A paradigm shift is under way. It is towards knowledge computing as the foundation for next generation information and communications technology (ICT).

Knowledge computing builds on IT advances of recent decades. It processes massive amounts of knowledge. It matches complex patterns in real time. It deeply analyzes web scale big data. It represents a new kind of architecture. And that’s not all.

In this presentation, we examine how knowledge computing transforms IT by separating the “know” from the data, processes, decision-making, user interaction, and infrastructure so that all solution dimensions are knowledge-driven, semantic, and scalable in ways that both humans and computers can interpret and put to work.
Here is a brief bio for Mills Davis. The current focus of his research and consulting is knowledge computing.

- Mills Davis is founder and managing director of Project10X. He is a professional services executive, industry analyst, consultant, and entrepreneur.
- Mr. Davis advises clients about emerging technologies, innovation strategy, and advanced applications.
- He conducts industry research and is author of more than 50 reports, whitepapers, articles, and industry studies, including the groundbreaking *Semantic Wave Report*. 

Mills Davis
This presentation discusses knowledge computing and how it impacts five aspects of IT — data, processes, decisions, user experience, and infrastructure.
What is knowledge?

Knowledge computing is based on a physical theory of knowledge that holds that knowledge is anything that decreases uncertainty. The formula is: Knowledge = Theory + Information.

Theories are the conditional constraints that give meaning to concepts, ideas and thought patterns. Theory asserts answers to “how”, “why” and “what if” questions. For humans, theory is learned through enculturation, education, and life experience.

Information, or data, provides situation awareness — who, what, when, where and how-much facts of situations and circumstances. Information requires theory to define its meaning and purpose.

Knowledge computing enables both machines and humans to understand, combine, and reason with any form of knowledge, of any degree of complexity, at any scale.

There are many different kinds of theory, many different types of information, and many different methods of reasoning. Theory persists and always represents the lion’s share of knowledge content — say 85%. Information represents a much smaller portion of knowledge — perhaps only 15%.

Knowledge computing represents a new dimension for smart systems and cognitive computing.
So, what is knowledge computing?

Different types of knowledge have distinct buty shared representation.

People and machines can revise, annotate, extend, add meanings, and update knowledge models at run time. Different reasoners access, interpret, and process these knowledge models.
Knowledge computing is not a break from IT, but rather the logical next step in its evolution.

In the early days of computing, there were only programs -- big decks of cards that were written as assembly language instructions. The first development was the operating system. The OS separated routines that controlled devices and system resources from the application. Next, databases separated data management functions from the application so that multiple applications could interact with the same data more easily. The progression continued. Next, workflow. Then rules processing. Then services. And more recently, goals and agents.

Each created an information structure or model and software functionality to process it. The good news is that each innovation delivered value. The bad news is that each used a technology that was separate from the others. Workflow software, for example, knew nothing about data or rules. The models remained separate, disconnected, requiring separate coding to glue these different aspects of computing together.

What's different is that knowledge computing relates all these kinds of modeling. Processes have goals (not swim lanes), Goals get achieved through activities that make decisions using knowledge and data. All aspects are model-driven. All connected. No code.
What forces are driving the shift to knowledge computing? Mobile internet of subjects, services, and things; super exponential growth of all kinds of data; the complexity of business and social communications; the huge burden of legacy systems.

There is a story about a scientist who discovered a way to grow the size of a flea by several orders of magnitude. She was terribly excited. After all, a flea can jump vertically more than 30 times its body size. She reasoned that a flea this big would be able leap over a tall building. Perhaps, there could be a Nobel Prize in this. When the day came to show the world, she pushed the button and sure enough out came this giant flea, over two meters high. But, rather than leaping a tall building, it took one look around and promptly fell over dead. Turns out it couldn't breath. No lungs. Passive air holes that worked fine for oxygen exchange in a tiny flea were useless for a creature so big.

The moral of the story is this:

Quantum increases in scale, complexity, sense modalities, communication bandwidth, dynamics of change, knowledge-intensivity of decisions, and execution speed demand significant change of architecture.
Notes:
Who else is thinking about computing with knowledge in this way? Most of the major players in the ICT space.

Here are three graphics that highlight IBM's viewpoint on the shift to knowledge computing.

1. The first slide depicts three computing eras: tabulation, computing, and smart systems where we’re currently headed.

2. The second slide identifies four technologies IBM thinks will change the world by several orders of magnitude. These are cognitive computing (including natural language understanding); big, fast, complex data; exascale computing; and nanosystems.

3. The third slide overviews Watson’s computing architecture. After Jeopardy, Watson technology is being developed and applied to scientific, technical, medical, and business domains. One lesson from Jeopardy is that real-world applications require vast amounts of many different kinds of knowledge and many different kinds of reasoning to understand and apply it.
Semantic Data

It's about meanings!
Describe the semantics of the data.

Separate the "know" from the info.

Unlock the *value in data*
A knowledgebase is for investigating questions for which the answers are in doubt.
From Search to Knowing

Increasing Reasoning Capability

Source: Dr. Leo Obrst, Mire: Mills Davis, Project10X
Auto-Text to Knowledge
Big, Fast, Complex Data

Diverse types of data: structured, semi-structured & unstructured

Myriad data sources

Hi-volume data, & large data sets

Rapid change & growth

Complex queries, data structures, & reasoning

Highly connected data

Time critical answers, real-time response, high availability

Concept-level security
Database Performance at Scale

- Salary list
- Real-time predictive intelligence
- Most web applications
- Semantic trading
- Social networks

RDBMS | NOSQL | SEMANTIC

Data, Query & Reasoning Complexity
Semantic collaboration platform for do-it-yourself data exploration, analytics, and adaptive reporting

**CHALLENGE**
- When events trigger action, researchers and analysts examine the data. Combining information from multiple spreadsheets and databases is tedious and manual. Desktop tools do not know the categories and properties expressed by column (or row) headings. Moreover, for IT to create a new database or data warehouse is time-consuming, costly, and assumes that all requirements are knowable in advance.

**SOLUTION**
- Semantic solution enables data exploration, analysis and reporting. Lets users link source data from spreadsheets, files, or database tables to a standard (semantic) model stored on a server using language they understand. Works with familiar desktop tools or via browser. Selecting is a pull-down menu option. “There’s an app for that”. Filters apply easily. Lenses exist for visualizing data and reporting. Data, analytics & reporting evolve easily.

**BENEFITS**
- Easily connect data across different silos, spreadsheets and “shadow data” sources, and/or myriad web sources. Ease of use. Business users and subject matter experts drive the solution and employ tools they know how to use. IT supports, deploys, extends.
- Rapid and low-cost to solution (hours/days), vs. slow and time-consuming for RDBMS, data warehouse, or manual. 10x or faster for ETL equivalent steps.
- Flexibility for changes: quick, low-cost modifications. Living dashboards and reports adapt to new concerns. Basis for new consulting relationships with clients.
Pragmatic Process

Separate the “know” from the “flow.”

It’s goal-driven!
WHAT IF EVERYTHING YOU KNOW ABOUT BUSINESS PROCESS MANAGEMENT IS WRONG?

WHAT IF THERE IS A METHODOLOGY THAT IS 5-10 TIMES FASTER TO SOLUTION...
WHERE DEVELOPMENT IS DECLARATIVE, RAPID, ITERATIVE, NON-INVASIVE, AND LEAN?

A KNOWLEDGE COMPUTING SOLUTION IS CHEAPER TO OPERATE, LESS COSTLY TO OWN, AND IS EASY TO REVISE, EXTEND, AND UPDATE BY MODIFYING ITS KNOWLEDGE MODELS.

WITH KNOWLEDGE COMPUTING, THE DEFINITION BECOMES THE DESIGN.
The DESIGN IS THE MODEL. THE MODEL IS THE APPLICATION.
The APPLICATION IS SELF-DOCUMENTING, SELF-JOURNALING, AND CAN EXPLAIN ITS EVERY DECISION.
Goal-driven Processes


Knowledge models connect data, and systems across functions, organizations, jurisdictions, and geographies.

Knowledge-centric vs. document or case-centric methodology for knowledge-intensive knowledge work. Authoring, collaboration, analysis, and communication tools are semantic and knowledge driven. Design = Application = Documentation. Simulation & automated version control are native.
NO SWIM LANES!
Goal-, Knowledge- & Event-driven
Citizen-centric services with semantic dynamic case management

CHALLENGES

1. Permitting site synthesizes requirements, processes, and information across multiple jurisdictions and 14 independent institutions into a unified user experience.

2. Immigration site helps new arrivals solve varied problems of relocation. It combines information, and “open decision” logic from 12 agencies into an easy to use single point of service delivery.

SOLUTION

- Goal, activity, and event driven solutions separate knowledge models from the flow and the function to create declarative applications configured by users with semantic models of legislation, knowledge, processes, data, and UI. The core infrastructure consists of an ontology, which is enriched with business rules. All functions use the same ontology, e.g., semantic search, information access, automated decision making, decision support, and dynamic processes.

BENEFITS

- “Open knowledge as a service” bridges the gap between government and citizens and facilitates effective cooperation between independent institutions – both public and private.

- Provides automated decisions and decision support; means for agencies to manage their knowledge / rules; ability to quickly adapt to external events / implement new legislation; improved decision making, guaranteed compliance, fewer errors; improved service delivery to the public; and substantial cost reductions.

Source: Be Informed
Axiological Decisions

Decisions are about values, not just logic!

Business rules are just trainer wheels of decisions.
Semantics for decision support

Knowledge-centric engineering & manufacturing

From Virtual Definition... to Reality
FirstRain – Business monitoring with semantic analytics

The web holds huge potential for business insight

Massive Volume & Content
- 10s of billions of webpages
- Nearly 200 million blogs per day, reaching more than 70% of web readers daily
- Near-real time reflection of what's happening in companies and industries

Massive Junk and Noise
- Much more than 50% of the content on the web is duplicate or spam
- Business-relevant content is buried
- Search engines don't give you any way to connect the dots and see the trends

Unusual concentration of events departures

Key enablers: Business structure awareness

Sectors
- Subjects & Topics
- Industries

Companies
- People
- Relationships

Subsidiaries
- Business Lines

Key enablers: Sequencing, Trending & Patterns

What’s really matters
- Time sequencing the open web, beyond matching & finding results
- Trends are revealed
- Similarity detection & clustering
- Anomaly detection

Key enablers: Triangulation

Armored & Unarmored Management Tunnels
- The key insights are not about any single source or result

Beyond the core technology, what does it take?

Walmart Stores (WMT)

Notes:
Intelligent decision automation in customer service

CHALLENGE
- As mobile devices and services shift to smartphones and tablets, telco customer support becomes more complex. Customer experience systems must evolve to better understand and predict the behavior of customers and provide individualized treatment.

SOLUTION
- Amdocs Intelligent Decision Automation (AIDA) is a semantic technology enabled, closed-loop, self-learning system that lets customer service see what happens, when it happens, understand what it means to the business, and take action and enforce business policy automatically, intelligently and in business real-time.

AIDA Runtime Architecture

BENEFITS
- Ontology and rule set anticipates reasons for the customer interaction, then automates access to the required information and guides the flow of action and decision making. Business benefits include: eliminating system and agent diagnosis time; providing consistent and efficient call handling; and increasing agent and customer satisfaction.
- Anticipated benefits based on 100K actual accounts assessment:
  - Average handle time reduction of 10-15%;
  - First call resolution improvement of 10-15%;
  - CSR training time reduction of 15-20%.
Ontology and rules-based mass customization of vehicles

**CHALLENGE**
- A fortune 250 company offers mass customization for a variety of trucks and busses. Customers describe the desired vehicle by selecting the base model and a wide range of attributes and features.
- More than 480,000 combinations of parts, assemblies, and locations for a given vehicle. Each vehicle off the assembly line can be one-of-a-kind.

**SOLUTION**
- Ontology and rules driven configurator and custom manufacturing process identifies best parts, assemblies, availabilities, and plant schedule to meet promised delivery date error-free. Bottom-up and top-down ontology development with domain-specific UI and auto-generation of rules. Fast rules engine: 600K rules with average of 24 condition elements configures a truck in under 10 seconds on a laptop.

**BENEFITS**
- Mission critical ontology allows quick and reliable specification. Rules specified by ontology auto-generate. Changes take effect immediately or at preset times.
- Significant opportunities for mass customization exist in the “long tail”. The efficient management of knowledge assets is key to unlocking those opportunities.
Smart User Experience

Make my digital life easier, more useful, and more fun.
Smart User Experience

As iPhone and iPad (& Android) fuel hyper growth of mobile internet and post-PC consumer platforms, services and ecosystems will get “smarter.”

The Big Think
If your computer were really smart...
It would understand you in your language.
It would make sense of your environment.
It would help you solve everyday problems.
It would be at your service, everywhere.

Brilliant Interfaces: The Senses
- Touch: Multitouch
- Hearing: Sound in and out
- Sight: Cameras
- Proprioception: GPS, accelerometer
- Taste: tasty
- Brain?

A Virtual Personal Assistant
Will we see this in our lifetimes?

The Phase Transition:
TIRED
- Keywords
- Typing
- Browsing
- Information

WIRED
- Language as Interface
- Sensory Awareness
- Problem Solving
- Personal Services

Bringing the Big Think to the Small Screen

Speech + Semantics + APIs

* SIRI acquired by Apple Computer in 2010 for ~$200 million
$1,000B Media Fuel for Mobile
Movie, Games, Magazines, News, Cable, TV, Books

More Media Requires More Performance

10x
Semantic Collaboration

MediaWiki

Wikipedia Read/Write

Semantic MediaWiki

Dbpedia Linked Data

SMW+ Semantic MediaWiki+

Desktop import Ontology mgmt Semantic search Semantic apps

Future Semantic Wikis

Natural language Transemiotics Machine learning Multi-agent apps
Semantic publishing is interchange of composite digital components that are both human & machine interpretable
Autonomic Infrastructure

- Model-based, semantic APIs, dynamic interfaces
- Self-declaring, self-defining stack elements
- Glass boxes
- M2M integration and interoperability

- Fixed interfaces
- Hard-wired stack at design time
- Black boxes
- H2M interoperability

- Autonomic
  - Goal-oriented
  - Multiple domain knowledge
  - Cognitive
  - Multi-agent
  - M2M learning

- Semantic
  - Self*-awareness, *-provisioning, *-configuring,
    *-diagnosing, *-protecting, *-repairing, *-optimizing.
  - Pervasive adaptivity (sense, interpret, respond)
  - Mobile dynamics, granular security,
    M2M performance optimization

- Fixed
CAN YOU ESCAPE YOUR LEGACY SYSTEMS?

Business is complex, but it doesn't need to be complicated!

Knowledge models integrate systems & data non-invasively.

Use above the line architecture. Standardize at a higher level. Transform incrementally. Intercept the future.
Above the Line Knowledge Models

- User Interaction: Client, Partner, Employee
- Channels: Call center, Front desk, Task list, Document scanning, Print, Electronic data exchange, E-mail, Mobile
- Product & Decisions: Eligibility, Benefit Amount, Benefit Duration, Legal Info, Premium, Insurance
- Functions: Benefits, Medical Assessment, Training, Education, Coaching, Levying, Collecting, Declaration, Appeal, Payment, Permits, Control/Inspection, Finance
- Registrations: Person, Company, Employment History, Income, Medical File, Policy, Digital Archive
- Control Services: Authorization, Authentication, Dashboard, Business Intelligence, Test & Analysis

Above the line: standards equivalent to ISO Common Logic. Embrace all IT open standards.
Non-Invasive Below the Line Integrations

Open standards: Java, JDBC, XML Web Services, HTTP(S), HTML, LDAP, SAML

- Datawarehouse
- Groupware / Mail server (smtp)
- Enterprise search
- B-2-B Gateway
- Content Management (webdav)
- Document Management
- Print- & Scanstraat
- Database server (jdbc)
- Directory server (ldap)
- Single Sign On support (saml)
- Authenticatie (jaas)
Autonomic security requires self-awareness at the lowest level of granularity as well as the capability to see into knowledge embedded inside objects.
Thank you

Mills Davis
millsdavis@project10x.com
www.project10x.com