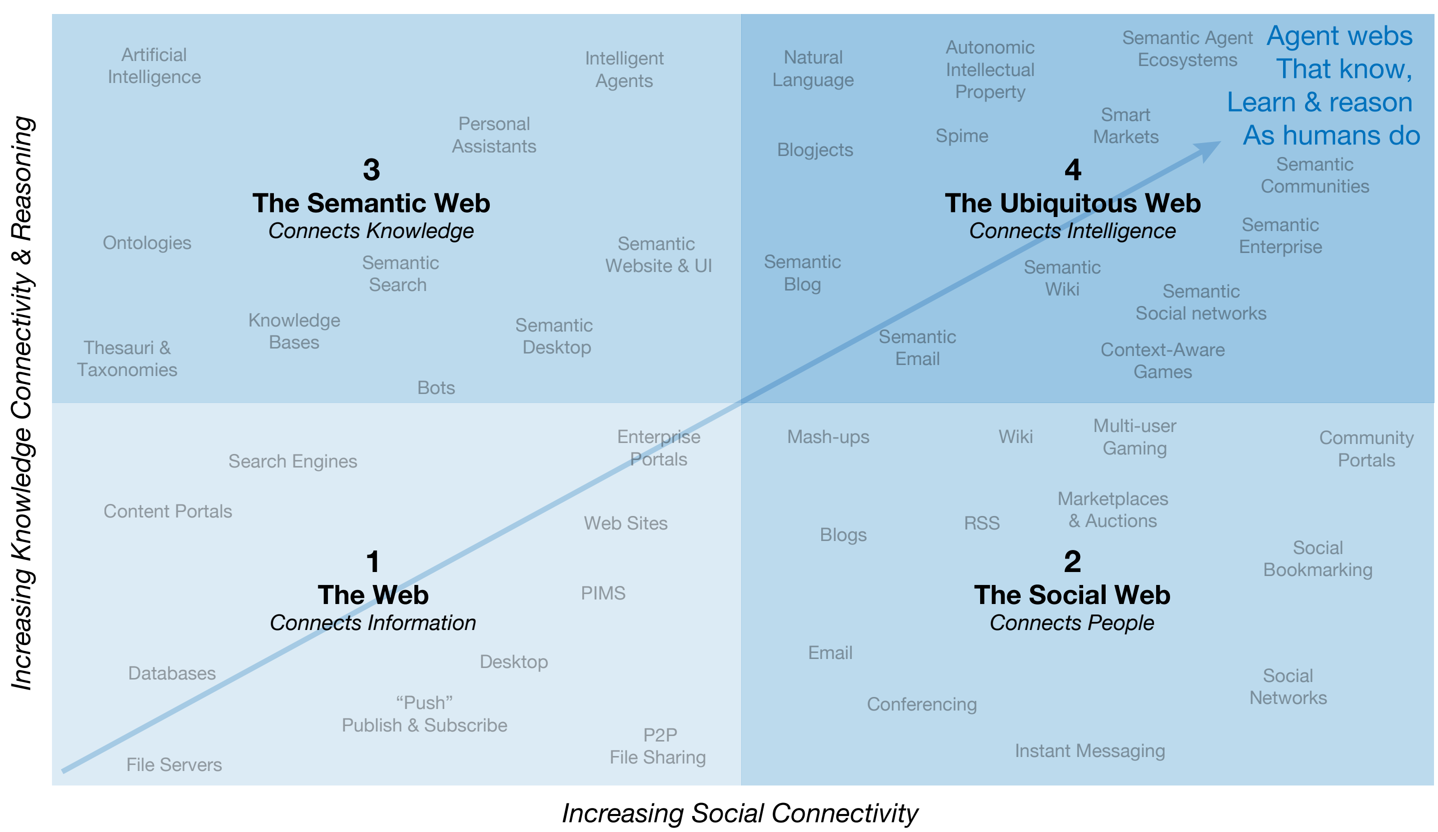
Over the next decade, the semantic wave will spawn multi-billion dollar technology markets that will drive trillion dollar global economic expansions to transform industries as well as our experience of the internet. The Semantic Wave report examines drivers and market forces for adoption of semantic technologies in Web 3.0 and maps opportunities for investors, technology developers, and public and private enterprises.

What are Semantic Technologies?

Semantic technologies are digital tools that represent meanings and knowledge (e.g., knowledge of something, knowledge about something, and knowledge how to do something, etc.) separately from content or behavior artifacts such as documents, data files, and program code. This knowledge is encoded in a digital form that both people and machines can access and interpret.

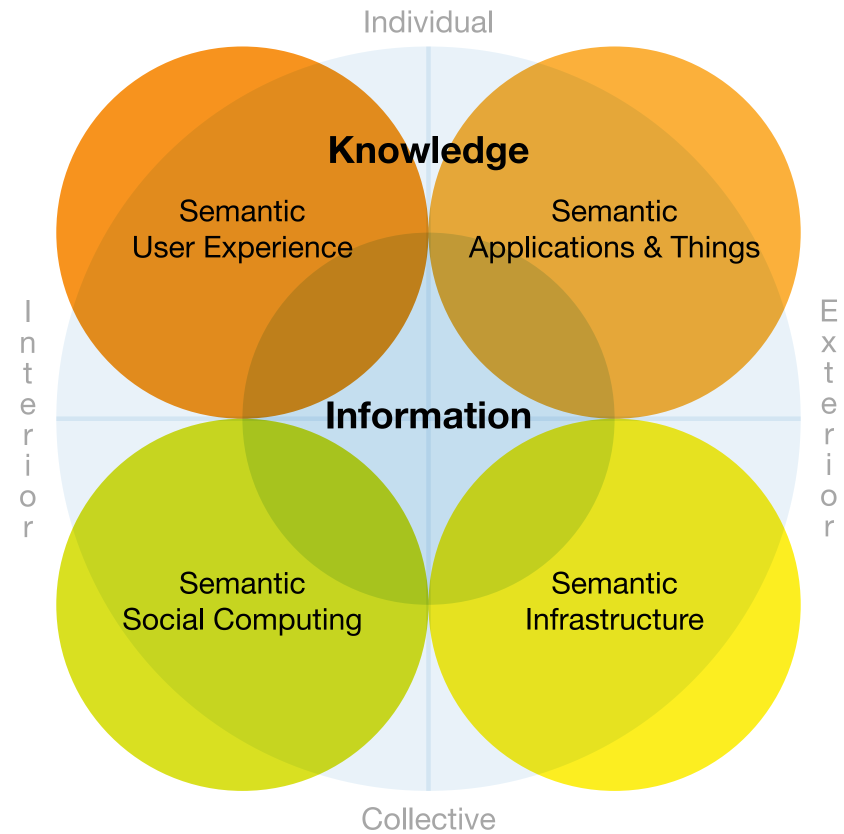
The basic shift in information and communications technology (ICT) that is occurring now is from information-centric to knowledge-centric patterns of computing. This is made possible by the application of semantic technologies and open standards that enable people and machines to connect, evolve, share, and use knowledge on an unprecedented scale and in new ways that make our experience of the internet better. Not restricted just to current Semantic Web standards, the next stage of internet evolution will encompass a broad range of knowledge representation and reasoning capabilities including microformats, semantic html, pattern detection, deep linguistics, ontology and model based inferencing, analogy and reasoning with uncertainties, conflicts, causality, and values.

Figure-1: What is the evolution of the Internet to 2020?
A tidal wave of four stages of growth.



Source: Nova Spivak, Radar Networks; John Breslin, DERI; & Mills Davis, Project10X

Figure-2: What value perspectives are key to successful product and service innovation?
Four perspectives are key: user experience, social computing, smart software and things, and semantic ecosystem.



Source: Ken Wilber, Integral Institute; Mills Davis, Project10X

What is Value in the Next Stage of the Internet?
Value is the measure of the worth or desirability of something and of how well something conforms to its concept or intension. Value is the foundation of meaning.

Product and service innovation is about value. It is the design, engineering and delivery of new configurations of value. Value architecture, not technology, is the key discipline for successful innovation. Technologies are merely ingredients that serve as enablers and drivers of value.

Value innovation in the next stage of the internet has four key perspectives as shown in Figure-2: user experience, social computing, smart software and things, and semantic ecosystem. These perspectives are present in any new offering. These four value innovation perspectives are unified through the shift from data, information, and procedure centric computing to new patterns of computing that are knowledge centric.

Semantic technologies drive value in the next stage of the internet. They provide key capabilities and building blocks for product, service, and business innovation.

What is the Value Space for Semantic Technologies?
The value space of semantic technologies has four dimensions or axes: capability, performance, user experience, and life cycle economics.

- *Capabilities* enabled by semantic technologies and new solution patterns that were not possible or economically feasible before. New capabilities provide the biggest wins.

- User experience of semantic solutions measured as the pleasure, relevance, helpfulness, and usefulness as experienced by the user — both individual and as groups. User experience is key to both technology and business model. differentiation.

- Performance of semantic solutions measured by improvements in efficiency, effectiveness, or strategic edge. Performance focuses on operational returns.

- Life cycle economics of semantic solutions measured as the ratio of benefits to cost and risk over the life of the investment.

How do semantic technologies tap new sources of value?

Semantic technologies tap new sources of value by modeling knowledge, adding intelligence, and enabling learning.

- *Value from knowledge modelling* — To model first, then execute the knowledge reduces time, risk, and cost to develop and evolve services and capabilities. Semantic model-based approaches achieve added development economies through use of: (a) shared knowledge models as building blocks, (b) autonomic software techniques (goal-oriented software with self-diagnostic and self-management capabilities such as self-configuration, self-adaptation, self-optimization, etc.), and (c) end-user and do-it-yourself life-cycle development methodologies (rather than requiring intervention by IT professionals). Knowledge that is sharable, revisable, and executable provides a key differentiator for applications where facts, concepts, circumstances, and context are changing and dynamic.

- *Value from adding intelligence* — A working definition of intelligence is the ability to acquire, through experience, knowledge and models of the world (including other entities and self), and use them productively to solve novel problems and deal successfully with unanticipated circumstances. A key new source of value is adding intelligence to the user interface, to applications, and to infrastructure. An intelligent system or agent is a software program that learns, cooperates, and acts autonomously. It is autonomic and capable of flexible, purposeful reasoning action in pursuit of one of more goals. An intelligent user interface (UI) knows about a variety of things such as system functionality, tasks users might want to do, ways information might be presented or provisioned. Intelligent UIs know about the user (via user models), which enables tailoring system behavior and communications. Adding intelligence helps users perform tasks, while making working with the computer more helpful, and as invisible as possible. As a result, systems do more for the user, yield more relevant results with less effort, provide more helpful information and interaction, and deliver a more enjoyable user experience. Adding intelligence can produce ten-fold gains in communication effectiveness, service delivery, user productivity, and user satisfaction.

- *Value from learning* — Machine learning is the ability of computers to acquire new knowledge from past cases, experience, exploration, and user input. Systems that learn increase in value during their lifetime. Their performance improves. They get better with use, and with scale. In addition to new or improved capabilities, systems that learn during operation may improve system life cycle economics by (a) requiring less frequent upgrading or replacement of core software components, and (b) enabling new incremental extensions to revenue models through add-on knowledgeware and software-as-a-service.

- *Value from semantic ecosystem* — An ecosystem is a self-sustaining system whose members benefit from each other's participation via symbiotic relationships (positive sum relationships). Principle drivers for semantic infrastructure and ecosystem include the economics of mobility, scale, complexity, security, interoperability, and dynamic change across networks, systems, and information sources. These problems are intractable at Web scale without semantics. The corollary is the need to minimize human labor needed to build, configure, and maintain ultra-scale, dynamic infrastructure. Current systems including the internet are designed to operate with predefined parameters. Change spells trouble. Mobility is a problem. Semantic ecosystems will be future-proof, able to grow dynamically, evolve, adapt, self-organize, and self-protect. Web 3.0 will lay the foundations for ubiquitous Web including autonomic intellectual property, Web-scale security and identity management, and global micro-commerce in knowledge-based assets. The value vector for semantic infrastructure is 2-3 orders of magnitude gains in capability, performance, and life cycle economics at Web scale.

Figure-3: Semantic User Experience Taps New Value
Intelligent user interfaces increase relevance, helpfulness, utility, and pleasure as experienced by the user.

Why is user experience a key value dimension?
Attention is the limited resource on the internet — not disk capacity, processor speed or bandwidth. Trends in user interface (UI) are towards personal avatars; context-aware, immersive 3D interaction; and reality browsing, augmented reality, and intelligent systems.

User experience is the sum of interactions and overall satisfaction that a person has when using a product or system. Users are becoming prosumers, creating content, participating in peer production, taking control of consumption.

Semantic user experience is the addition of intelligence and context-awareness to make the user interface more adaptive, dynamic, advisory, proactive, autonomic, and autonomous, and the resulting experience easier, more useful, and more enjoyable.

Values shape user experience. Simplicity, versatility and pleasurability are the new watchwords. Context is king. Context is information that characterizes a situation of an entity, object, event, etc. Context awareness is using this knowledge to sense, predict, interpret and respond to a situation. Identity is information used to prove the individuality of a person as a persisting entity. Mobility, wireless, and video are the new desktop, for creating and delivering seamless, self-configuring, context-ware, secure services anytime, any where.

How much can semantic technologies impact performance?

The classic motivation for new investments in technology is improved performance, measured typically as efficiency gain, effectiveness gain, and strategic edge. We call these the 3-Es.

- *Efficiency* gains mean doing the same job faster, cheaper, or with fewer resources than it was done before. The key measurement is cost savings. Semantic technologies can have a dramatic impact on labor hours, cycle time, inventory levels, operating cost, development time and cost. Early adopter case examples documented by Project10X have showed 20-90% reductions in these measures.

- *Effectiveness* gains means doing a better job than the one you did before, making other resources more productive, and improving the attainment of mission. The key measurement is return on assets. Semantic technologies can drive dramatic improvements in quality, service levels, and productivity. Combined with process improvements, these can allow existing staff to handle a greater number (or complexity) of current projects, product releases, and units of work. Early adopter case examples documented by Project10X showed increases in effectiveness and return on assets from 2-50 times.

- *Edge* means changing some aspect of what the business entity does, resulting in growth, new value capture, mitigation of business risk, or other strategic advantage. The key measurement is return on investment. The strategic value of semantic technologies comes from new capabilities that tap new sources of value, resulting in new advantages.

Project10X research has examined 700 case examples, and reported on 150 of them in our Semantic Wave Report. In early adopter case examples, we have documented 2-10 times improvements in measures of performance today. But, potential exists for gains of 2-3 orders of magnitude.

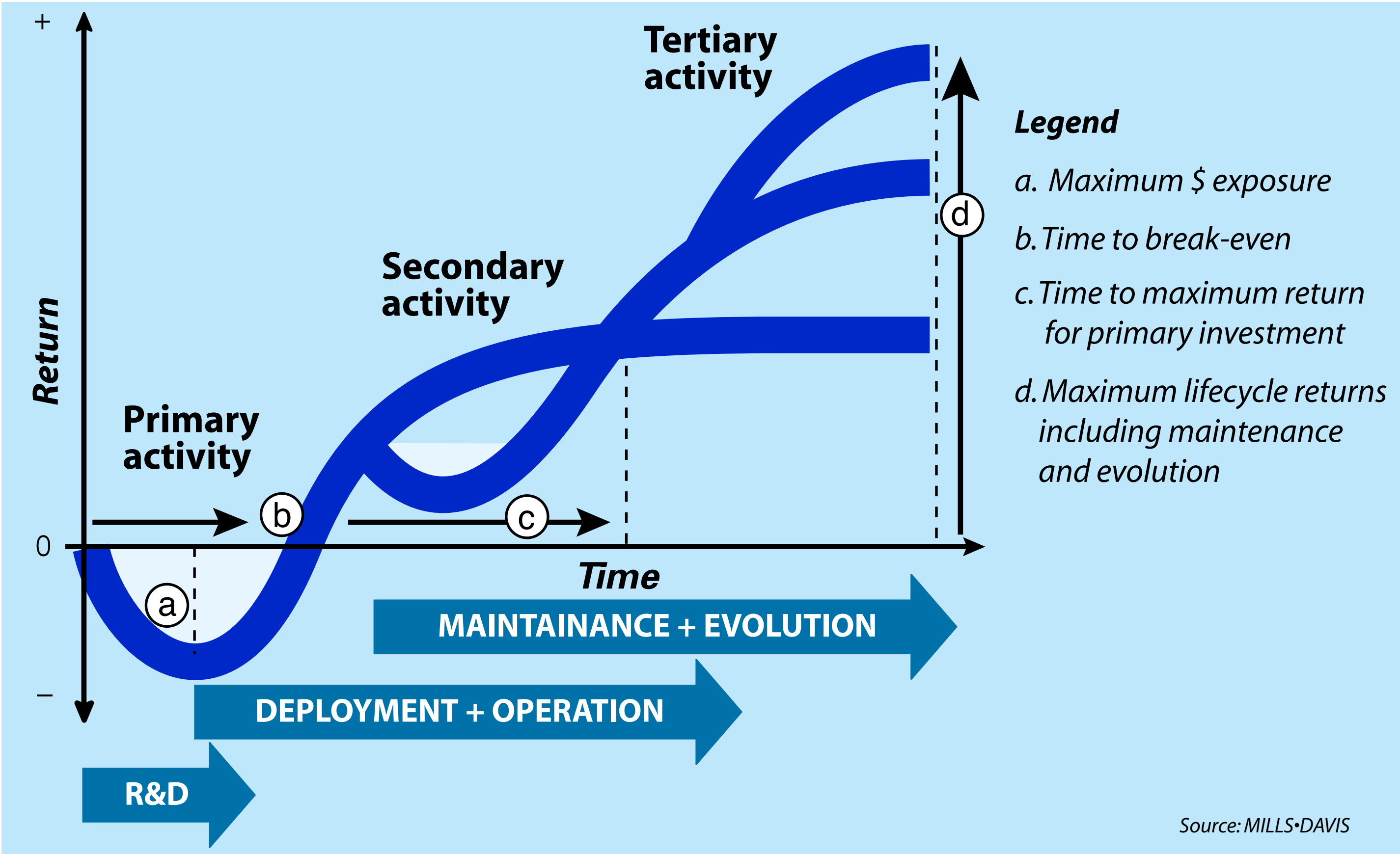
Figure-4: Performance Impact of Semantic Technologies

2-10 times improvements in measures of performance today, with potential for gains of 2-3 orders of magnitude.

EFFICIENCY	EFFECTIVENESS	EDGE
Cost savings	*Return on assets*	*Return on investment*
Doing the same job faster, cheaper, or with fewer resources than it was done before	Doing a better job than the one you did before, making other resources more productive and increasing their return on assets and attainment of mission	Changing some aspect of what the business does, resulting in growth, new value capture, mitigation of business risk, or other strategic advantage
EARLY ADOPTER CASE EXAMPLES		
20-80% less labor hours	50-500% quality gain	2-30X revenue growth
20-90% less cycle time	2-50X productivity gain	20-80% reduction in total cost of ownership
30-60% less inventory levels	2-10X greater number or complexity of concurrent projects, product releases & units of work handled	3-12 month positive return on investment
20-75% less operating cost	2-25X increased return on assets.	2-300X positive ROI over 3-years
25-80% less set-up & development time		
20-85% less development cost		

Source: MILLS•DAVIS

Figure-5: Life Cycle Value of Semantic Technologies
Semantic technologies improve economics and reduce risks across all stages of the solution life cycle.



How do semantic technologies maximize life cycle value?
Semantic technologies improve economics and reduce risks across all stages of the solution life cycle. Figure 5 depicts the concept of cumulative value creation across the life cycle of a semantic technology solution investment. The life cycle model has three phases: R&D, deployment and operation, and maintenance and evolution.

The diagram depicts ROI curves for primary, secondary, and tertiary development activities.

1 Research and Development — Rapid, iterative development speeds time to solution and reduces risk. The first part of the solution life cycle is the innovation stage. Every project begins at zero, with nothing ventured and nothing gained or lost. The slope of the ROI curve during innovation is negative. Investments outweigh returns. This is the time of greatest risk and greatest exposure. A key question in evaluating this stage of a project is: how deep into its pockets is the enterprise being asked to go?

Building products and solutions with semantic technologies impacts R&D stage ROI as follows:

- Knowledge capture and modeling allows early validation and iterative refinement of requirements, minimizing cost and risk.
- Semantic modeling of UI, data, and system interrelationships minimizes time/cost to prototype.
- Semantic modeling unlocks data and logic and facilitates switching between make, buy, rent, share options at least cost.
- Reduced coding minimizes labor, time, and cost for interoperability, integration, federation.
- Semantic models and composite applications provide unified user interface across multiple legacy systems, services and data sources, to preserve legacy value, minimize disruption to operations, and reduce development, training, use, and maintenance costs.

- Fast, incremental, non-invasive development cycles accelerate time to value, reduce cost to solution and mitigate development risk.

2 Deployment and operations — Characteristics of semantic solutions in operation include rapid, flexible deployment, lower cost of operation, ease of maintenance, robust security.

The second part of the solution life cycle is the operations stage. Solution deployment and initial operations can overlap. When cumulative returns equal cumulative investments — this is the break-even point. If the time to break-even takes too long, the project may be a bad risk. The curve continues to rise ("in the black") so long as benefits such as revenues exceed operating costs. Net present value analysis is used to compare the relative return on assets employed. Eventually, the benefit stream will slow. Eventually, requirements change, the curve flattens, and the project reaches a point of diminishing returns. Key questions in evaluating this stage of a project are: how long will the business have to wait for positive returns? Also, what is the maximum positive benefit (or upside)?

A semantic technology approach impacts deployment and operations stage ROI as follows:

- Semantic solutions deploy rapidly, incrementally, iteratively, and flexibly, resulting in lower exposure and faster time to value.
- During operation, the semantic model integrated solutions require the less overhead for staffing and support, which helps reduce total cost of ownership.
- Composite applications provide common context and access to underlying information and processes so that users do not have to learn multiple methods to search and navigate across them, which increases their productivity.
- Semantic model driven solutions can be self-documenting and self-explaining, which reduces training and support costs, and helps mitigate risks from knowledge erosion when personnel change roles.
- Semantic models allow robust, policy-based, role and concept-level security that is comprehensive & much easier (and less expensive) to ensure for mission critical work flows.

3 Maintenance and evolution — The third part of the solution life cycle is secondary and tertiary maintenance and enhancement projects that build off of the solution established by the primary project. The measure of performance that is relevant here is the ratio of added value to added cost and risk. A good ROI curve would enable these projects to begin in a timely manner, and be funded by positive returns from the base project. A key question in evaluating this stage of a project is: What is the total upside for related projects that can be funded from the proceeds of this project?

A semantic technology approach impacts maintenance and evolution stage ROI as follows:

- Semantically modeled solutions are easier to scale up and scale out — adding new capabilities, users, locations, security or capacity.
- Semantic models and open standards (knowledge plane) insulate components to minimize impact of changes. This facilitates best-of-breed substitutions, integration of new capabilities, and extension to embrace legacy applications. Faster time to enhance, lower switching costs.
- Semantic models provide leverage to accelerate secondary and tertiary ROIs. There is relatively less capital re-investment, and lower development risks.

Semantic technologies provide multiple value levers for product, service, and infrastructure innovation. New capabilities and user experience lead to blue ocean opportunities. The three Es of semantic technologies can drive quantum improvements in business performance. But, gains are not just operational. Semantic technologies speed time to solution, improve economics and reduce risks for solution development. And semantic technologies deliver integral value, which means solutions built with semantic technologies can be modified and extended more easily and at less cost and risk than with previous era approaches.

How Do Capabilities of Semantic Technologies Drive Value?

Figure-6 following this page presents a framework for next stage internet semantic technology product and service innovation. The map is divided into four quadrants reflecting the value innovation perspectives set forth in Figure-2.

The diagram identifies 16 categories of semantic technology capabilities as follows:

- Knowledge Representation
- Automated Reasoning
- Semantic Content Tools
- From Search to Knowing
- Semantic User Experience
- Semantic Social Computing
- Semantic Collaboration
- Semantic Enterprise Processes
- Knowledge-based Applications
- Intelligent Systems
- Semantic Architectures
- Semantic Storage
- Semantic Transport,
- Semantic Processors
- Semantic Software Development
- Semantic Ecosystem

The map depicts 70 elements of value for building Web 3.0 products and services. They are grouped by capability category and dominant value perspective. The topics which follow discuss capability categories as areas of opportunity, highlight key trends and associated value building blocks.

Knowledge Representation (KR)

Executable knowledge is defined as theory plus information that reduces uncertainty. Knowledge representation is the application of values, logic and ontology to the task of constructing computable models of some domain. Semantic technologies represent meanings, associations, theories, rules, and know-how about the uses of things and their presentation separately from documents, data, and program code.

In Web 3.0, knowledge representation (KR) goes mainstream. This is what differentiates semantic technologies from previous waves of IT innovation. KR capabilities needed include:

- *Manual knowledge modeling* — Personal tools and collaborative environments for building different types of knowledge model, e.g. domain entities and relationships, policies and rules, processes and services, events. Support different authoring styles: (textual, schematic, visual). Use open standards.
- *Automated and semi-automated KR* — Use machine learning, linguistics, and ontology to recognize, extract and model concepts and relationships from varied forms of language -- text, information graphics, imagery, sound, structured data, metadata, etc.. Widgets collaborative workbenches, and server-based solutions. Auto-tag. Automate building of taxonomies,

Figure-6: Web 3.0 Semantic Technology Product and Service Opportunities

Value perspectives, catagories of capability, and value building blocks

Source: AQAL integral framework: Ken Wilber; Web 3.0 semantic technology opportunity map: Mills Davis, Project10X.

thesauri, conceptual graphs, and ontologies. Computer-assist curation of knowledge models.

- *Knowledge representation analytics* — Use statistics, linguistics, and ontologies to analyze, map, align, harmonize different knowledge models.

Automated Reasoning

Reasoning is the ability to make inferences. Automated reasoning is the use of software and computing to derive conclusions from a known set of facts or premises expressed in a language. Knowledge-based computing models information, process, and logic separately from algorithms, and black box objects so that multiple software systems can access, interpret, augment, and take action based on it. There is no reasoning without representation. More complex, expressive knowledge representation needs progressively more capable and scalable inferencing. Automated reasoning will both encompass and move beyond SQL, business rules engines, RuleML, Prolog, Datalog inferencing. Next generation reasoning engines will support:

- *Multiple types of inferencing* — Web 3.0 needs pattern reasoning, analogy, statistical inference, induction, abduction, and deduction. Analogy is logical inference based on the assumption that if two things are known to be alike in some respects, then they must be alike in other respects. It is the foundation for every form of reasoning, including logic. Logic is a subset of natural language use for reasoning. It is a disciplined use of analogy. Various types of logic exist. Deduction is deriving implications from premises. Every step in a deductive process requires a unification, which is special case of the structure mappings used in analogies. Induction is deriving general principles from examples. Analogies are used to find common generalizations of multiple instances. Abduction is forming a hypothesis that must be tested by induction and deduction. It involves inferring the best or most plausible explanation from a given set of facts or data.. The operation of guessing or forming an initial hypothesis, called abduction, requires analogies to find likely causes or explanations.

- *Semantic graphs that query like databases* — SPARQL, RDF/S, OWL, RuleIF

- *Common Logic and extensions* — making all first-order logics interoperable.

- *Logics for uncertainty, conflicts, values* — Bayesian, statistical inference, IKL, modal logics, second-order logics, higher order logics, causality, argumentation, axiology. Multi-agent reasoners for recognition, disambiguation, resolution of uncertainty, causality, conflicts, and values.

Semantic Content Tools

Content tools are electronic pencils. We use them to create, edit, and present speech, text, tables, graphics, pictures, sound, video, and other types of information. Each kind of content tool manipulates a different file format and data structure, but has no knowledge of what the content means. Nor does it know how to interconnect and interrelate the meaning contained in different forms of information.

Semantic content tools not only encode different forms of information, they create and manage the meanings and structure of this information in a form that both people and computers can share and interpret. Web 3.0 will see

a major retooling to semantically enable authoring, design, presentation, engineering, illustration, web development, and rich media creation. This will change how we use content tools in the office, studio, engineering, and home. Semantic web developers have barely touched the possibilities.

What directions are semantic content tools heading? New capabilities will include:

- *Visual language and semantics* — Visual language is the tight integration of words, images, and shapes to produce a unified communication. In Web 3.0, visual semantics become explicit, sharable aspect of smart authoring, design, and presentation tools.
- *Mission-, task- and context-awareness* — data structures link to, and are driven by knowledge structures. Semantic content tools model intent and context, and combine these with semantically-enabled information and presentation models.
- *Semantic authoring* — create, edit and annotate speech, text, data, graphics, imagery, video, etc, and link information to underlying knowledge representations and domain models.
- *Semantic design* — modeling presentation, navigation, and interaction with dynamic rich media and adaptive UIs. Lenses using semantic models to transform information one form of presentation to another.
- *Semantic content generation* — Knowledge representations drive creation of communications, using text, tables, graphics, imagery, and speech. Also multilingual, multi-model, and trans-semantic capabilities.

From Search to Knowing

Search technologies look for information based on some criteria. Full-text search is fast, efficient, and simple, but delivers poor relevance in the absence of an exact keyword match. Statistical search mechanisms focus on the frequency of keywords, but provide imperfect results: a keyword may be misspelled in some target documents; it may appear in a plural or conjugated form; it may be replaced by a synonym; it may have different meanings according to context. Often, statistically-based searches return results that prove either too voluminous or too restricted to be helpful. Natural language search uses linguistic analysis, rules, and reference knowledge to improve named entity extraction, semantic analysis of word senses, and meaning of texts.

Semantic search expands keyword search by understanding the meaning of concepts and context of the query. It looks at the meaning of sentences and documents as well as equivalent ways of saying the same thing. It exploits reference knowledge about relationships between concepts. Semantic search can be cross-lingual (queries in the user language, answers in all languages). Semantic innovations in search are happening across multiple fronts, for example:

(a) What types of information can be searched?
(b) What sorts of questions can be asked?

(c) What form does the query take?
(d) What is the intent and context of the question?
(e) What form does the answer take?
(f) How can results be reasoned with and put to work?

Web 3.0 is about putting knowledge to work to improve our experience of the internet. We'll see a spectrum of semantic solutions for recovery to discovery, to analysis & intelligence, to question answering, to reporting, to smart behaviors. The spectrum of opportunities from search to knowing includes:

- *Search* — Natural language, multi-lingual, audio-visual media, vertical domain search, semantic search (understanding concepts, relationships)

- *Discovery* — Pattern detection and recognition, clustering, machine learning, voice and image feature extraction, knowledge extraction (locations, people, organizations, dates, relationships, events), IT discovery. Semantic discovery combining domain ontologies, deep linguistics, and pattern reasoning --e.g. legal e-discovery, drug discovery.

- *Analytics & intelligence* — identify and interpret patterns in information, linkages between things, placing extracted items into frameworks, data mining, text analytics, relationship analytics, perpetual analytics, predictive analytics, business intelligence, analytics integrating structured and unstructured content, information fusion, ontology-driven data merging, situation awareness, and impact understanding.

- *Question answering & reporting* — extract or synthesize an answer to a request from factoids to complex, contextually based scenarios in an open domain with multiple media, languages & data types. Find just information of interest, then report it just as wanted.

Semantic User Experience

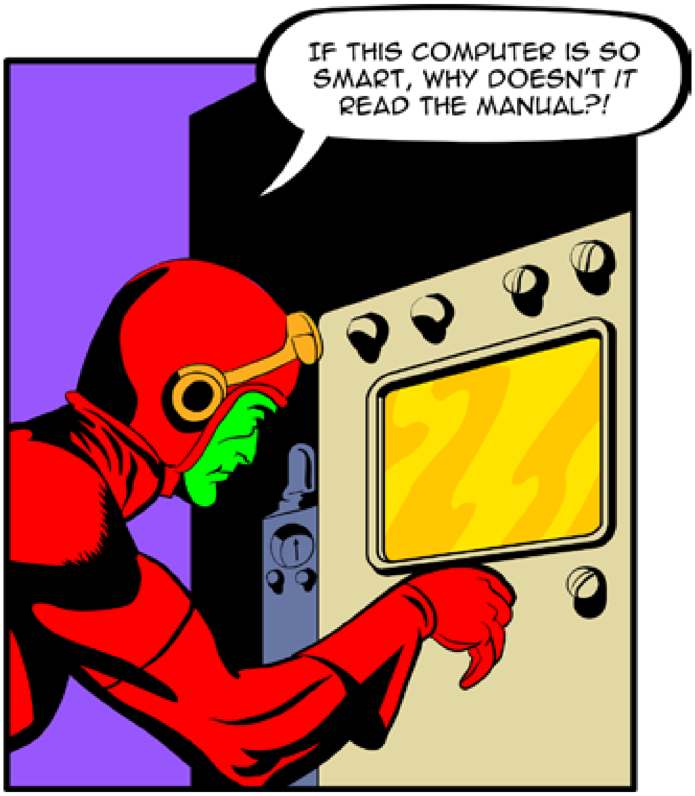
User experience is the sum of interactions and overall satisfaction that a person has when using a product or system. Semantic user experience (SEX) is the addition intelligence and context-awareness to make the user interface more adaptive, dynamic, advisory, proactive, autonomic, and autonomous, and the resulting experience easier, more useful, and more enjoyable.

Just as a focus on user interface (e.g. putting the "I" in UI and the "we" in web) differentiated Web 2.0 from Web 1.0, a focus on adding intelligence to the user experience will become a signature characteristic of Web 3.0. Some key areas of opportunity for semantic user experience include:

- *Identity* — Identity is information used to prove the individuality of a person as a persisting entity. The trend is towards semantic avatars that enable individual to manage and control their personal information, wherever it is across the net. Opportunities include semantic modeling and management of identity, getting control over personal information, link and share information across social networks, semantic avatars (that learn), web 4.0 personal appliances.

- *Context* — Context is information that characterizes a situation of an entity, object, event, etc. Context awareness is using this knowledge to sense, predict, interpret and respond to a situation. Opportunities include semantics for sensing, predicting, interpreting, and responding to situations and events (e.g. context-aware games)

- *Mobility* — Mobility is the new platform. It demands semantic technologies to deliver seamless, self-configuring, customizable, context-aware services, anytime, anywhere.



- *Semantic browsing* — Semantic browsers will understand the semantics of data, will broker information, and will automatically interpret metadata. The emerging display landscape will be semantically connected and contextually aware. It will unify displaying and interacting. It will personalize experience. Reality browsing is querying the physical world live and up close from anywhere. Opportunities include semantics-aware semantic portals, webtops, and dashboards, semantic search, immersive 3D UIs, location-aware reality browsers.

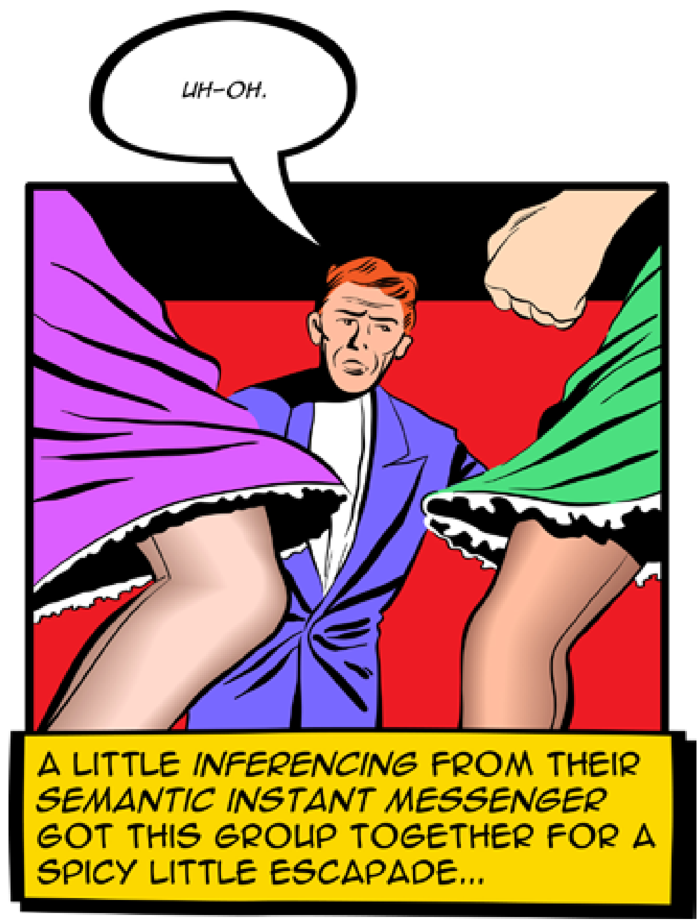
- *Intelligent user interface* — An Intelligent user interface learns, cooperates, and acts autonomously. It is autonomic and capable of flexible, purposeful reasoning action in pursuit of one or more goals. An intelligent UI knows about a variety of things such as system functionality, tasks that users might want to do, ways that information might be presented or provisioned. Also, intelligent UIs know about the user (via user models), which enables tailoring system behavior and communications. Adding intelligence helps users perform tasks, while making working with the computer more helpful, and as invisible as possible. Opportunity is to build semantic systems that do more for the user, yield more relevant results with less effort, and deliver a more enjoyable experience.

Semantic Social Computing

Social computing is software and services that support group interaction. Semantic social computing adds an underlying knowledge representation to data, processes, services, and software functionality. Semantic technologies will enrich many categories social applications including instant messaging, email, bookmarking, blogging, social networking, wikis, user driven "communitainment", and do-it-yourself applications and services.

Semantic technologies will enable social computing applications to provide concept-based rather than languagebased search and navigation across most standard applications, document types, and file formats, regardless where these resources reside on the net, be it a desktop, mobile device or server, etc.

Web 3.0 will see platforms, applications, and intelligent connecting technologies for social communication, information literacy, and cooperation. Almost every category of application will become social to some extent, and every category of social computing application will become semantic. Semantic social computing opportunity areas include:



- *Semantic instant messaging* — Use semantic technology for online messages, chat, and conference to understand conversations; keep track of people, topics & history; search by concept; act on messages.

- *Semantic email* — Use semantic technology to understand messages. Models & tags people, profiles, threads, contents, and addresses; Searches semantically. Links messages to other information. Performs actions according to a semantic model.

- *Semantic blog* — Enhance web journal with machine interpretable annotations and models & personal ontologies to harvest, link, and search information of interest by concepts and relationships.

- *Semantic desktop and webtop* — Use natural language understanding, ontologies, data space concepts, and semantic processing to manage every piece of information a person encounters.

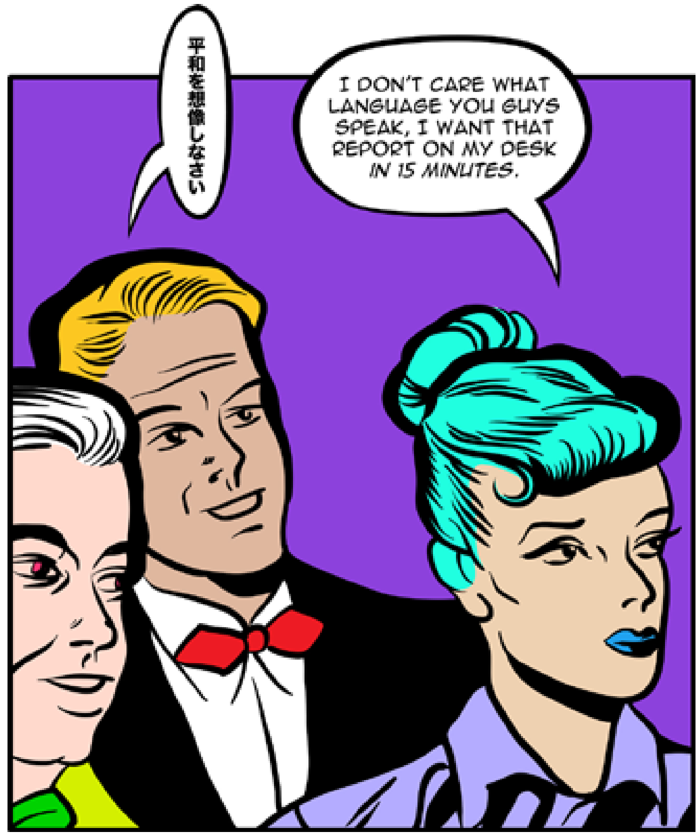
- *Semantic bookmarking & tag clouds* — Associate links to web resources with concepts represented in an external ontology. Use semantic auto-tagging to Map folksonomy + semantic relationships between tags, users, and site resources.

- *Semantic social networks* — Web of people, content, sites, and profiles that machines help build, interrelate, communicate with, and enjoy.

Semantic Collaboration

Collaboration tools enable groups to read, write, edit, and present information, coordinate their activities, share information and manage knowledge together. Semantic collaboration adds a layer of knowledge representation and meanings that enrich the collaborative experience and utility of its results.

Web 3.0 will see the co-evolution of tools and social practices to support ever more complex forms of cooperative society. A key trend in Web 3.0 is toward collective knowledge systems where users collaborate to add content, semantics, models, and behaviors, and where systems learn and get better with use. Collective knowledge systems combine the strengths of social Web participation with semantic Web integration of structure from many sources. Key features of Web 3.0 social computing environments include (a) user generated content, (b) human-machine synergy; (c) increasing returns with scale; and (d) emergent knowledge. Incorporating new knowledge as the system runs is what enables Web 3.0 systems to get smarter.



Opportunities for semantic collaboration include:

- *Semantic content management* — Manage the knowledge expressed in documents and other artifacts at a conceptual level, separately from and across the artifacts of originating systems.

- *Collective knowledge systems* — New class of applications that combine strengths of social web, with semantic technologies. Features include user generated content, human-machine synergy, increasing returns with scale, and emergent knowledge.

- *Semantic wikis* — Read-write web site that includes an underlying model of the knowledge described in its pages. Features include concept- rather than language-based searching; richly structured content navigation (multiple views, perspectives, levels of abstraction); context-specific visualization and presentation; mining of relationships; linking with external repositories, feeds, and systems.

- *Semantic agent wikis* — Collaboration platforms that combine content creation, knowledge extraction & modeling, behavior specification, knowledge computing operations, and learning.

Semantic Enterprise Processes
Enterprise processes provide the core functionality to plan, operate and interrelate with customers, suppliers, and internal constituencies. Historically, enterprise processes have been monolithic, difficult to implement, and dependent on fixed formats, interfaces, and program logic, which makes solutions inflexible and costly to modify and adapt as business circumstances change.

Semantic enterprise processes address these issues by phasing out hard coded schemas, interfaces, and procedures in favor of shared executable semantic models. Web 3.0 will see virtually all business processes that are supported by commercial-off-the-shelf (COTS) software products become semantically enabled. The entire "stack" will be transformed from core infrastructure, to system middleware and plumbing, to application features, to user experience. Already this is happening. From the perspective of the application suites, semantic enterprise COTS opportunities include:

- *Semantic ERP* — Integrate enterprise planning and operations, finance and human resources, customer and supplier processes, manufacturing and services using enterprise ontology.

- *Semantic CRM* — Use executable shared knowledge models to specify the logic, interrelate information, and orchestrate activities comprising marketing, sales, service, and support of customers.

- *Semantic SCM* — Represent knowledge about goals, services, rules, processes, and information structures separately from application code so that it is discovered, interpreted and executed directly and adaptively in real time by systems of supplier, manufacturer, wholesaler, retailer, and consumer.

- *Semantic PLM* — Use knowledge models to specify policies, interconnect processes, and integrate information relating to R&D, engineering, manufacturing, deployment, and support. New concepts of operations such as knowledge-based engineering, virtual manufacturing (semantic models drive simulation and testing), adaptive production systems (goal oriented agents), and self-optimizing, multiple organization value chains.

- *Semantic SCADA* — Replace hard-coded message structures and application logic with sharable semantic models that represent, integrate, and process the characteristics of sensor devices, data stores, applications, & real-time controls.

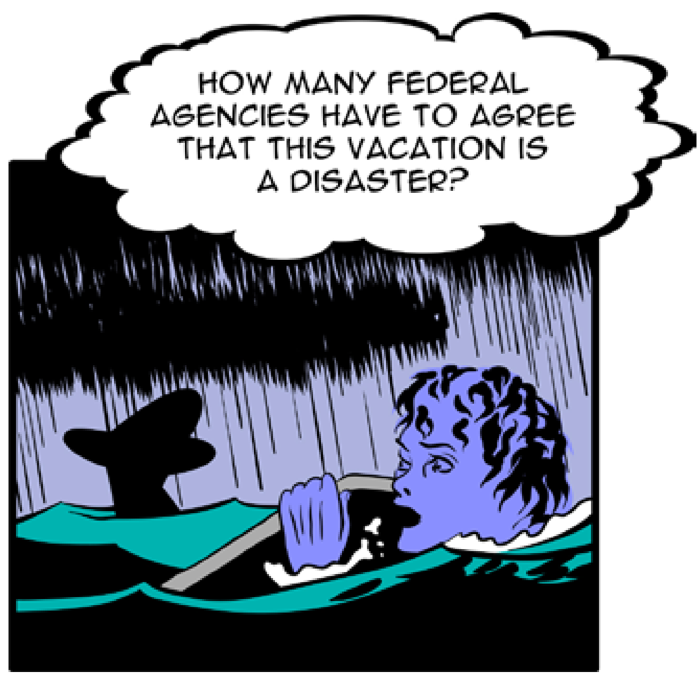
Knowledge-based Applications
Semantic technologies enable us to put knowledge to work through knowledge-centric versus document centric processes for authoring, research, design, engineering, simulation, eScience, professions, logistics, virtual manufacturing, policy & decision support, and cognition. The trend towards semantic applications is:

- From knowledge in paper documents to digital documents to knowledge (semantic models) to agents;

- From functional processes that are static and passive to active, adaptive, and dynamic, to autonomic to autonomous ones;

- From programmer encoded interpretations of meanings and logic at design time to computer interpretation of meanings and logic at run time;

- From smart program code to smart data;



- From hard-coded reasoning with SQL database engines to declarative graph-based reasoning with all of first-order logic, and uncertainty, conflict, causality, and values.

Web 3.0 will bring benefits from new concepts of operation, and new categories of application for knowledge workers and knowledge-intensive tasks. First, semantic technologies will deal with structured, semi-structured, and unstructured information both intelligently and interchangeably. Second, semantic technologies will reason evolving knowledge and put it to work.

Opportunities for knowledge-based applications include:

- *Semantic mashups* — Fuse data and services from multiple applications, correlate information in context, drill-down and across in real-time, ask questions across databases, and infer links across systems.

- *Policy-based computing* — Use externally declared definitions (semantic models) and decision-making technologies to configure and control execution of an application program at run-time. Specify management operations in terms of goals to meet, rather than detailed instructions.

- *Governance, risk & compliance* — Also fraud, exceptions, emergency response and case management. Policy driven, need to span multiple silos, make sense of structured & unstructured information, case tracking, and communications in context.

- *Semantic simulation, testing, planning, and scheduling* — Use declarative models to represent, predict, test, and refine the behavior of a system. Replace hard coded goals, services, rules, processes, and data structures with sharable, easily updated semantic models accessible to other applications.

- *Knowledge-centered engineering* — Semantic model and simulation-driven research, design, development, manufacturing, and operations. Multi-disciplinary, language neutral representation, model-based design/build, advisors, virtual processes.

- *In Silico Science* — Simulate and test hypotheses in knowledge-based silicon laboratories. Putting knowledge to work is more than mining literature.

Intelligent Systems

Intelligent systems learn, cooperate, and act autonomously. They are capable of flexible, purposeful and reasoning action in pursuit of one or more goals and in response to external stimuli from their environment.

Web 3.0 will bring intelligent systems to the masses and to the net, and on a massive scale. It's now possible to create adaptive, autonomic, autonomous systems that know, learn, reason and pursue goals, and to do this at virtually any scale across the net.

Intelligent systems opportunities include:

- *Machine learning* — Automatically acquire new knowledge from past cases, experience, or exploration, to solve problems, improve system performance, adapt to change. Intelligent systems learn during their existence.

- *Semantic agents* — Use sharable ontologies to power agents to sense, know, reason about, communicate, and take action proactively with respect to their goals, roles, tasks, behaviors, environment, and current situation.

- *Autonomic products and services* — Use self-describing interfaces that include roles, profiles, policies to control manufacturing, plan logistics, promote sales, explain use, induce recycling. Self-governing via self-knowledge of capabilities and constraints.

- *Robots* — Autonomous semantic agents that sense, respond, learn, and take action in an environment without intervention. Networked robots are multi-agent systems. Robotics brings together diverse threads of AI research such as vision, planning, sensor fusion, natural language, face recognition, learning, and autonomous behavior.

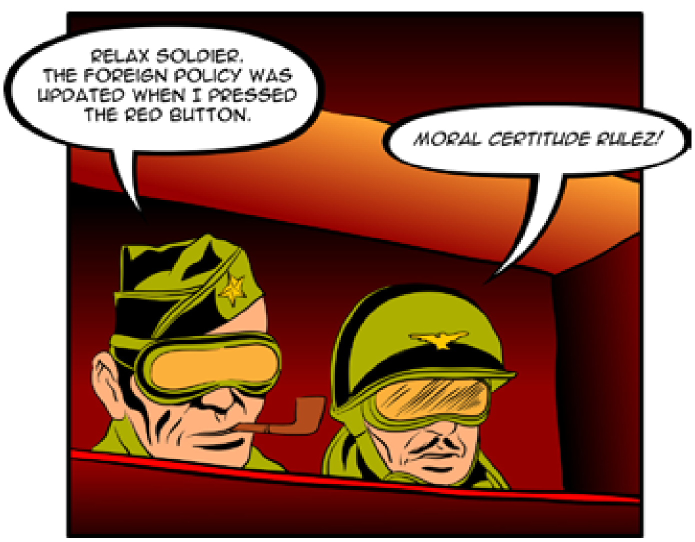
- *Blogjects and Spime* — Blogject are "objects" and "things" that participate in the sphere of networked social discourse variously called the blogosphere, or social web. Spime are objects that can be tracked through space and time throughout the lifetime of the object.

Semantic Architectures

The architecture of a system consists of: the structure(s) of its parts including design-time, test time, and run-time hardware and software parts; the externally visible properties of those parts; and modules with interfaces, hardware units, objects and the relationships and constraints between them. An architecture defines behavior — the interactions between structural elements through which functionality is expressed. And, an architecture embodies decisions based on a rationale. It is more than the structure and behavior of things; it is the rationale for why things are the way they are.

Semantic architecture models the knowledge about structure, properties, modules, behaviors, and rationale in a human understandable and machine executable form, that is separate from the artifacts that express the system.

There are two classes of semantic architecture. One is about building intelligent systems that people with different kinds of skills can design and implement themselves, with and without IT specialists. The other kind of architecture is for evolving systems and ecosystems of such



complexity, scale, and pervasive adaptivity that no central control is practical; rather the systems components must be able to sort things out for themselves. Semantic patterns can solve problems of integration, interoperability, parallelism, mobility, pervasiveness, scale, complexity, speed, power, cost, performance, autonomics, automation, intelligence, identity, security, ease of programming, and ease of use. Opportunities include:

- *Semantic enterprise architecture* — The trend is from reference documentation to operational, executable knowledge models. A business ontology is a formal specification of business concepts and their interrelationships that facilitates machine reasoning and inference.

- *Semantic model-driven architecture* — Specification of business functions, rules, roles, interactions, etc. are human readable and directly machine executable.

- *Semantic interoperability* — Use semantic models that encompass policy, organization, information, and technical knowledge to enable sharing, discovery and machine interpretation of intention and knowledge in a purposeful context.

- *Semantic service oriented architecture* — Linking information sources, work flows & processes through knowledge models, rather than hard-coded interfaces. Machine-interpretable descriptions of policies and services automate discovery, negotiation, adaptation, composition, invocation, and monitoring of web services.

- *Context-aware services* — Integrate knowledge about the user, community, physical world, and digital world to enable entities to complete tasks on their own, discover other services, and use them to compose new functionality.

- *Semantic event-driven architecture* — Represent knowledge about events, triggers, behaviors, processes, entities, relationships, information, and application logic separately from program code, in the form of sharable, machine interpretable models. This allows autonomic (self-declaring) events, dynamic and self-optimizing event handling and adaptive service planning.

Semantic Storage

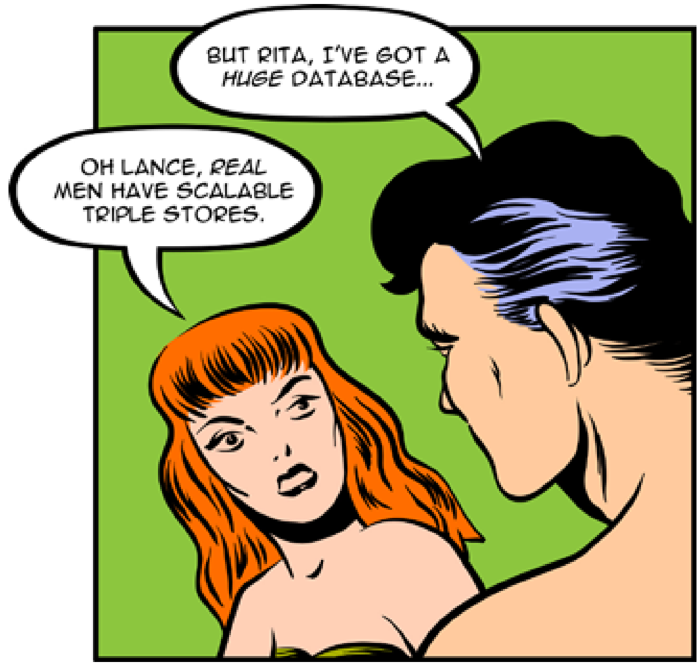
A data model is a collection of: data structure types, operators or inferencing rules, and general integrity rules. Capabilities of a storage solution are constrained by the types of data structures it supports, and the kinds of reasoning it can perform over them. Performance is constrained by how much knowledge (theory + information) is operated upon, how coherently and intricately it is organized, and how extensive and long are the reasoning paths, and the deployment of these things.

As we move into Web 3.0, we are reaching the limit of what we can do with hierarchical file folders and relational database tables. The next big thing is the semantic graph. Four factors drive semantic storage capability, performance and cost. These include: the quantity of data, the complexity of its structure, its deployment, and the kinds of reasoning performed over it. That is:

- How many bits are needed to store the knowledge-base on disk, in memory, (or both)?;
- How many instructions and iterations are required to reason over the knowledge to the answer? (A direct lookup of the result in memory would be the fastest way);
- What processing is required to load, or otherwise prepare the data model for processing; and
- What amount of processing is required when something happens that requires changing, or restructuring the semantics of the data model.

Semantic storage opportunities include:

- *Semantic data space management* — Use semantic models to connect and manage heterogeneous data stores. Enable developers to focus on applications, rather than recurring challenges of dealing consistently and efficiently with large amounts of interrelated but disparately managed data.
- *Scalable semantic graph databases* — Store information as nodes and their respective relationships as arcs. Overcome challenges of recursive queries, long wait times, and complicated SQL programming required to analyze data.



- *Triple stores & semantic object databases* — Absolutely. And for maximum scalability and performance, the direction will be towards n-ary, variable length, concept encoding and declarative processing.

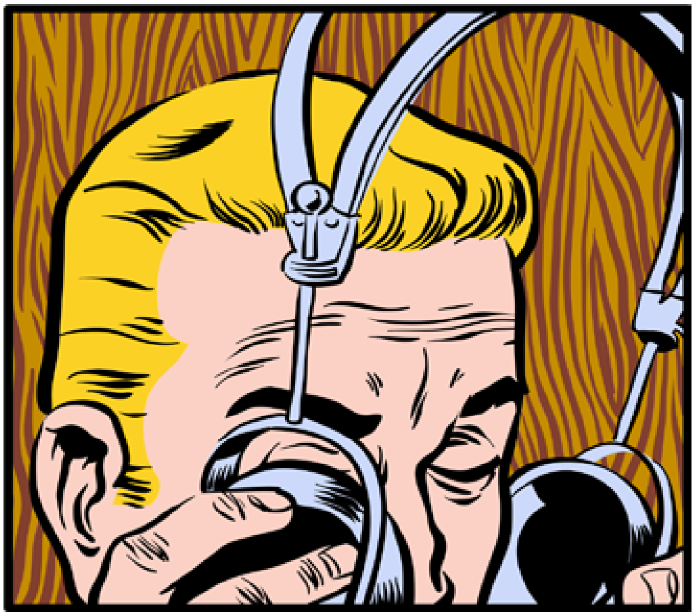
Semantic Transport

Key trends driving networking towards semantic solutions include bandwidth explosion and ubiquity. Mobility means dynamic context. Grids and meshes move beyond stacks. The web evolves to connect knowledge, then intelligences.

Web 3.0 opportunities include:

- *Semantic mobility* — Use semantic models to deliver easy to create, self-describing, seamless, self-configuring, customizable, context-aware services, anytime, anywhere. The focus was listen, watch, command, surf, play, and record your life with a box. The future is sense, communicate, and compute where physical and digital worlds fuse.
- *Semantic grids & semantic meshes* — Grids (applying many resources across a network at the same time to a problem) are moving to semantics for managing virtualization of infrastructure, services and "organizations". Grid architecture is moving from traditional stacks to multi-dimensional autonomic semantic meshes that use semantic descriptions of resources, services, and policies.

THE HOME APPLIANCES HAVE SOME ARCANE RULES-OF-ENGAGEMENT. SOMETIMES I LIKE TO LISTEN IN AS THEY SORT IT OUT.



- *Semantic security* — Concept-level transparency is key to developing fine-grained, autonomic, effective identity and security mechanisms. Security challenges are shifting from: predictable, slowly-evolvable threat & risk models, interaction scenarios, and behavior patterns to unpredictable and highly-dynamic ones; platform monopolies to massively distributed systems exhibiting unprecedented levels of software and hardware platform heterogeneity; device-and infrastructure-centric security models, towards user-context and information-centric ones; predefined to opportunistic interactions with unknown parties in open, inherently insecure environments; and limited and fragmented data to unparalleled level of personal information richness and precision collected/processed/stored and communicated.

- *Service-oriented knowledge utilities* — Give grid/mesh/net services and content semantic descriptions automating dynamic composition and automated reasoning.

Semantic Processors

Key trends driving processors towards semantic solutions include multi-core, multi-thread computing, and the need for semantic processing at scale.

Semantic processor opportunities include:

- *Semantic programming* — Use semantic technologies (such as semantic multi-agent technology) to vastly simplify programming of concurrent and distributed applications in multi-core, multi-thread hardware and distributed or federated processing environments.

- *Semantic processing at scale* — Computing and memory optimized for hi-performance declarative semantic graph operations at scale. Characteristics include huge memories, massively parallel processing, and non-Von Neumann architectures.

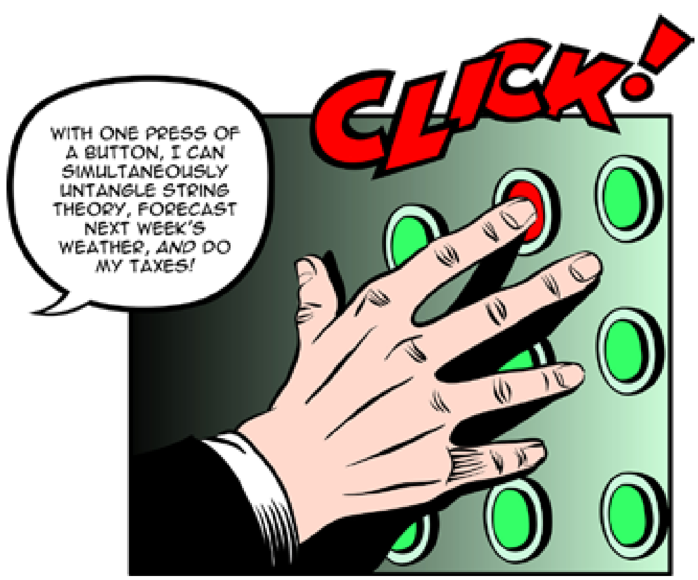
Semantic Software Development

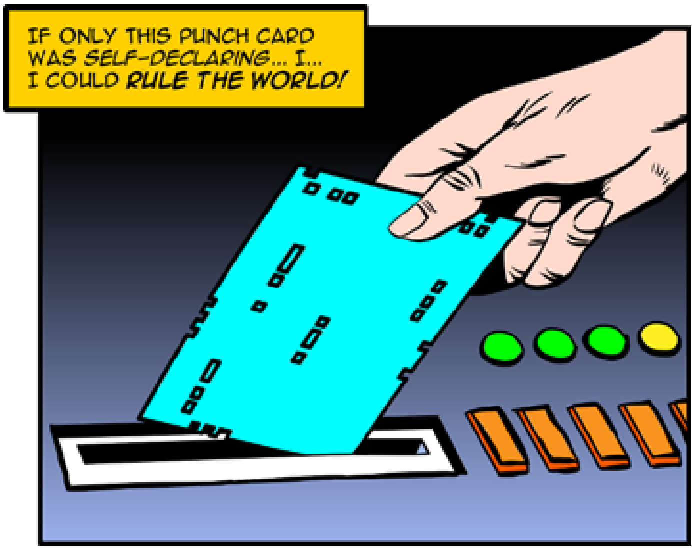
In semantic software development, emphasis shifts from objects and procedural code to modeling and integrating the knowledge about a desired capability. End-user development increases as computers help generate intelligent services and manage application functionality, security, versioning, and changes automatically.

Opportunities for semantic software development include:

- *Semantic application platforms* — evolve desktops, mobile services, social computing, e-commerce sites and search engines to become semantic application platforms for user communities. Provide self-describing machine interpretable semantic APIs. Use ontologies to integrate capabilities and services (e.g. email, wiki, content management) that support roles and tasks in a personalized, context-aware application workflow.

- *Do-it-yourself services* — empower consumers (prosumers) to make their own content, knowledge, and services, manage these semantically, and build their





own mashups using semantic agents and recombinant knowledge (data & logic).

- *Semantic social operating systems* — use semantic technologies to enable systematic management and facilitation of human social relationships and interactions.

- *Goal-oriented software engineering* — Declare knowledge about data, processes, rules, services and goals separately from application code to enable sharable, adaptive, autonomic, and autonomous solutions.

- *Semantic multi-agent systems* — Key software paradigm for intelligent systems and the ubiquitous web. Declarative systems trade processing cycles (time) for storage (space). Smart data trumps procedural algorithms. Environment is an active process. A flock is not a big bird. Emergent behavior is distributed. Think small.

Semantic Ecosystem

Semantic ecosystems are dynamic, evolve-able families of systems consisting of ensembles (societies) of smart artifacts. The Web 3.0 mantra is to design for robustness, uncertainties, pervasive adaptation, organic growth, self-evolution.

Emerging semantic ecosystem opportunities include:

- *Semantic cloud computing* — Web 3.0 will see the advent of web-scale semantic computing. Grids, meshes and mobile nets will become semantic grids, semantic meshes, and service-oriented knowledge utilities (SOKUs), Swarm computing,

- *Autonomic intellectual property* — New categories of self-aware knowledge assets, blogjects and spime (neologisms for objects and things participating in the sphere of networked social discourse, and whose histories can be tracked through space and time throughout the lifetime of the object), society of mind principles.

- *Knowledge commerce* — Semantic advertising services, Services to search, find, assess and obtain knowledge assets, architectures for sharing, adaptation, and re-use of recombinant knowledge building blocks.

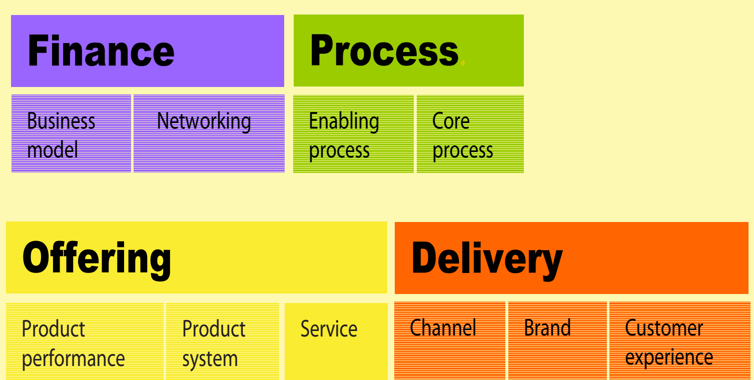
Why is Business Concept Innovation Important in the Next Stage of the Internet?
While semantic technologies provide critical value levers for next stage internet products and services, successful innovation is more than technology, and more than coming up with a hot new product or service.

In a 2006 study of innovation, IBM concluded that business model innovation matters. Change how you add value. Make the business model deeply different. Also, external collaboration matters. Partners and customers are top sources of innovative ideas. Collaborate massively, systematically across organization and geographic boundaries. Force an outside look.

As shown in Figure-7, Dolgin, Inc. defines ten types of business concept innovation that should be part of the strategy canvas. The business model is how you makle money. Networks and alliances is how you join forces with other companies for mutual benefit. Enabling process is how you support your core processes and workers. Core process is how you create and add value to your offerings. Product or service performance is how your design your core offering — features, functionality, and performance. Product system is how you link and/or provide a platform for multiple products and services. Service is how you provide value to customers and consumers beyond and around your products. Channel is how you get your offerings to market. Brand is how you communicate your offerings. And, customer experience is how your customers feel when they interact with your company and its offerings.

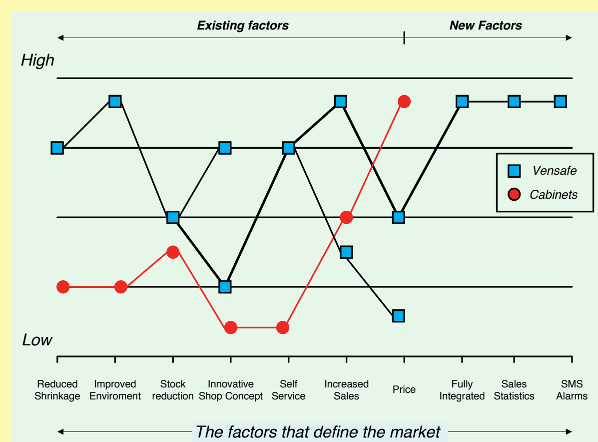
Figure-7: Innovation Strategy
Business concept innovation matters. Product and service innovation are only part of successful innovation.

Ten types of business concept innovation



Source: Doblin

Strategy canvas



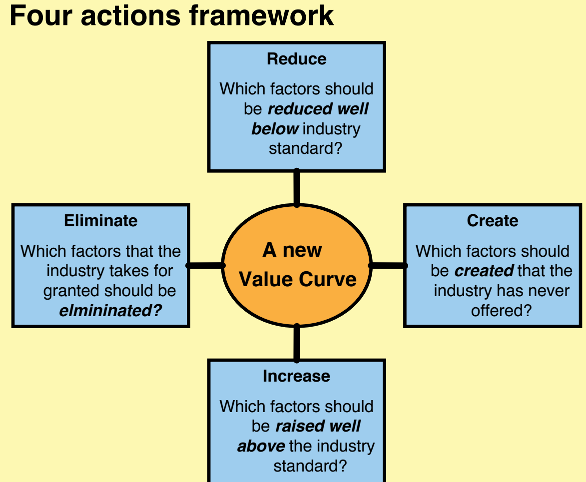
Source: Kim & Mauborgne

How do red ocean & blue ocean strategies differ?

Red Ocean Strategy	Blue Ocean Strategy
Competing in existing market space	Create uncontested market space
Beat the competition	Make the competition irrelevant
Exploit existing demand	Create and capture new demand
Make the value/cost trade-off	Break the value/cost trade-off
Align the whole system of a company's activities with its strategic choice of differentiation or low cost	Align the whole system of a company's activities in pursuit of differentiation and low cost

Source: Kim & Mauborgne

Four actions framework



Source: Kim & Mauborgne

Kim and Mauborgne argue that a fundamental strategic decision is whether to compete in an existing market space, which they call the “red ocean” strategy, or to create a new, uncontested market space, which they call the “blue ocean” strategy. As summarized in Figure-6, The red ocean strategy focuses on beating the competition, exploiting existing demand, making value/cost trade-offs, and aligning the whole system of company’s activities with its strategic choice of differentiation or low cost. The blue ocean strategy seeks to change the game, make competition irrelevant, create and capture new demand, break existing value/cost trade-offs, and align the whole system of the company’s activity to pursue both differentiation and low cost in the new space.

Internet innovation has a direction. It is towards greater bandwidth, more intense social connectedness, smarter applications and devices, and pervasive adaptability. The next stage of internet affords numerous opportunities of both red and blue ocean varieties.

The key to successful innovation is design, engineering and delivery of new configurations of value. As experienced by customers, value is contextual, multidimensional, and co-evolving. It encompasses all aspects of the business, including the value contributed by its technology building blocks.

Semantic technologies will drive value in the next stage of the internet, and will burgeon into billion dollar markets for semantic technologies and solutions that, in turn, will fuel trillion-dollar economic expansions world-wide over the next decade.

Next stage internet technology vectors include networked intelligence, rich media, and ubiquitous connectivity. Semantic technologies will play a central role in all of these. The fundamental transition for ICT will be from information-centric (i.e., data, procedure, documents) to knowledge-centric patterns of computing and communication. Key sources of new value will include knowledge modeling, techno-social-economic collaboration, declarative processes, and architectures of learning involving both humans and machines. Dimensions for measuring the worth of semantic solutions include: capability, user experience, performance ,and life cycle economics.

Is the Market Ready for Semantic Technologies?

“The genius of investing is recognizing the direction of a trend — not catching highs and lows.” I’m not sure who said this, but it does call attention to an inflection point that has been reached in markets for business, consumer, and infrastructure solutions built with semantic technologies. Is now the time to act? We think so.

Signs of life in mainstream markets are now plentiful. Research, analysts, & think tanks are getting it. Media & events are increasingly covering semantic technologies. Standards, tools, & methodologies have arrived. A spectrum of semantic technology capabilities have matured over the past decade. There are now plenty of suppliers & providers, including big ones. And, level of market activity in R&D, ICT, consumer, enterprise and industry vertical sectors is now significant.

Here is a sampling from industry analysts and media. Gartner now includes semantic technologies a one of its top-10 strategic technologies for 2008. Forrester is now covering semantic technologies as part of search, business intelligence, and business services specification. Accenture has identified semantic integration a key trend shaping IT. In the information services, publishing, and media space, Outsell analysts have pointed to the growing importance of semantics in search, community driven content, and agile publishing. The Research Board, a think tank funded by Fortune 100 CIOs/CTOs has concluded that semantic technologies look like a “game changer” for business intelligence and information management. Computer Science Corporation’s Leading-Edge Forum on Digital Disruptions cites semantic technologies as one of the top-5. Also, media and blog coverage of semantic technologies has continued to increase. Similarly, the number of events, conferences, webinars, training programs, etc.worldwide covering semantic technology research and applications is growing.

It bears emphasizing that semantic technology standards, tools, and methodologies have arrived. Semantic web standards such as RDF, OWL, SPARQL, RulesIF, and linked data best practices are now ready for tactical and strategic use in production environments. Further, these standards are being supported across standards groups including W3C, OMG, ISO, OASIS. Plus, these standards are aligned with even more encompassing standards for knowledge representation and reasoning such as Common Logic and IKL. More complete semantic solution development tool suites and methodologies ready to use from companies such as TopQuadrant, Ontoprise, and Altova. Similarly, training in knowledge modeling, semantic web standards, and semantic solution development is now available from a number of qualified experts.

Figure-8 overviews the structure of semantic technology markets. Activity in all sectors is increasing. Here are top-10 lists of opportunities for Enterprise and Consumer sectors.

Figure-9, following this page, lists research organizations, specialty firms, and major ICT product and service organizations that are providing semantic technology research, products, services, and solutions. The market has seen a significant increase in the number specialist firms and mainstream consultants and system integrators providing professional services based on semantic technologies.

Summary

This special report has investigated semantic technology-based product and service opportunities in the next stage of the internet — Web 3.0. First, we defined what we mean by semantic technologies. Next, we discussed what value means in the next stage of the interet and how semantic technologies deliver value. Then, we examined capabilities of semantic technologies that drive value. We precised 70 capabilities in 16 categories, that can be building blocks for Web 3.0 products, services, and infrastructure. Next, we explored product and service innovation as just one aspect of business concept innovation. Finally, we presented a market view and call for action that included some picks for potentially high-value consumer and enterprise semantic applications.

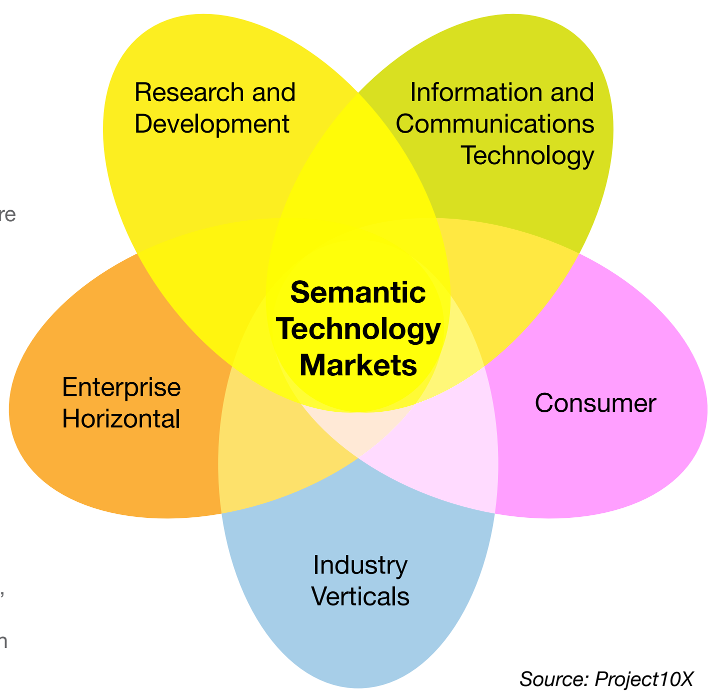
The information presented in this Web 3.0 Manifesto is drawn from more comprehensive technology and market assements provided in Project10X's Semantic Wave Report. Information about this research report is provided on page 28.

To learn more, order the ***Semantic Wave Report*** from the Project10X web site: http://www.project10x.com/.

Figure-8: What are Semantic Wave Market Opportunities?
Market divisions include research and development, information and communications technology, consumer internet, enterprise horizontal applications, and industry vertical markets. Here are top-10 lists for Enterprise and Consumer markets.

Top-10 List — Enterprise

1 Information sharing
2 Semantic search, discovery, & navigation
3 Semantic mashups and composite applications
4 Semantic infrastructure / middleware SSOA, SBPM, SWS, virtualization, policy-based computing
5 Semantic business intelligence
6 Semantic ERP applications CRM, PLM, SCM, HRM
7 Semantic governance, compliance, & risk
8 Semantic web sites, wikis, collaboration, interest networking, & collective knowledge systems
9 Semantic advertising, marketing, personalization, & customization
10 Intelligent systems knowledge-based research, design, engineering, simulation, planning, scheduling, optimization, & decision support.



Top-10 List — Consumer

1 Interest networking
2 Semantic social networking
3 Semantic bookmarks
4 Semantic search & QA
5 Semantic desktop / webtop
6 Semantic blogs, wikis
7 Semantic identity management
8 Semantic mobility
9 Semantic email & IM
10 Reality browsing, avatars, & context-aware games

Source: Project10X

Figure-9: Who Are the Semantic Solution Suppliers?
Research organizations, specialist firms, and major players are joining the semantic wave.

7 Degrees
42 Objects
Above All Software
Abrevity
Access Innovations
Active Navigation
Adaptive Blue
Adobe Systems
Aduna
Agent Logic
Agent Software
Agilense
Alitora
Altova
Amblit Technologies
Apelon
Arisem
Articulate Software
AskMe
AskMeNow
Aspasia
Astoria Software
AT&T Research
ATG
Attensity
Autonomy
Axontologic
BAE Systems
BBN Technologies
Be Informed
BEA Systems
Biowisdom
Boeing Phantom Works
Bouvet
Bravo Solution
Business Semantics
Cambridge Semantics
Celcorp
Celtx
Centriguge Systems
CheckMI
Circos
Cisco Systems
Clarabridge
CognIT a.s
Cognition Technologies
Cognium Systems
Cohereweb
Collarity
Collexis
Composite Software
Computas AS
Computer Associates
Connotate
Content Analyst
Contextware
Contivo
Convera
Copernic
Correlate
Cougaar Software
Coveo
Crystal Semantics
CureHunter
Cycorp
Dapper
Dassault Systemes
Data-Grid
Day Software
Deepa Mehta
Design Power
DERI
Design Power
DFKI
DiCom Group
Digital Harbor
Digital Reasoning Sys.
Discovery Machine
DreamFactory Software
EasyAsk
Effective Soft
Ektron
EMC Corporation
Empolis
ENDECA
Enigmatec
Enterra Solutions
Entrieva
Epistemics
Evri
Exalead
Expert System
ExpertMaker
Factiva
Fair Isaac
Fast Search & Transfer
Fortent
Fortius One
FourthCodex
Franz Inc.
Fujitsu Laboratories
General Dynamics IT
Generate
GeoReference Online
Gist
Global 360
Google
Graphisoft
Groxis
Gruppometa
H5
hakia
HBS Consulting
Hewlett-Packard
Hypertable
i2
IAC Search & Media
iCognue
IBM
ILOG
Image Matters
Imindi
iMorph
Infolution
Inform Technologies
Informatica
Information Extraction
Sys.
InforSense
InfoSys
Innodata Isogen
InnoRaise
Intellidimension
Intelligent Automation
Intellisemantic
Intellisophic
Interwoven
Invention Machine
Iona Technologies
iQser
Irion Technologies
Iron Mountain
iSOCO
ISYS Search Software
Janya
JARG Corporation
Jiglu
Joost
JustSystems
K2
Kalido
Kapow Technologies
Kennen Technologies
Kirix
Knewco
Knova Software
Knowledge Based Sys.
Knowledge Computing
Knowledge Concepts
Knowledge
Foundations
Knowledge Media Inst.
Knowledge Systems, AI
Kosmix
Kroll Ontrack
Kyield
Language&Computing
Language Computer
Corp. (LCC)
LEGO Americas
Leximancer
Lexxe
Liminal Systems
Linguamatics
Linguistic Agents
LinkSpace
Lockheed Martin
LogicLibrary
Lymba Corporation
Magenta Technology
Makna Semantic Wiki
Mandriva
Mark Logic
Match4J
MatchMine
Matrixware
McDonald Bradley
Mendix
MetaCarta
MetaDolce
MetaIntegration
Metallect
Metatomix
Metaview 360
MetaWeb Technologies
Métier
Microsoft Corporation
Mind-Alliance Systems
Mindful Data
Miosoft
Modulant
Modus Operandi
Molecular
Mondeca
Moresophy
Motorola Labs
mSpace
Mulgara.org
Nervana
Netbreeze
Netezza
NetMap Analytics
NeOn
NeurokSoft
NextIT
Nielsen BuzzMetrics
Noetix
Nokia
Northrop Grumman
Novamente
nStein
Numenta
NuTech Solutions
Ontology Online
Ontology Works
Ontomantics
ontoprise
Ontos
OntoSolutions
OpenLInk Software
Open Text
Oracle
PeoplePad
PhraseTrain
Pier39
Polymeta
Powerset
Pragatic
Profium
Progress Software
Project10X
Proximic
PTC
Qitera
Quigo
Radar Networks
Raytheon
Readware
Rearden Commerce
Recommind
Red Hat
Reengineering
Reinvent Technology
Revelytix
RuleBurst
SAIC
SaltLux
Sandpiper Software
SAP
SAS Institute
SchemaLogic
seekda
Semandex Networks
Semansys
Technologies
Selmantech, Inc.
Semantic Arts
Semantic Discovery
Semantic Edge
Semantic Insights
Semantic IQ
Semantic Knowledge
Semantic Light
Semantic Research
Semantic Search
Semantic Solutions
Semantic System
SemanitiNet
Semantra
Semaview
SemperWiki
SenseBot
SERENA Software
SiberLogic
Siderean Software
Sierra Nevada Corp
SilkRoad Technology
Silobreaker
Sirma Group–Ontotext
Smart Desktop
Smart Info-System
SmartLogic
Soar Technology
Software AG
Sony
Spock
SRA International
SRI International
Sun Microsystems
SunGard
Sybase
Synomos
SYS Technologies
System One
TACIT
Talis
Taxonomy Strategies
TÉMIS Group
Teradata
Teragram
TextDigger
Textual Analytics
Textwise
The Brain Technologies
The METADATA Co.
Thetus
Thinkmap
Thomson Reuters
ThoughtExpress
TopQuadrant
TripIt
Troux Technologies
True Knowledge
True Thinker
Ultimus
Ultralingua
Versatile Info Systems
Vignette
Vitria
Vivísimo
Vivomind Intelligence
WAND
WebLayers
Whatever
WiredReach
Wordmap
XSB
Yahoo!
Zepheira
ZoomInfo
Zotero
ZyLAB

Source: Project10X

Semantic Wave Report: Industry Roadmap to Web 3.0 and Multibillion Dollar Markets.

Purchase the Semantic Wave Report from the Project10X web site: http://www.project10x.com/.

Report Specifications	
Format	PDF — Color and B&W
Pages	721
Figures	290
Vendors	300
Applications	110
Market sectors	14
Case examples	150
Price	$1000 USD
Availability	Now

Semantic Wave Report explains Web 3.0 and the new semantic technologies that drive value in it. This research charts the evolution of the internet from Web 2.0 to Web 3.0, the emergence of semantic technologies for consumer and enterprise applications, and the growth of multi-billion dollar markets for Web 3.0 products and services. It is must reading for investors, technology developers, and enterprises in the public and private sector who want to better understand semantic technologies, the business opportunities they present, and the ways Web 3.0 will change how we use and experience the internet for pleasure and profit.

Report Outline

1 Introduction
2 Semantic Wave
- 2.1 Strategic Vision
- 2.2 Web 1.0
- 2.3 Web 2.0
- 2.4 Web 3.0
- 2.5 Web 4.0

3 Semantic Technologies
- 3.1 Technology Themes & Perspectives
- 3.2 Knowledge
- 3.3 Semantic User Experience
- 3.4 Semantic Social Computing
- 3.5 Semantic Applications
- 3.6 Semantic Infrastructure

4 Semantic Markets
- 4.1 Market View
- 4.2 Research and Development
- 4.3 Information & Communications Technology
- 4.4 Consumer Internet
- 4.5 Enterprise Horizontal
- 4.6 Industry Verticals

Addenda
- A Suppliers
- B Bibliography

The Web 3.0 Manifesto is published in association with the Semantic Exchange — a collaborative industry news, research, and education initiative about all things web 3.0 and semantic web. Semantic Exchange is sponsored by the industry leading organizations presented here.

Semantic Exchange educational activities will include a series of monthly webinars, briefings, publications, and media articles. Also, we're planning a "smart innovators laboratory" where public and private sector organizations can gain access to people, research, and technologies, and can conduct pilot tests to prove out the benefits of semantic solutions.

Semantic Exchange will be bringing you an open collaborative industry news, research, and education portal about semantic technologies, applications, and next stage internet. The site is part semantic community wiki, part internet magazine, part technology showcase for new capabilities, and part knowledge outfitter where you can gain access to both commercial and open source tools, widgets, building blocks, and solution blueprints.

Whether you are a newcomer to semantic technologies or already have experience with them, the goal of Semantic Exchange is to help you better keep up with the rapid pace of technology and infrastructure development, connect with the people and companies making the next stage of the internet happen, and understand the breadth of applications across consumer and enterprise industry sectors.

Aduna

Aduna offers enterprise search solutions based on guided exploration: during the search process users receive guidance in the form of contextual hints for further exploration and user-friendly visualization to keep overview. RDF(S) metadata storage and retrieval using Sesame, which is an open source RDF database with support for RDF Schema inferencing and querying.

Be Informed

A leading supplier of semantic software and infrastructure for knowledge management. Semantic framework integrates subject and process ontologies with business rules to deliver intelligent e-forms, knowledge bases over heterogeneous information sources, advisory services, auto-classification, decision trees, calculators, and semantic search and navigation.

Cambridge Semantics

Develops a semantic application server and a suite of SOA based semantic middleware toolkits which dramatically simplify, as well as accelerate the building of scalable, fluid applications that incorporate the most advanced semantic techniques and integrate easily with other industry leading technologies.

Celtx

Celtx is the world's first fully integrated solution for media pre-production and collaboration powered by semantic technologies. This engaging, standards based software for the production of film, video, theatre, animation, radio and new media, replaces old fashioned 'paper, pen & binder' media creation with a digital approach to writing and organizing that's more complete, simpler to work with, and easier to share.

CHECKMi

CHECKMi semantic solutions improve the control, agility and cost of service oriented agent & semantic grid computing. The CHECKMi:Mate is a product platform for networking semantic software agents together to power information analytic services and deliver secure business processing.

Collibra

Collibra provides semantic integration and business semantics management solutions that enable rapid, efficient linking and consolidation of diverse enterprise data and information sources to support federated queries, enterprise mash-ups, and composite applications. Collaborative tools and frameworks enable employees to model, maintain, and manage master data, metadata, and semantic indexes that define the concepts, information structures and interrelationships amongst data sources improving utility and reducing total cost of ownership.

Cycorp
Developer of large-scale "ontology of the universe," common sense knowledge base, and associated reasoning systems for knowledge-intensive applications. Cyc KB provides a deep layer of understanding that is divided into thousands of "microtheories", each of which is essentially a bundle of assertions that share a common set of assumptions about a particular domain of knowledge, a particular level of detail, a particular interval in time, etc.

Digital Harbor
The industry-leading Operational Intelligence Software Suite for proactive management of risk and compliance. Serving public sector, retail and healthcare Industries our operational risk and compliance solutions include theft, fraud & criminal Investigations, improper payments, intelligence fusion, emergency management and auditory compliance. This platform delivers real-time analytics, case management and dynamic dashboard technologies for detection, investigation, assessment and monitoring.

empolis
empolis, The Information Logistics Company, offers enterprise content and knowledge management solutions for company-wide information logistics and for improving business processes. empolis' core competencies are information management, service management, product & catalog management and media management. empolis consistently relies on open standards, such as XML, Java or OWL and RDF.

Expert System
Semantic software, which discovers, classifies and interprets text information. Patent pending technology, Cogito, enables organizations to: extract, discover and understand the connections in your strategic information sets – the thousands of files, e-mails, articles, reports, web pages you have access to everyday; and, understand automatically the meaning of any text written in the language we use to communicate (natural language). Cogito improves business decisions in real time for the majority of corporate functions.

iQser
iQser provides semantic middleware for the integration and evaluation of data in networks of information. The iQser GIN server does not need to modify or migrate information. It virtually integrates the pieces of information from various data sources. Semantic analytics to link and interpret diverse sources of information are fully automatic. Reasoning capabilities over linked data resources are extensive.

KBSI
KBSI provides advanced R&D, products, and solutions in areas such as artificial intelligence and expert systems, geometric reasoning, computer-aided design and manufacturing, manufacturing systems design and analysis, enterprise integration, process modeling, computer-aided software development, systems simulation, business process design and development, and total quality management.

Kirix
Kirix Strata is a "data browser" — a fusion of a web browser and a built-in relational database. Strata brings the sensibilities and simplicity of a web browser to the world of tabular data, making it easy to access, view and use data from any source, even the Web. Strata provides business analysts, researchers and IT professionals a tool for extremely quick ad hoc analysis and reporting, whether working with local data, database systems or back-end business intelligence systems.

KFI
KFI's Mark 3 Associative Knowledge Platform enables cost effective, long-term retention and application of enterprise knowledge, providing intelligent business process, integrated financial simulations, knowledge-based training, and complex decision support.

Metatomix
The Metatomix Semantic Platform integrates data, uncovers and defines information relationships, and provides meaning and actionable insight to applications. It does so by creating a real-time virtual integration layer that non-invasively accesses data from any source (static and dynamic) and allows it to be understood & leveraged by practically any application.

Mondeca
Mondeca provides software solutions that leverage semantics to help organizations obtain maximum return from their accumulated knowledge, content and software applications. Its solutions are used by publishing, media, industry, tourism, sustainable development and government customers worldwide.

Netbreeze
Leading European supplier of knowledge generation solutions that use semantic technologies and artificial intelligence to extract knowledge from varied Internet sources and integrate it with business processes. Applications include early warning, risk management, marketing and sales tools, media monitoring, asset management, corporate governance and compliance, issue management, anti money laundering, know-your-client, executive search, project management, and other business applications.

Ontotext
Ontotext is a semantic technology lab of Sirma Group. Ontotext researches and develops core technology for knowledge discovery, management,and engineering, Semantic Web, and web services.

Ontos

Ontos creates semantic web solutions for publishers and media providers that provide better search and navigation through related content. Ontos portals create on-the-fly views of information aggregated from the Internet. Advertising links to related content in a meaningful way. Web widgets enrich website pages with intelligent content, resulting in a more compelling experience that attracts readers, increases page views, and enhances search engine optimization. Increasing traffic on the website leads to more ads and more revenue.

Project10X

Project10X is a premier industry research, education, and consulting firm specializing in next wave semantic technologies, solutions, markets, and business models. Project10X publishes the Semantic Wave research series including the Semantic Wave Report. The firm provides educational and training services, and consults with technology manufacturers, global 2000 corporations, government agencies, and technology start-ups. Project10X is directing the Semantic Exchange industry education initiative.

Radar Networks

Twine is the first application on the Radar Networks Semantic Web platform. Twine helps users leverage and contribute to the collective intelligence of their friends, colleagues, groups and teams

Reinvent

The Reinvent media group's mission is to enlighten and connect people through words and visual information. Its resources include domain names, global advertising networks, virtual cities, semantic technology and a venture capital arm. The group's vision is to evolve from basic advertising services into a knowledge engine that provides useful content and relevant information to all people.

Riverglass

RiverGlass meaning-based search and discovery helps people and organizations locate and make sense of information relevant to their areas of interest. RiverGlass moves beyond keyword searching and tagging into the meaning of the data to deliver focused, relevant search results that zero in on key pieces of information around people, locations, and events of interest and relationship among them. Connecting the dots sparks insights and improves decision-making.

Sandpiper

Develops W3C and OMG standards-compliant, semantically aware, knowledge-based software products that facilitate business information interoperability, terminology normalization and context resolution across web-based and enterprise information systems. Visual Ontology Modeler™ (VOM) UML-based ontology modeling environment supports frame-based knowledge representation and construction of component-based ontologies that capture and represent concepts, resources and processes.

Semantech, Inc.

Semantech is a professional services firm that provides enterprise-level semantic solutions that unify process, logic, data, and user experience through semantic integration and agile model driven design.

Semantic Arts

Semantic Arts is a USA-based consulting firm that helps large firms transform their Enterprise Architectures. Our specialty is reducing complexity through the intelligent use of Semantic Technology and Service Oriented Architecture.

Semantic Insights

Leading supplier of semantic research solutions. SI services help people access the internet to read just the information they're interested, use their computer to help reason about it, and then report it just the way they want, easy, fast, and automatically.

Semantic Research

Semantica software provides semantic network theory-based knowledge capture, representation, management, transfer and visualization. Semantica products capture what experts know, organize it, and visually represent it the way that humans store information in long-term memory. In addition to concept mapping, product suite integrates with natural language processing and geospatial integration technologies.

Semantic System

Semantic System ag manufactures hardware technology for intelligent computer systems. Its first generation computer chip "thinks" like a biologic brain making it possible to run complex thought and analyzing processes in hardware to obtain results equivalent to those obtained manually by a skilled humans.

Semantic Universe

Semantic Universe's mission is to raise awareness and explain the usage of semantic technologies in business and consumer settings. Projects by Semantic Universe include the annual Semantic Technology Conference (HYPERLINK "http://www.semantic-conference.com/"www.semantic-conference.com) and the SemanticReport newsletter (HYPERLINK "http://www.semanticreport.com/"www.semanticreport.com).

Smartlogic

Ontology driven technology solutions for information management projects. Professional services and semantic middleware for government, media, and financial services industries. Semaphore semantic processor provides description logic based automatic classification and categorization for taxonomies, thesauri, and ontologies based on rules., intelligent guided search, taxonomy management, dynamic profiling and recommendation software for intranet, internet and portal applications.

Talis

The Talis Platform is an open technology platform for mass collaboration and human-centric and information-rich applications. It combines Semantic Web, information retrieval, collective intelligence, and behavioral mining technologies, which can be accessed through a suite of RESTful web services. Talis Platform provides data management, organization and analysis components that can learn and understand patterns of behavior and present them through an API to be interwoven into applications.

Textwise

Leading supplier of fully automated and real-time contextual targeting services for both advertisements and web pages. Natural Language Processing (NLP) and Machine Learning (ML) technologies automate establishment of semantic signatures with contextual attributes that enable high precision customer targeting and media placement.

TopQuadrant

TopQuadrant provides products, services, knowledge, training programs and methods to help organizations integrate data and processes and to harness the knowledge distributed across systems and parties. TopQuadrant helps customers implement new capabilities for integration, policy management, search, enterprise architecture and model-driven applications. The TopBraid product suite provides an enterprise-level platform for developing and deploying semantic applications.

WAND

WAND provides structured multi-lingual vocabularies with related tools and services to power precision search and classification applications on the internet, including custom travel, jobs and skills, and medical taxonomies to our cornerstone and product and service taxonomies. In addition to licensing its taxonomies for integration into third party applications, WAND builds precision online horizontal and vertical business directory applications.

Whatever

Enterprise 2.0 solution: combines Knowledge Plaza platform and new knowledge management methodology, Enterprise Social Search. to leverage the expertise of colleagues' to access relevant information and which enhances those individuals who share their knowledge, facilitating access to other's valuable information and capitalizing it for the benefit of the group.