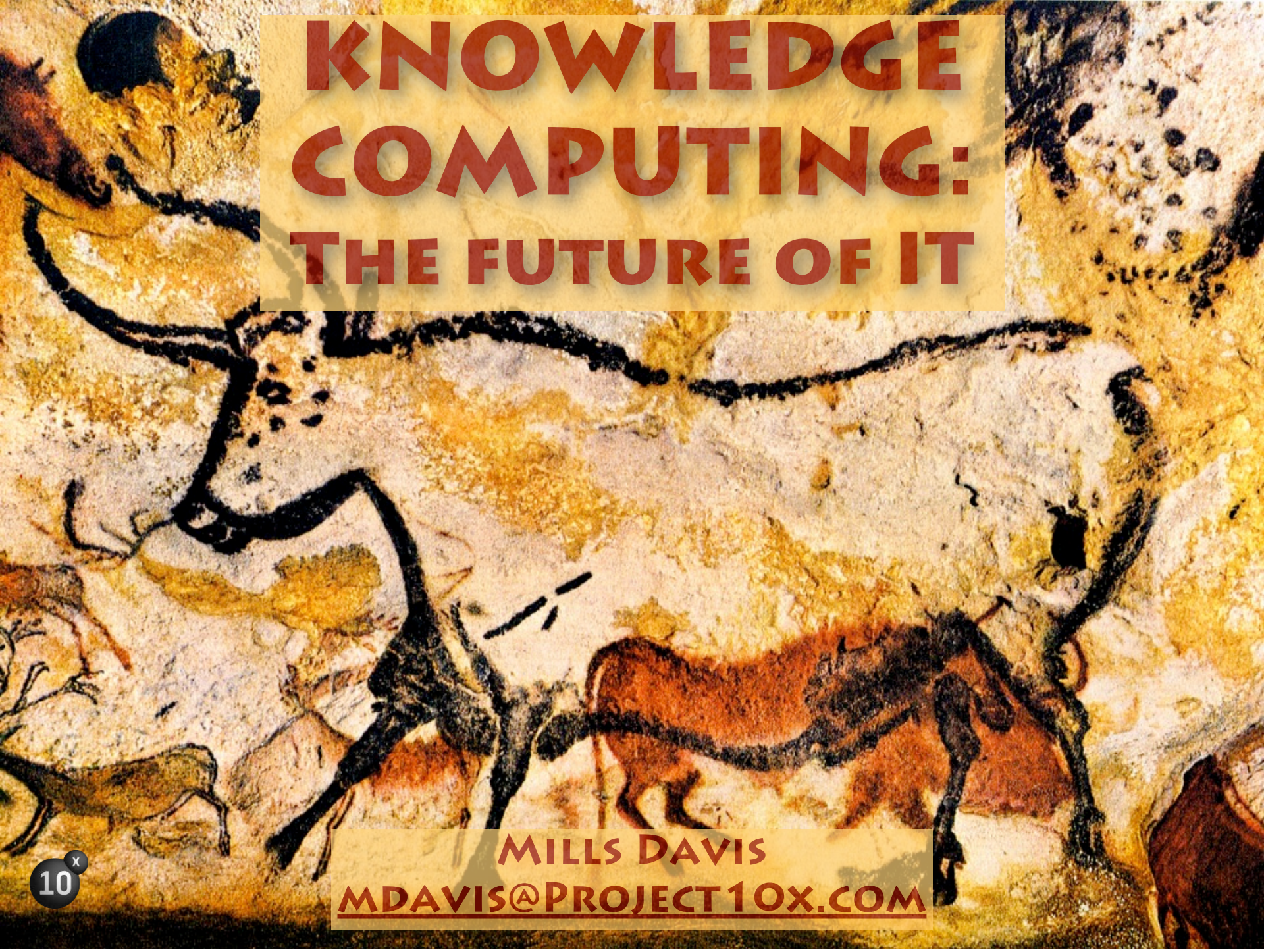


Knowledge Computing: The future of IT

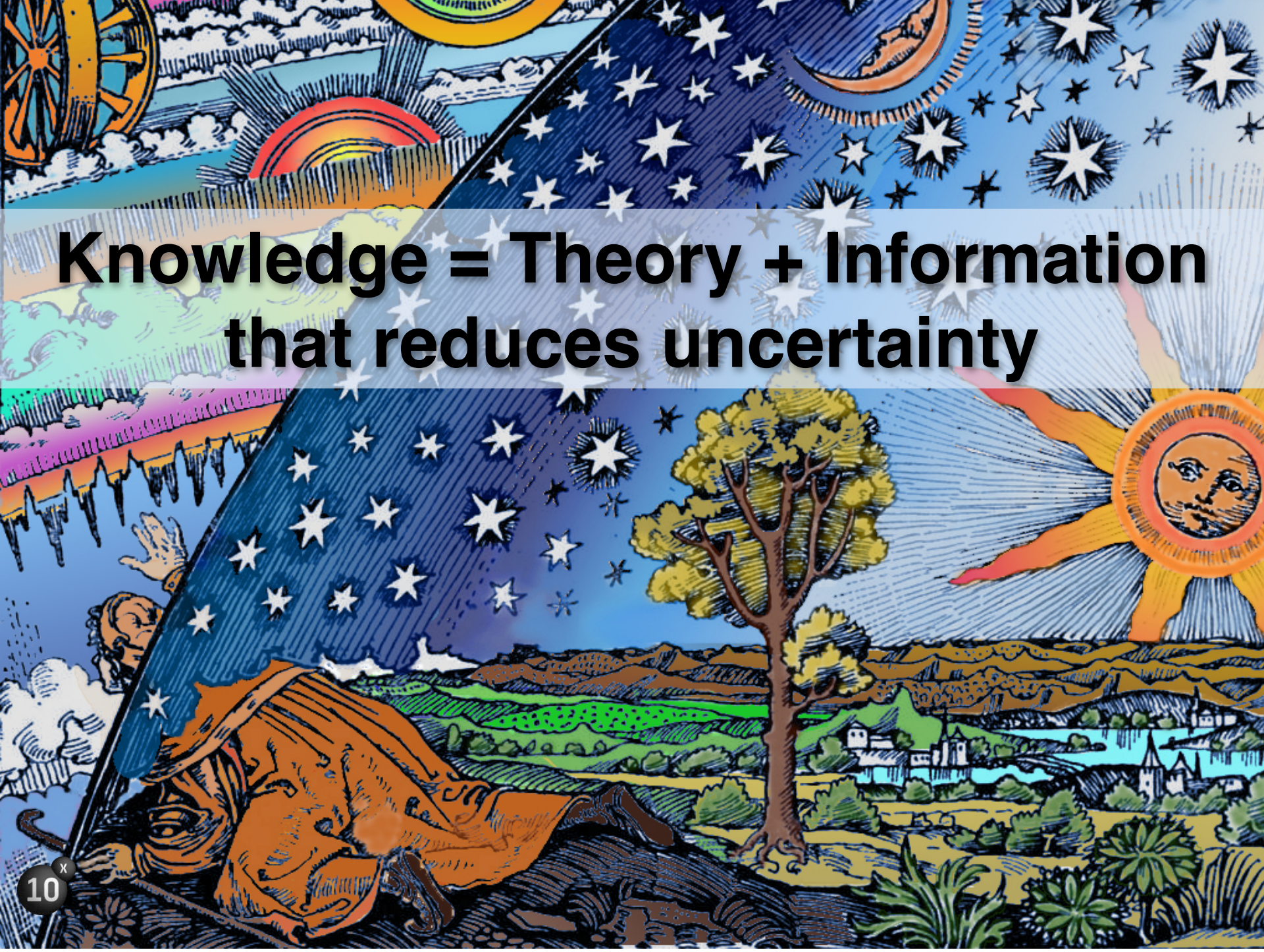
Mills Davis
mdavis@Project10x.com

Mills Davis

- 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*.

Topics

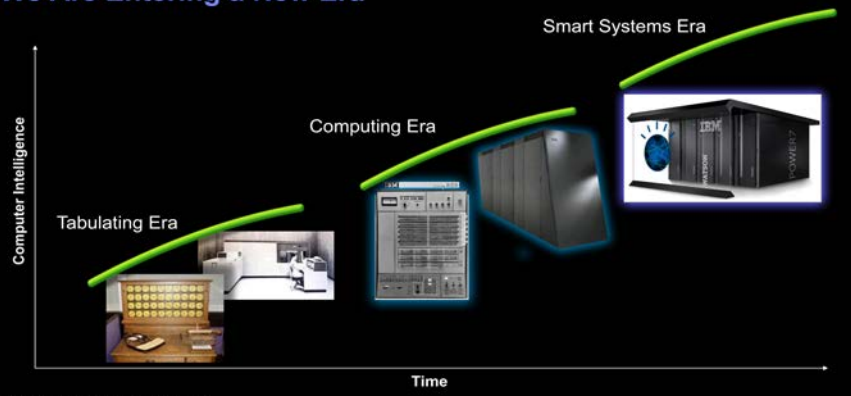
- Knowledge computing
- Semantic data
- Pragmatic processes
- Axiological decisions
- Smart user experience
- Autonomic infrastructure


Knowledge = Theory + Information
that reduces uncertainty

IBM **Investor** Briefing

IBM

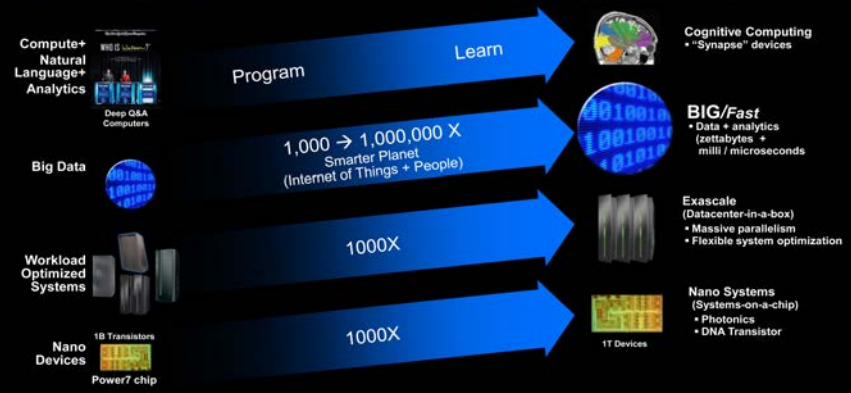
We Are Entering a New Era



IBM **Investor** Briefing

IBM

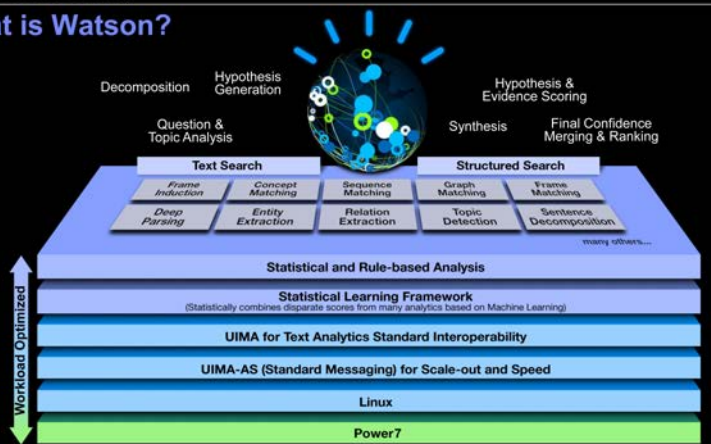
4 Technologies that Will Change the World – *and IBM Will Lead*

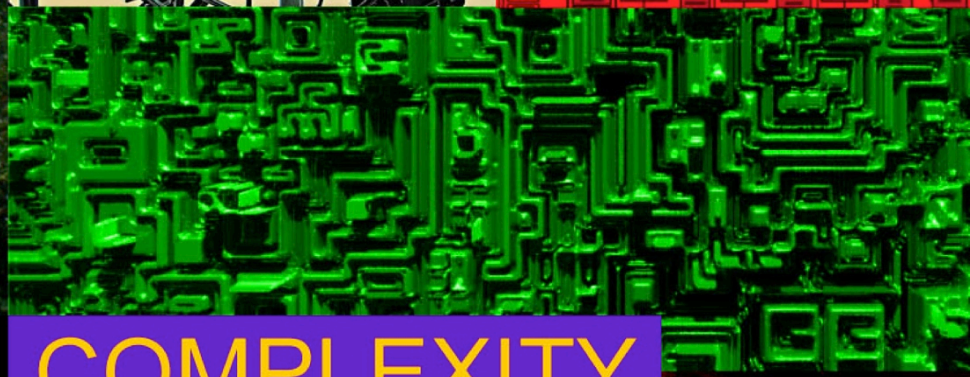


IBM **Investor** Briefing

IBM

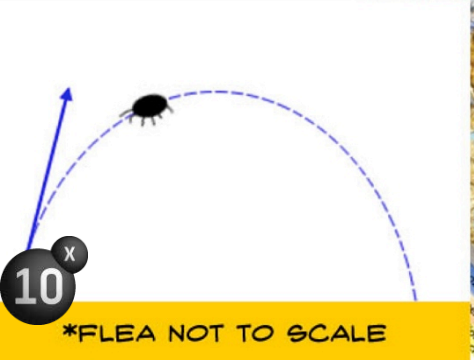
What is Watson?



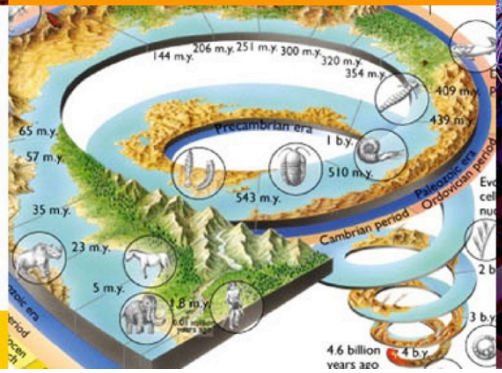


SCALE COMPLEXITY

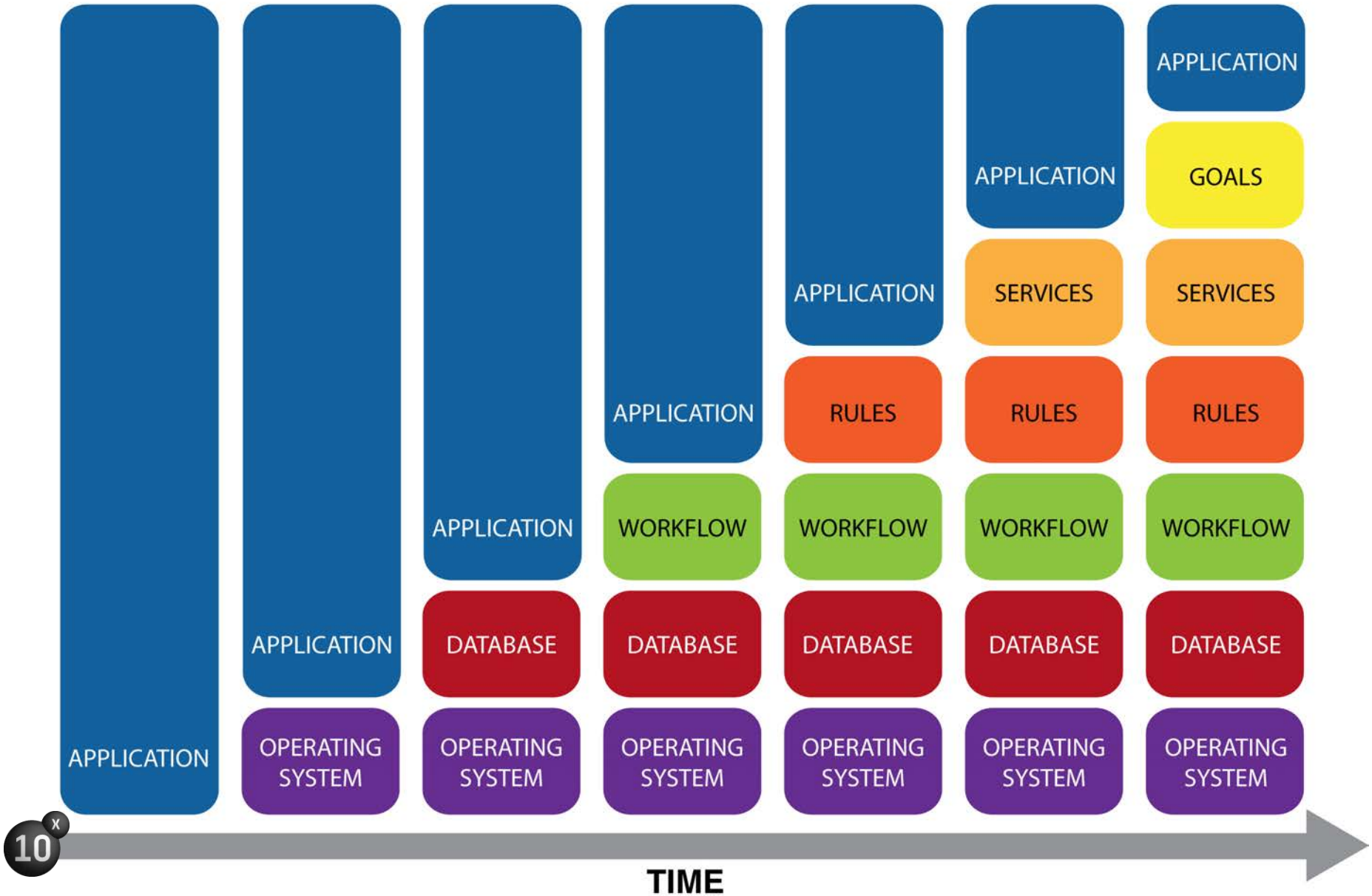
*UNIVERSE NOT TO SCALE



*FLEA NOT TO SCALE

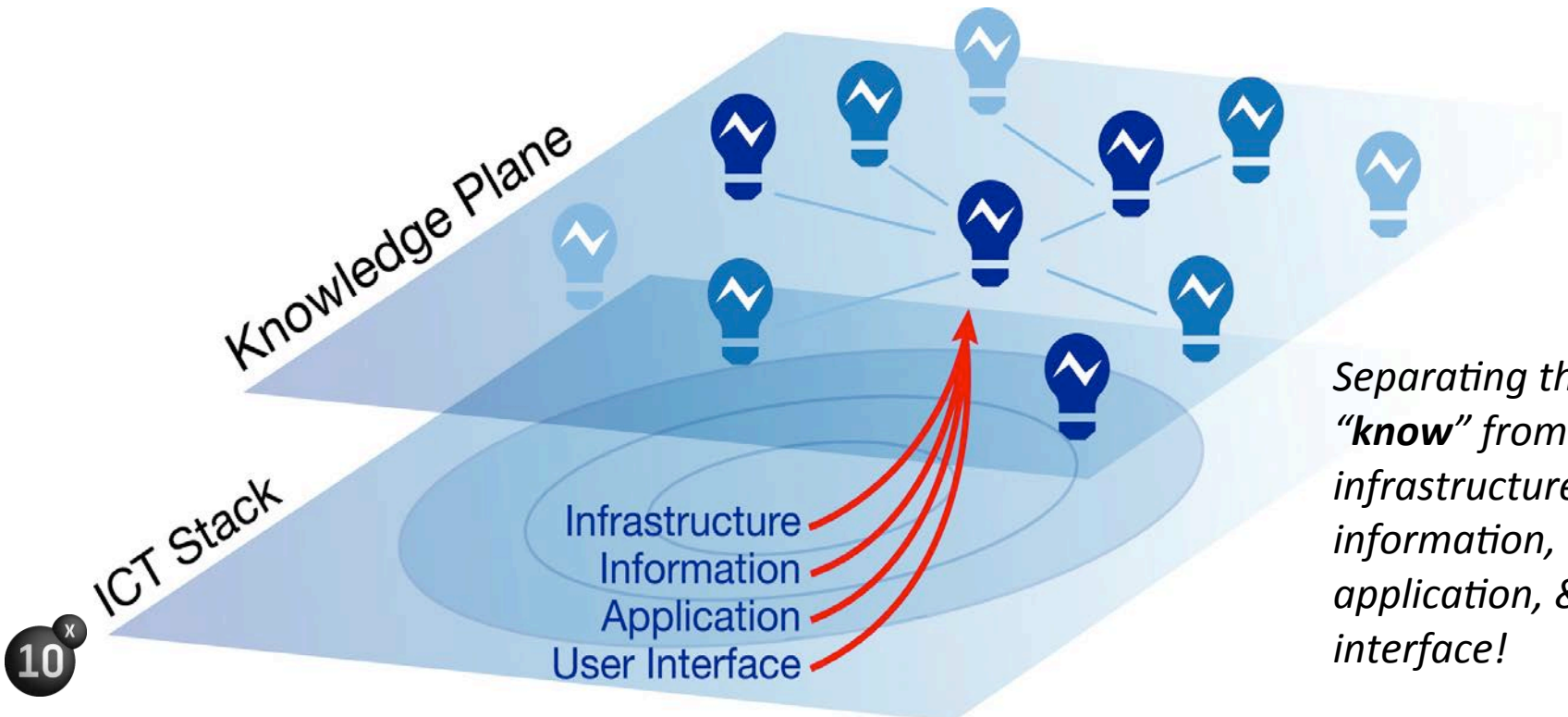


Software Architecture Innovations



Knowledge Computing

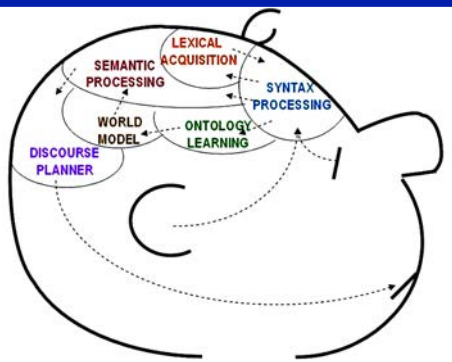
- Represent and process knowledge separately from data formats, processes, decision-making code, devices, and other artifacts…
- So that both people and computers can interpret it at run time. So that both can put it to work. So that systems can learn.



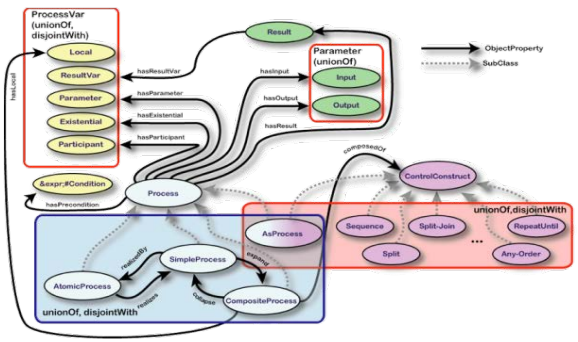
*Separating the "**know**" from the infrastructure, information, application, & user interface!*

Five ways knowledge computing impacts IT

Intelligent User Experience



Goal-driven Processes



Superior Decisions

Autonomic Infrastructure

Cloud

Mobility

XaaS

Internet of subjects, services & things

Semantic Information

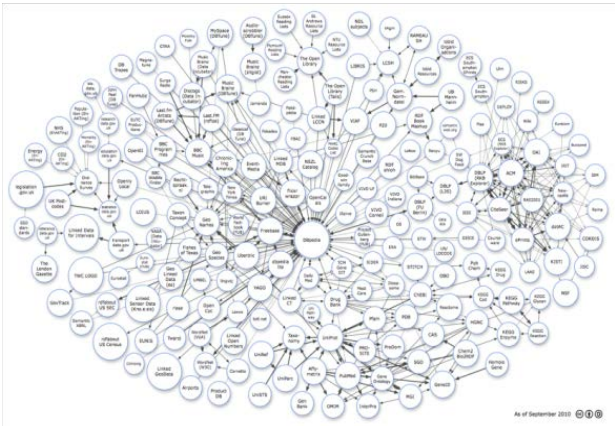
Text

Table

Graphic

Image

Video



Semantic
Data
It’s about meanings!

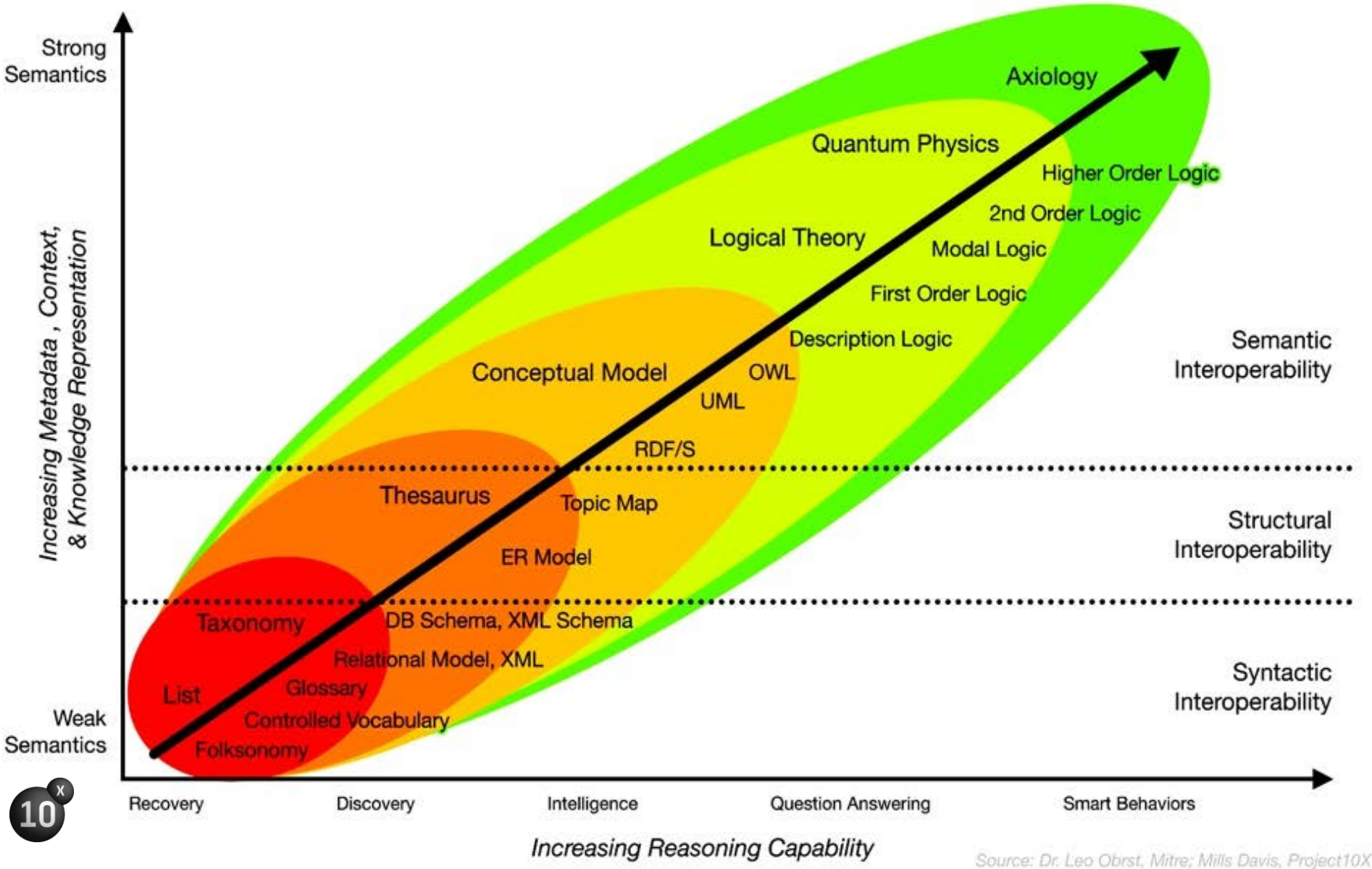
Describe
the semantics
of the data.

Separate
the “know”
from the info.

Unlock the *value in* data

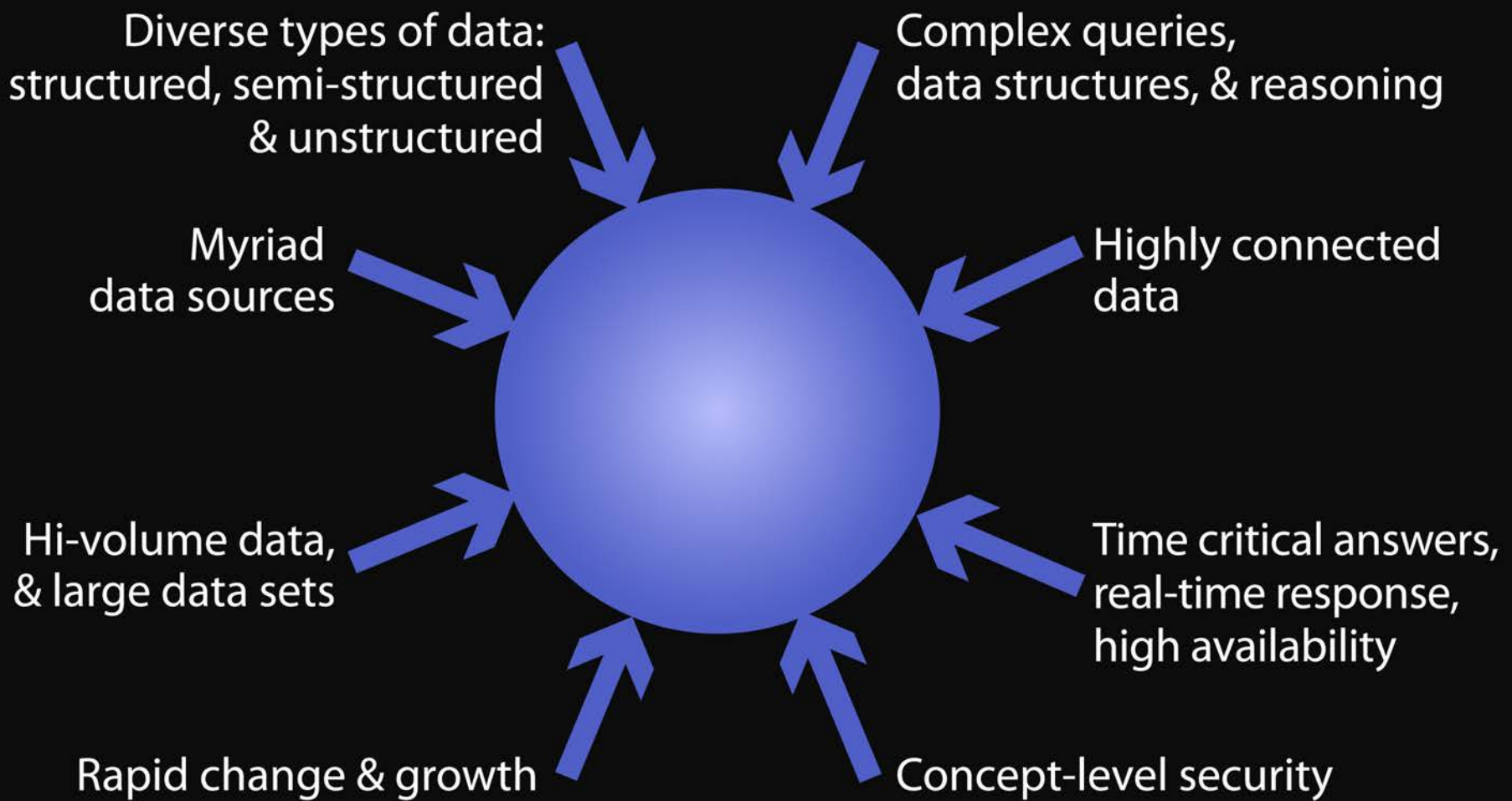
Auto-Text to Knowledge

From Search to Knowing



Source: Dr. Leo Obrst, Mitre; Mills Davis, Project10X

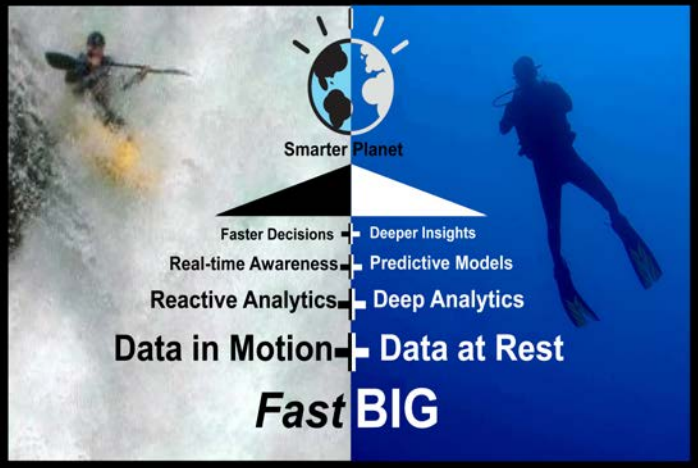
Big, Fast, Complex Data



Big, Fast, Complex Data

IBM Investor Briefing

Every Smarter Planet Solution Has Big/*Fast* Data and Needs Big/*Fast* Analytics



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Elements of Big Data Analytics

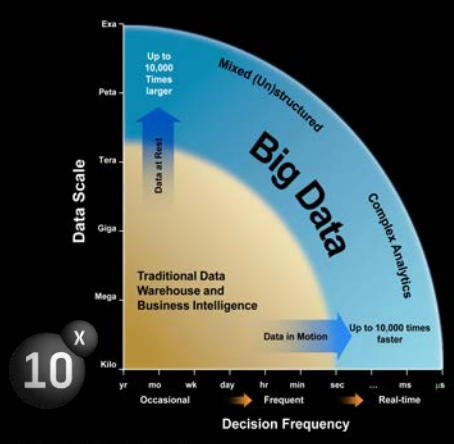
Hindsight	Insight	Foresight
• Descriptive analytics: *What happened?*	• Operational intelligence: *Why is it happening?*	• Simulation: *What could happen...if?*
• Ad hoc reporting: *How many, how often, where, when, and how much?*	• Business, social, event, behavioral analyses: *What trends, patterns, and business rules shape events?*	• Forecasting: *What if these trends continue?*
• Query & drill down: *What exactly is the problem?*	• Alerts: *What actions are needed?*	• Predictive modeling: *What will/should happen next?*
		• Optimization: *How do we get the best outcome?*

Text Mining | Natural Language Processing | Entity Extraction | Semantic Analysis | Sentiment Analysis | Social Media Analytics | Ensemble Modeling

Data Mining | Time-series Analysis | Multivariate Statistical Analysis | Complex Event Processing | Behavioral Analytics | Social Network Analysis | Predictive Modeling | Constraint Based Optimization

IBM Investor Briefing

New Big/*Fast* Data Brings New Opportunities, Requires New Analytics



Homeland Security
600,000 records/sec, 50B/day
1-2 ms/decision
320TB for Deep Analytics

Telco Promotions
100,000 records/sec, 6B/day
10 ms/decision
270TB for Deep Analytics

DeepQA
100s GB for Deep Analytics
3 sec/decision

Smart Traffic
250K GPS probes/sec
630K segments/sec
2 ms/decision, 4K vehicles

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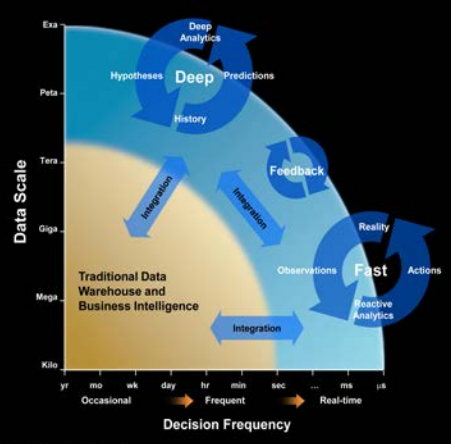
IBM Investor Briefing

Maximum Insight Requires Combining Deep and Reactive Analytics



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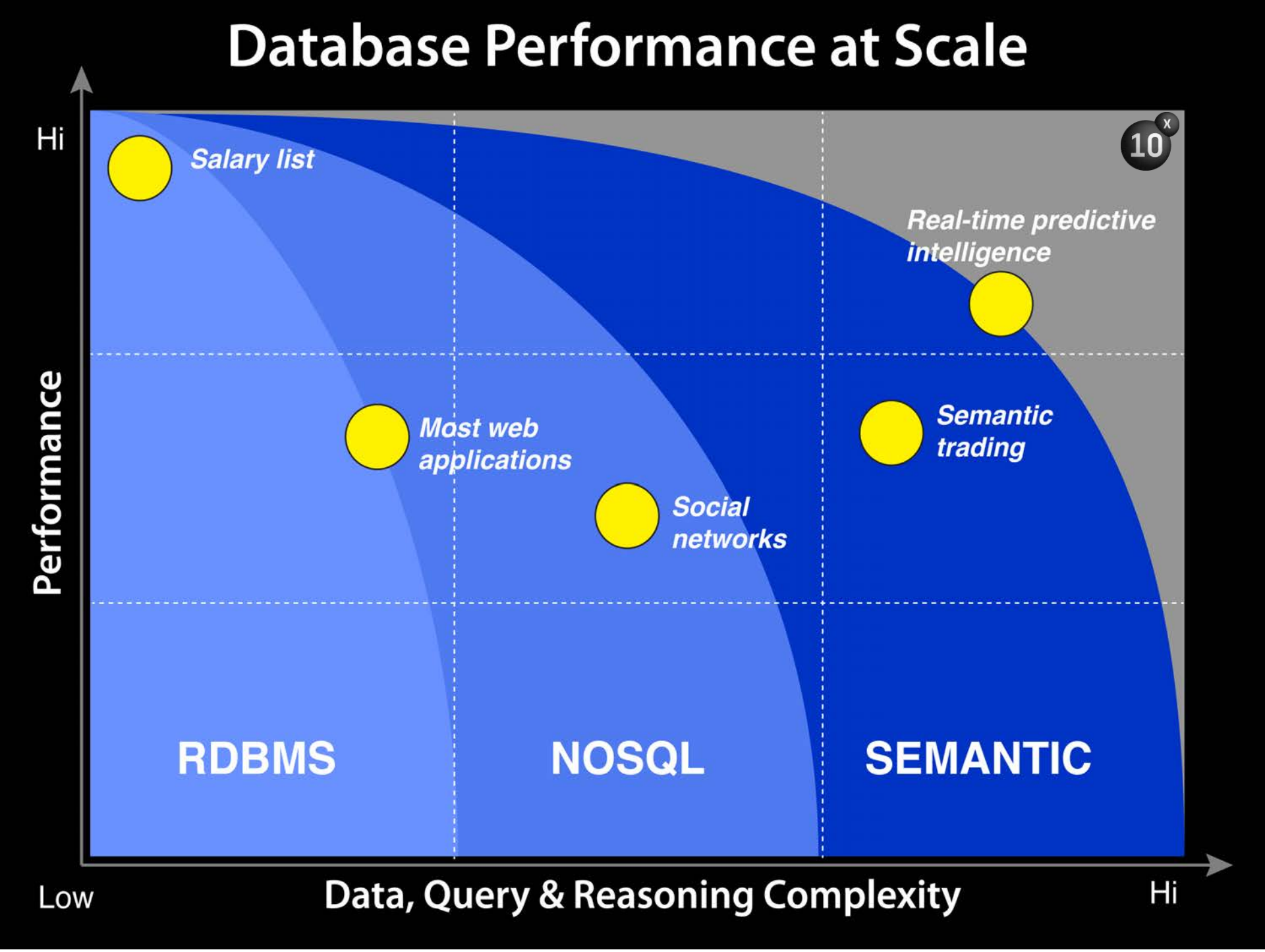
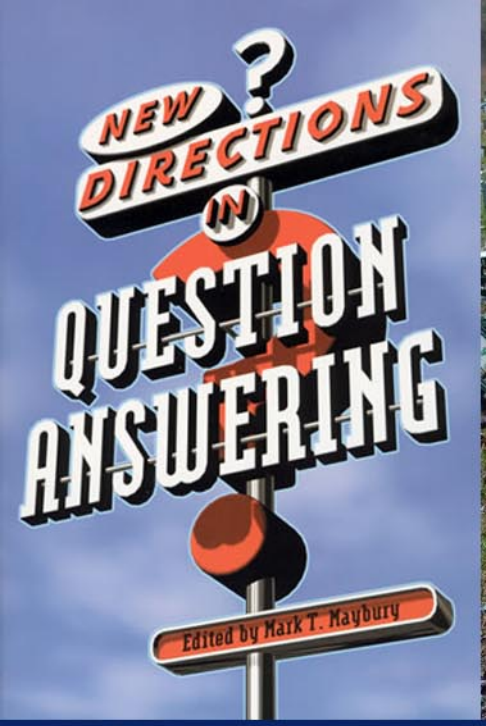
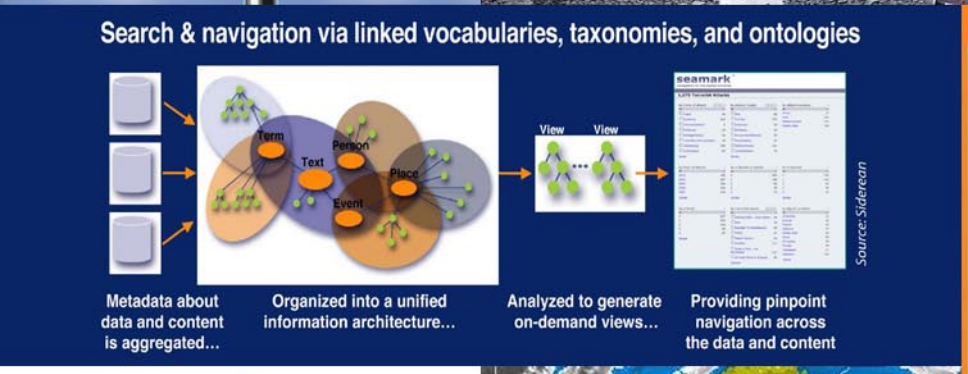
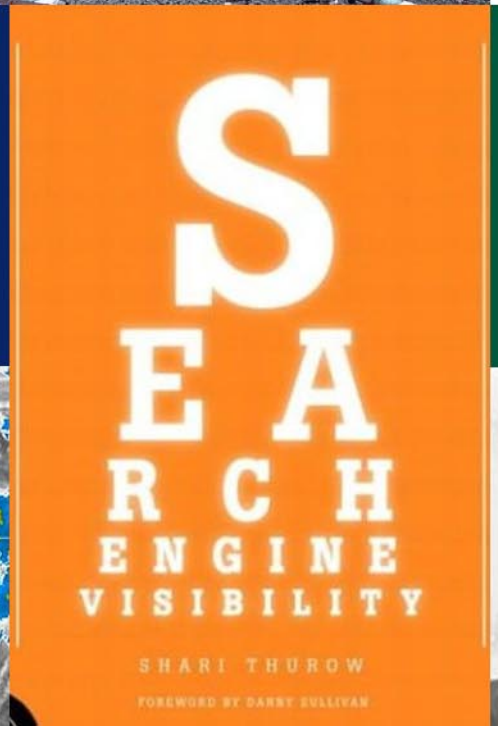
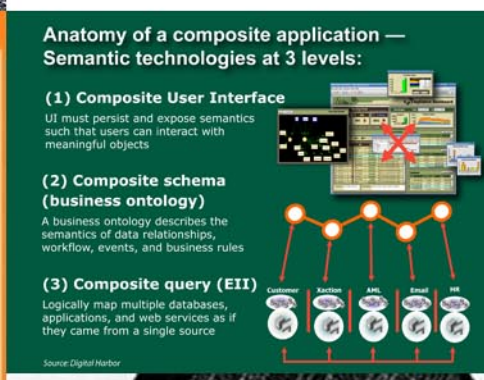

Database Performance at Scale
Hi
Performance
Low
Salary list
Most web applications
Social networks
Real-time predictive intelligence
Semantic trading
10x
RDBMS
NOSQL
SEMANTIC
Data, Query & Reasoning Complexity
Hi

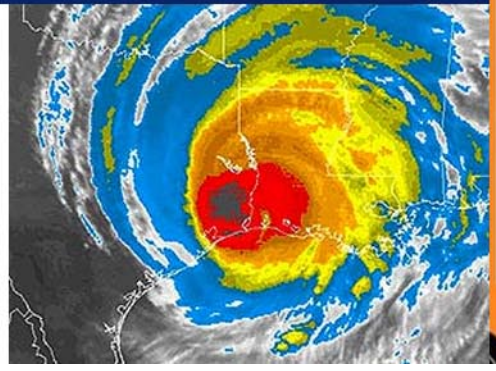

NEW
DIRECTIONS
IN
QUESTION
ANSWERING
Edited by Mark T. Maybury

SEMANTIC
CONTENT
MANAGEMENT


Search & navigation via linked vocabularies, taxonomies, and ontologies
Term
Text
Person
Place
Event
View
View
seamark
Source: Siderean
Metadata about data and content is aggregated...
Organized into a unified information architecture...
Analyzed to generate on-demand views...
Providing pinpoint navigation across the data and content


SEARCH
ENGINE
VISIBILITY
SHARI THUROW
FOREWORD BY DANNY SULLIVAN


Anatomy of a composite application —
Semantic technologies at 3 levels:
(1) Composite User Interface
UI must persist and expose semantics such that users can interact with meaningful objects
(2) Composite schema (business ontology)
A business ontology describes the semantics of data relationships, workflow, events, and business rules
(3) Composite query (EII)
Logically map multiple databases, applications, and web services as if they came from a single source
Customer
Xaction
AML
Email
HR
Source: Digital Harbor



FirstRain — Business monitoring with semantic analytics

The web holds huge potential for business insight

Massive Volume & Content

- 10's of billions of indexable pages. Nearly 200 million bloggers create nearly a million posts every 24 hours, reaching more than 70% of web readers daily
- Near-real time reflection of what's happening in companies and industries is "out there"

Business structure, changes, material events and anomalies are implicitly encoded and reflected within millions of web documents every day

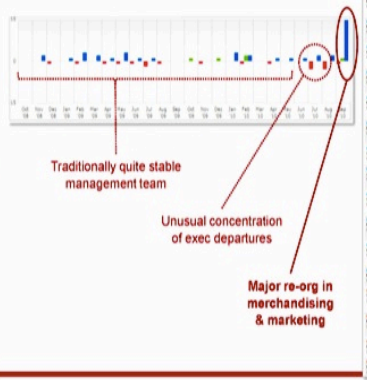
Massive Junk and Noise

- 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

FirstRain Confidential 3 FirstRain

If you could connect the dots...

Announced and unannounced Management Turnover results for:
Wal-Mart Stores (WMT)



FirstRain Confidential 4 FirstRain

Beyond the core technology, what does it take?

Announced and unannounced Management Turnover results for:
Wal-Mart Stores (WMT)

It's not about

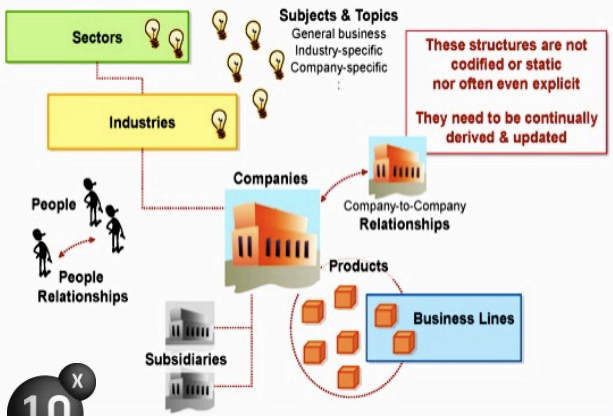
- Searching for a document-match
- Keyword-filtered news or feeds

What it takes

- Understanding **companies** and **business concepts**
- Discovering **connections** and mapping **relationships**
- Uncovering **changes** and **anomalies** that signal meaningful events
- Dynamically derive **business-structure** – implicit, up-to-the-minute

FirstRain Confidential 6 FirstRain

Key enablers: Business structure awareness



These structures are not codified or static nor often even explicit

They need to be continually derived & updated

FirstRain Confidential 7 FirstRain

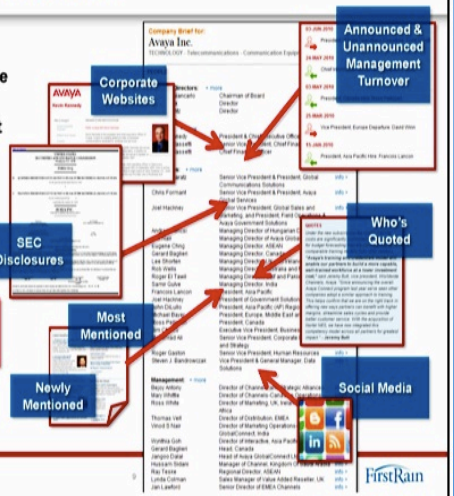
Key enablers: Sequencing, Trending & Patterns

- **"When" really matters**
  Time-sequencing the open web, beyond matching & finding results
- **Trends are revealed**
- **Similarity detection & clustering** uncovers concentrations & spikes
- **Anomaly detection** highlights what's unusual and emerging

FirstRain Confidential 8 FirstRain

Key enablers: Triangulation

For example…
Getting a picture of the key people related to a company / market



The key insights are not about any single source or result

FirstRain Confidential 9 FirstRain

Pragmatic Process

Separate the “know” from the “flow.”

It’s goal-driven!

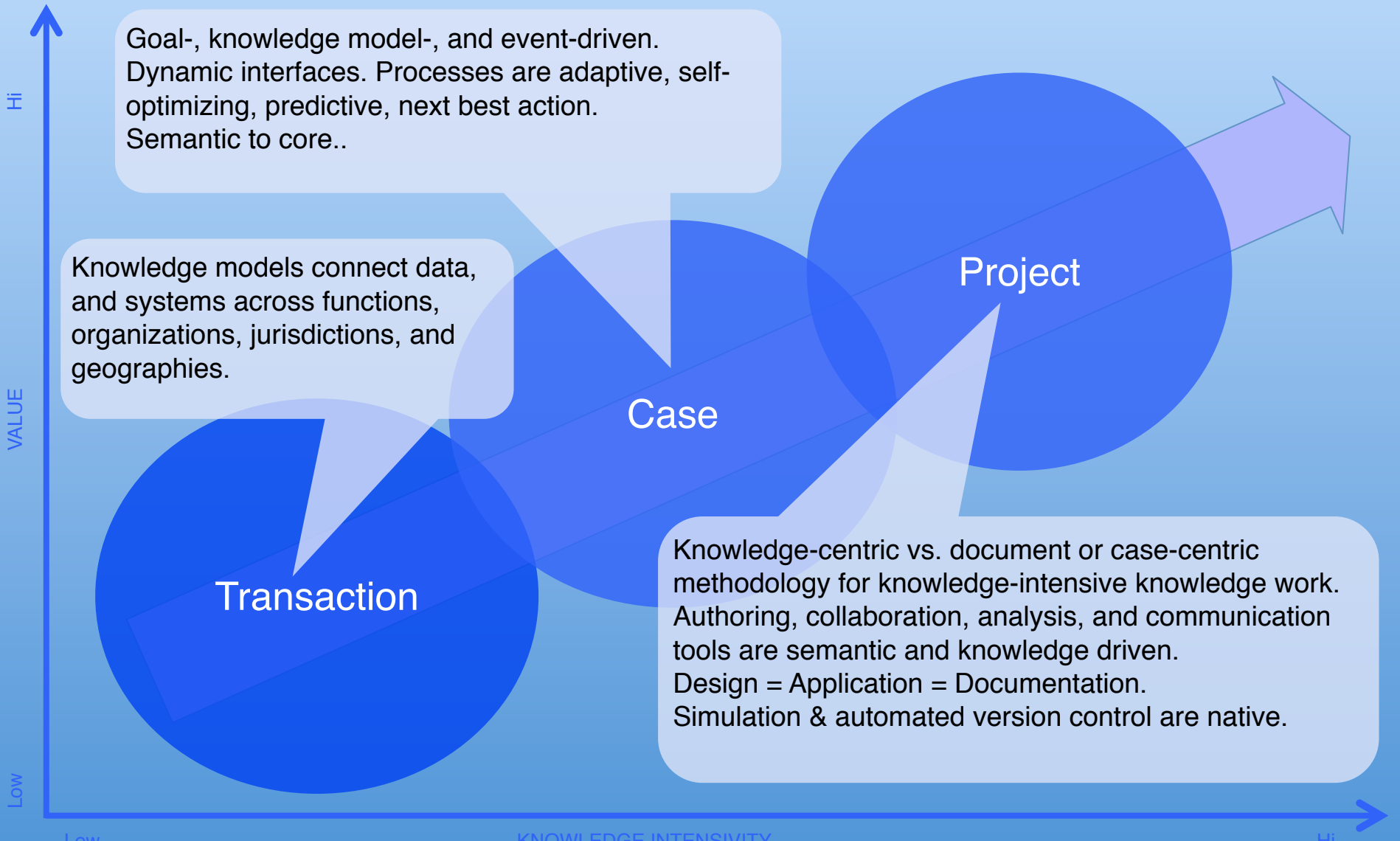
WHAT IF EVERYTHING YOU KNOW ABOUT BUSINESS PROCESS MANAGEMENT IS WRONG?

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

WITH KNOWLEDGFE 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 EXPLAN ITS EVERY DECISION.

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

Goal-driven Processes



NO SWIM LANES!

Goal-, Knowledge- & Event-driven

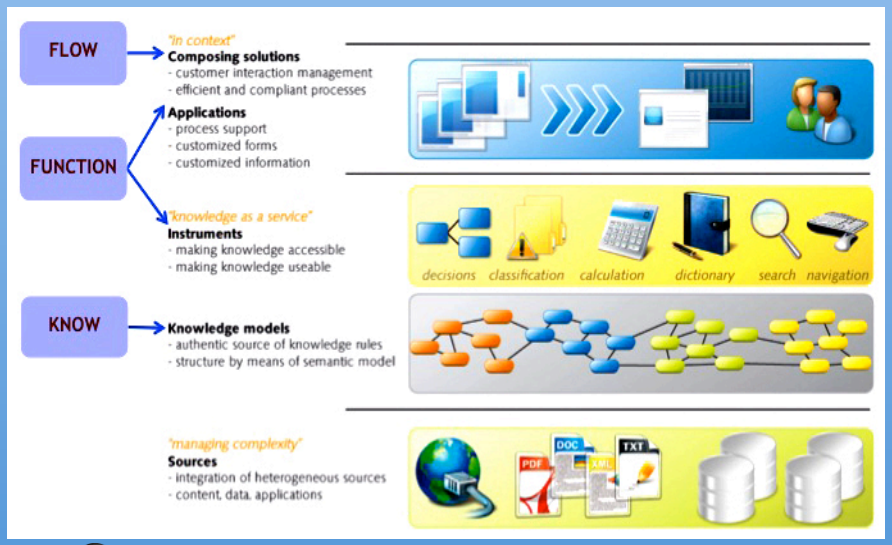
Citizen-centric services with semantic dynamic case management

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.



Source: Be Informed

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 compliancy, fewer errors; improved service delivery to the public; and substantial cost reductions.

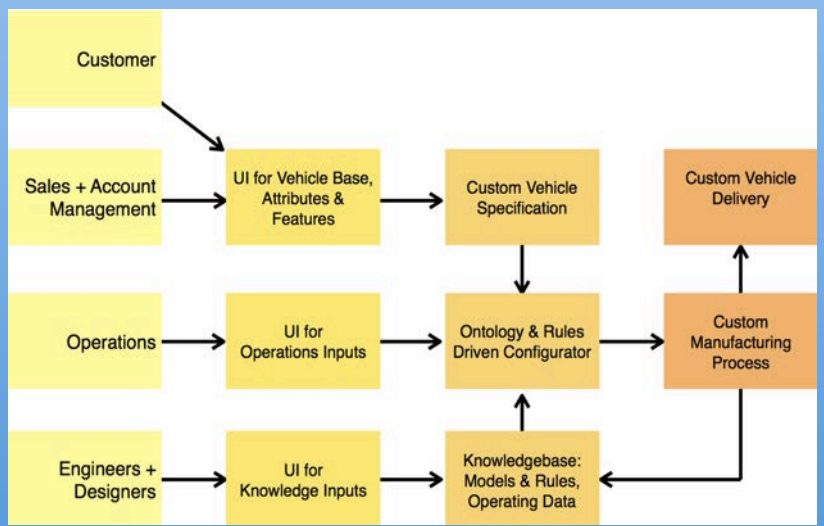
Ontology and rules-based mass customization of vehicles

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.

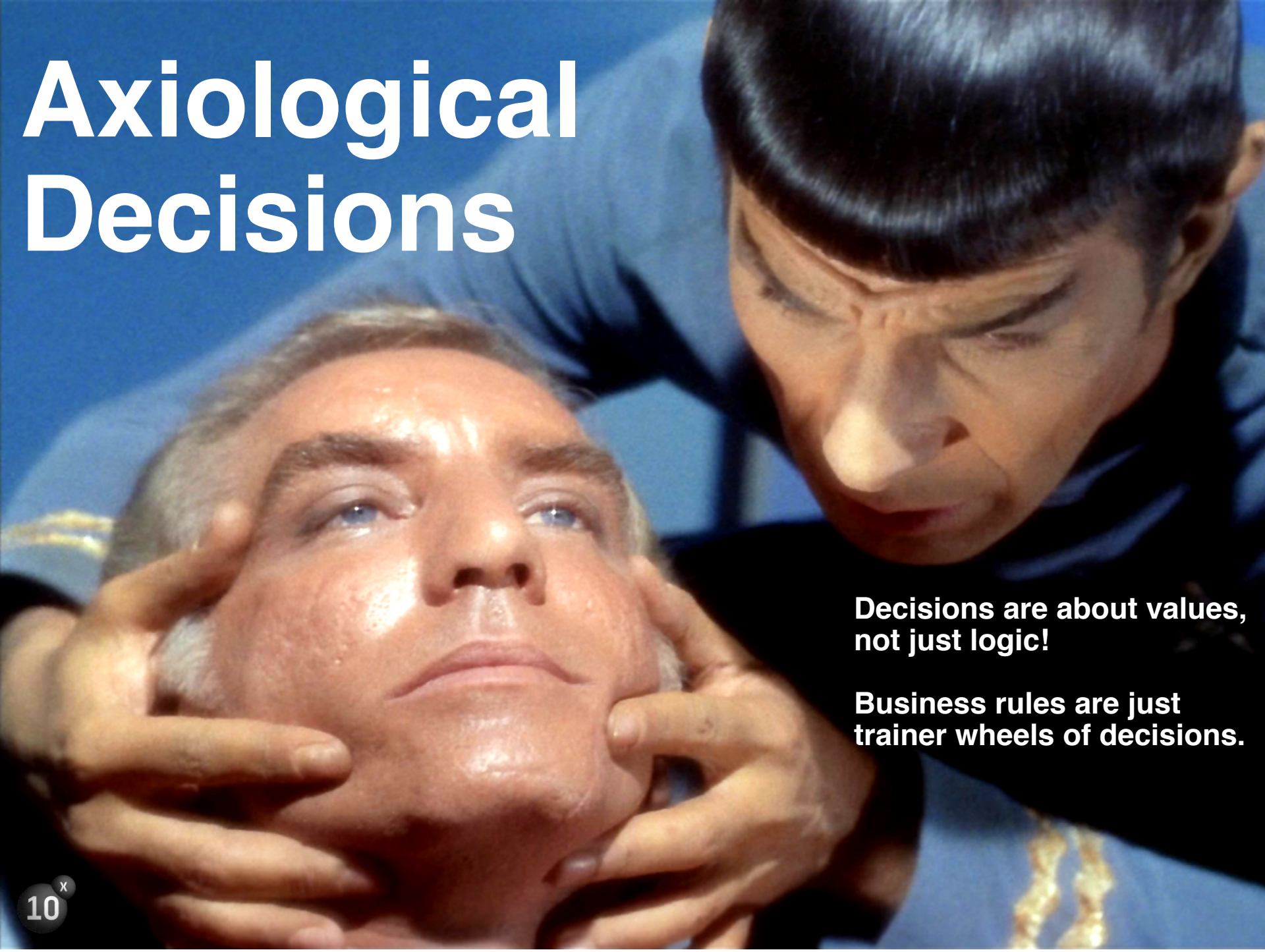


Source: Trigent + Navistar

BENEFITS

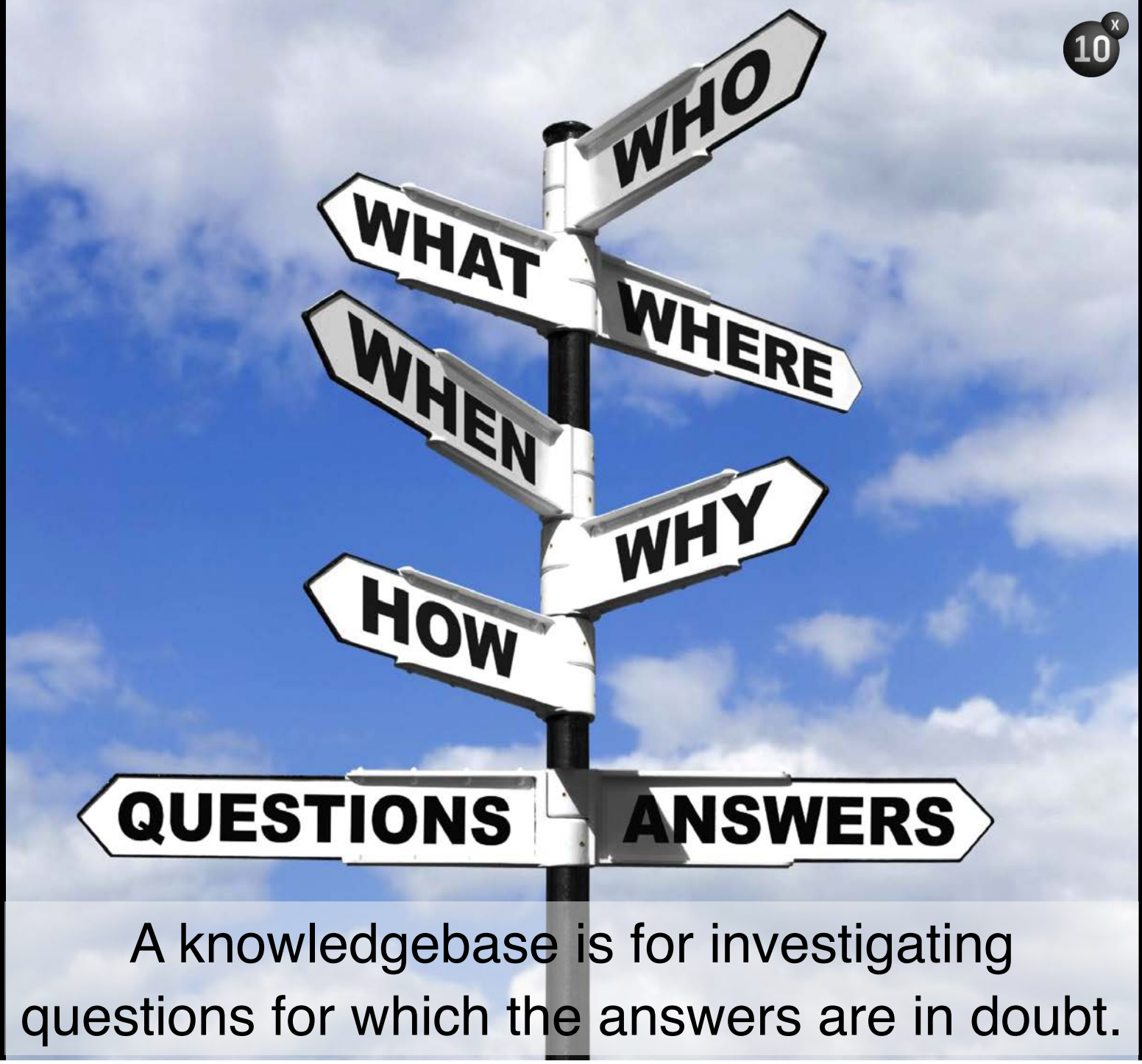
- Mission critical ntology allows quick and reliable specification. Rules specified by ontology auto-generate. Changes take effect immediately or at preset times.
- High-performance rules-based technologies exist. E.g., Worlds fastest most scalable rules engine – recently patented (2008) – Not based on RETE; Much better memory profile.
- Significant opportunities for mass customization exist in the “long tail”. The efficient management of knowledge assets is key to unlocking those opportunities.

Axiological Decisions



Decisions are about values, not just logic!

Business rules are just trainer wheels of decisions.



A knowledgebase is for investigating questions for which the answers are in doubt.

Semantic Technologies Landscape Map

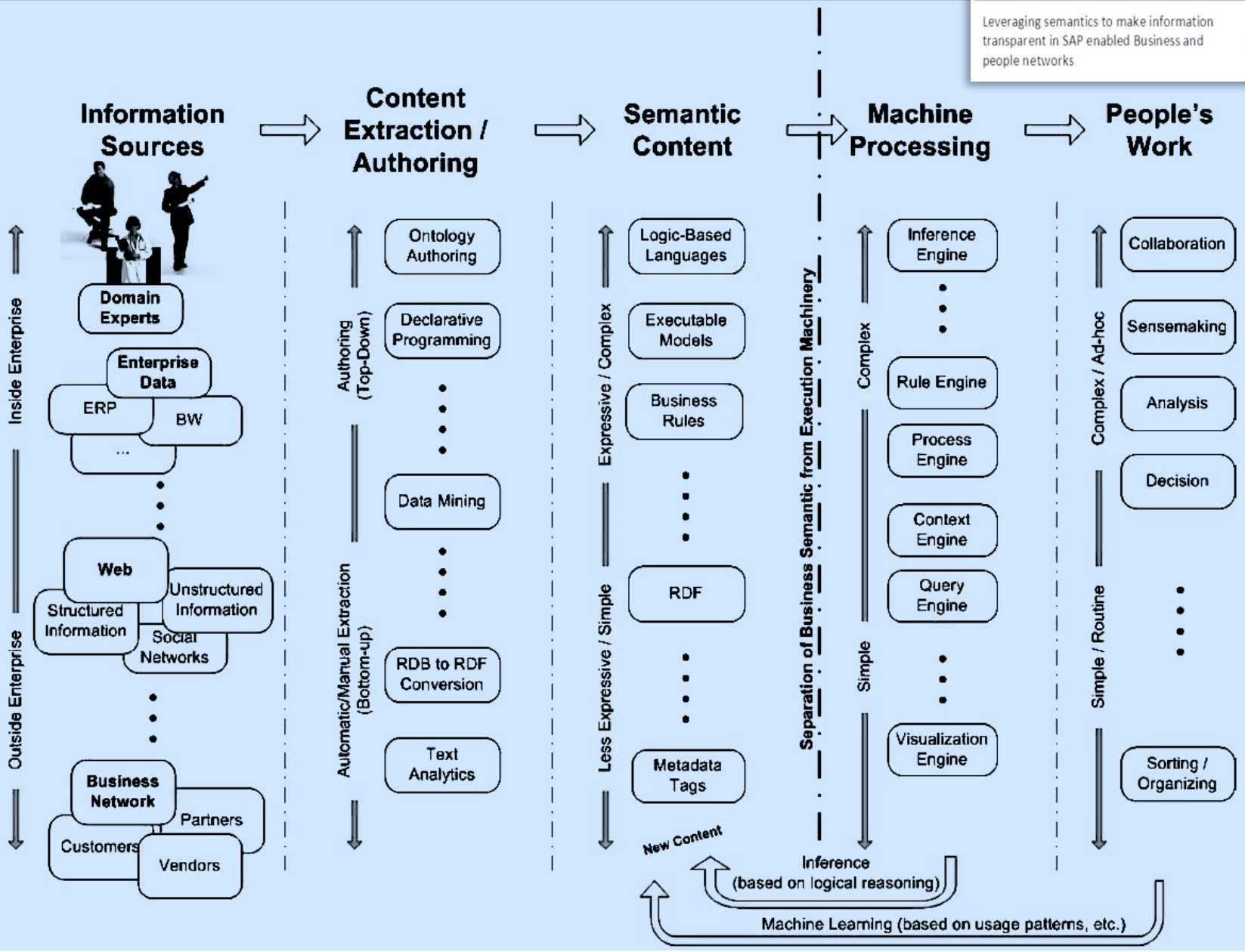
Semantic Technology Strategy

SAP

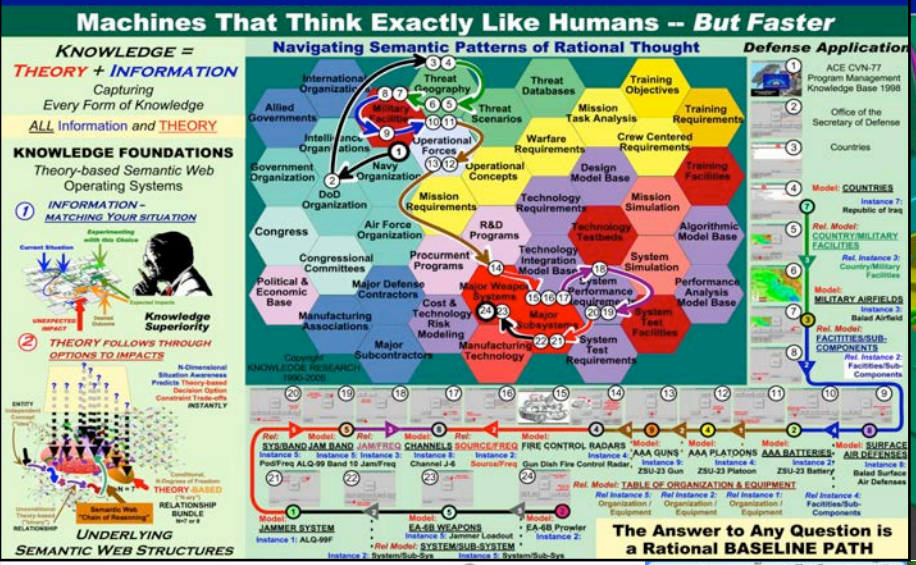
November 8, 2010

Leveraging semantics to make information transparent in SAP enabled Business and people networks

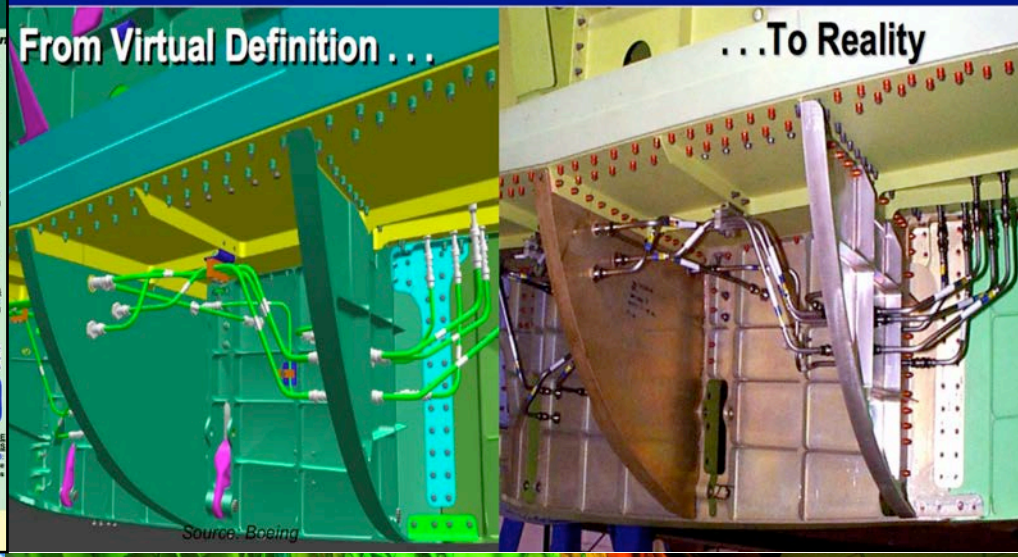
Semantic Technology Strategy Team Version 0.2.3

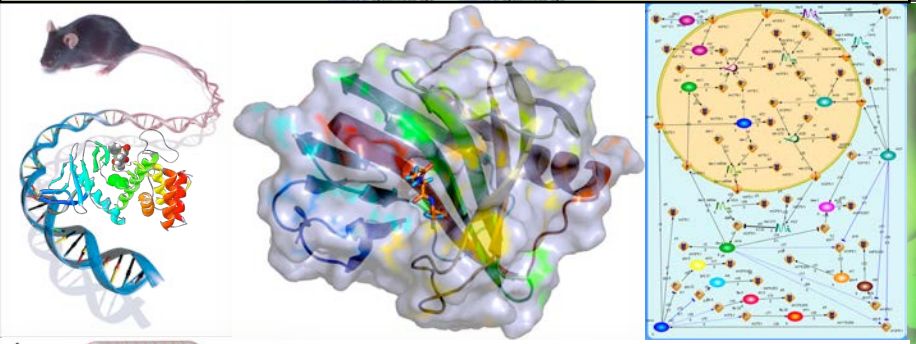


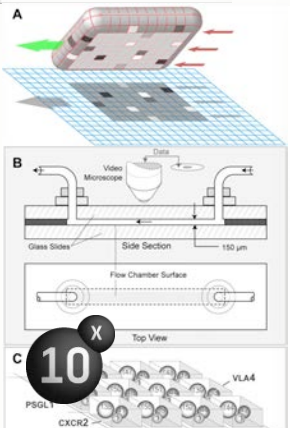
Semantics for decision support



Knowledge-centric engineering & manufacturing







Modeling
(multilayer / hierarchical, discrete / continuous, local / global)

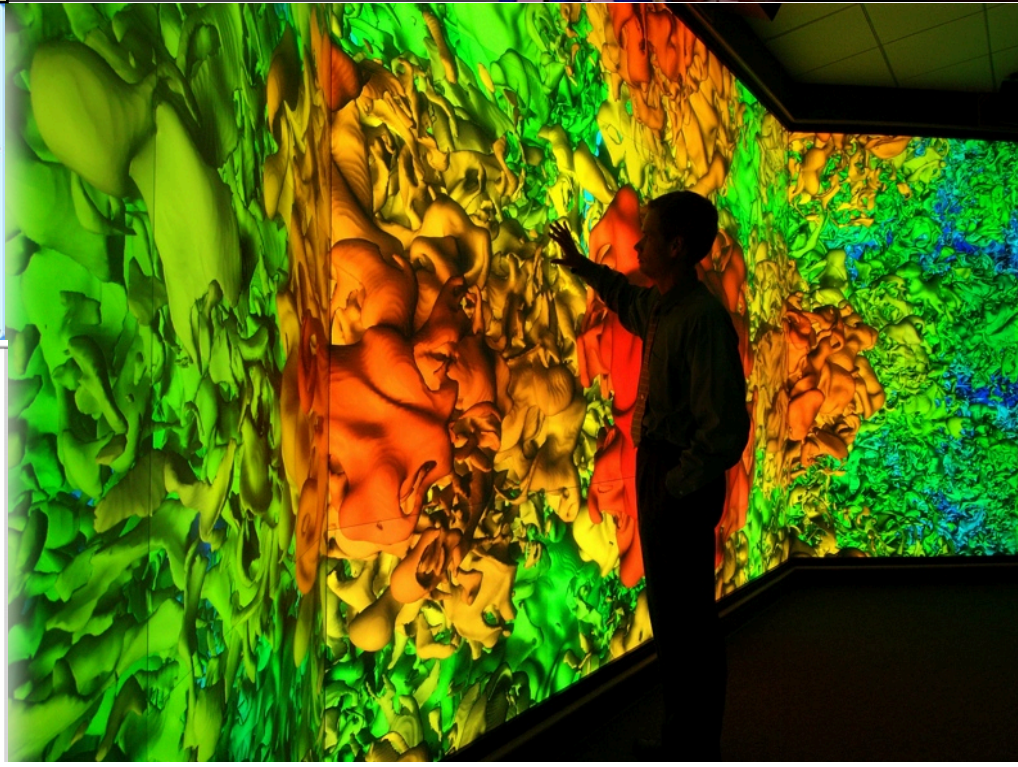
Natural world
(Scientific disciplines: Biology, Physics, Social Sciences, …)

Strategies
(Replications, growth, re-generation, evolution, learning, adaptation, plasticity, self-assembly)

Virtual artifacts
(e.g. algorithms: evolutionary computation, immunocomputing for security, etc.)

Artificial artifacts
(e.g. robots, self-repairing computers, self-assembling circuits, etc.)

Hybrid artifacts
(e.g. implants, artificial organs, memory / vision / hearing aids, etc.)



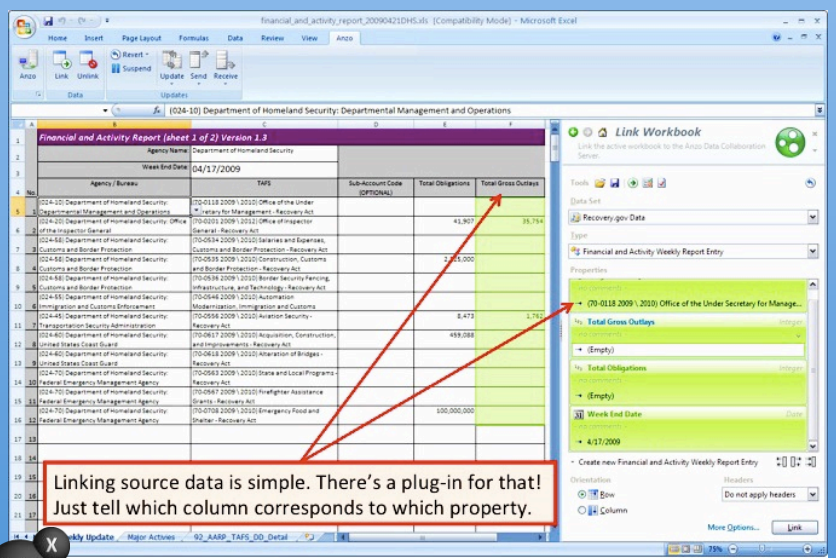
Semantic collaboration platform for do-it-yourself data exploration, analytics, and adaptive reporting

CHALLENGE

- When events trigger action, researchers and analysts examine the data. Combining information from multiple spread sheets 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.



Source: Cambridge Semantics

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.

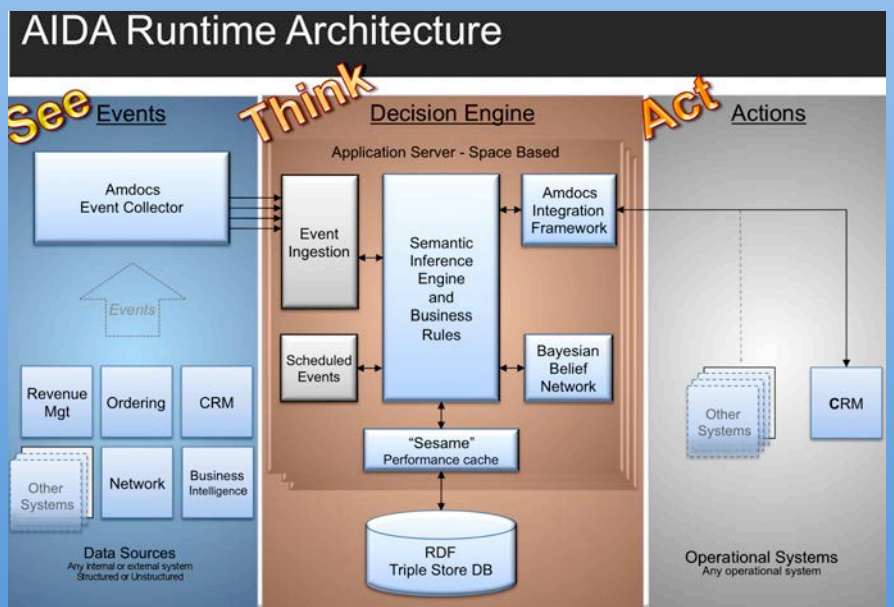
Intelligent decision automation in customer service

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.

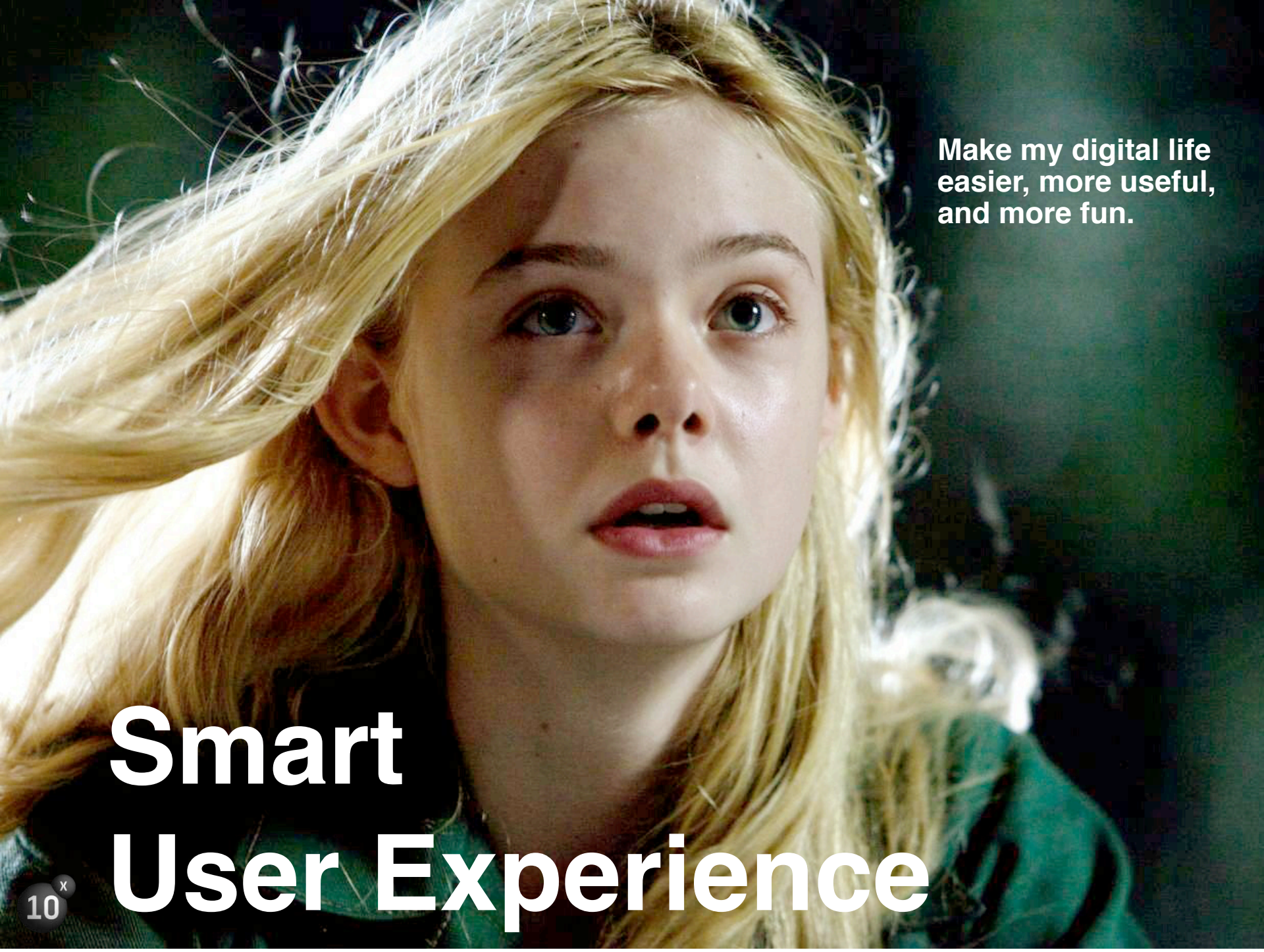


Source: Franz + AMDOCS

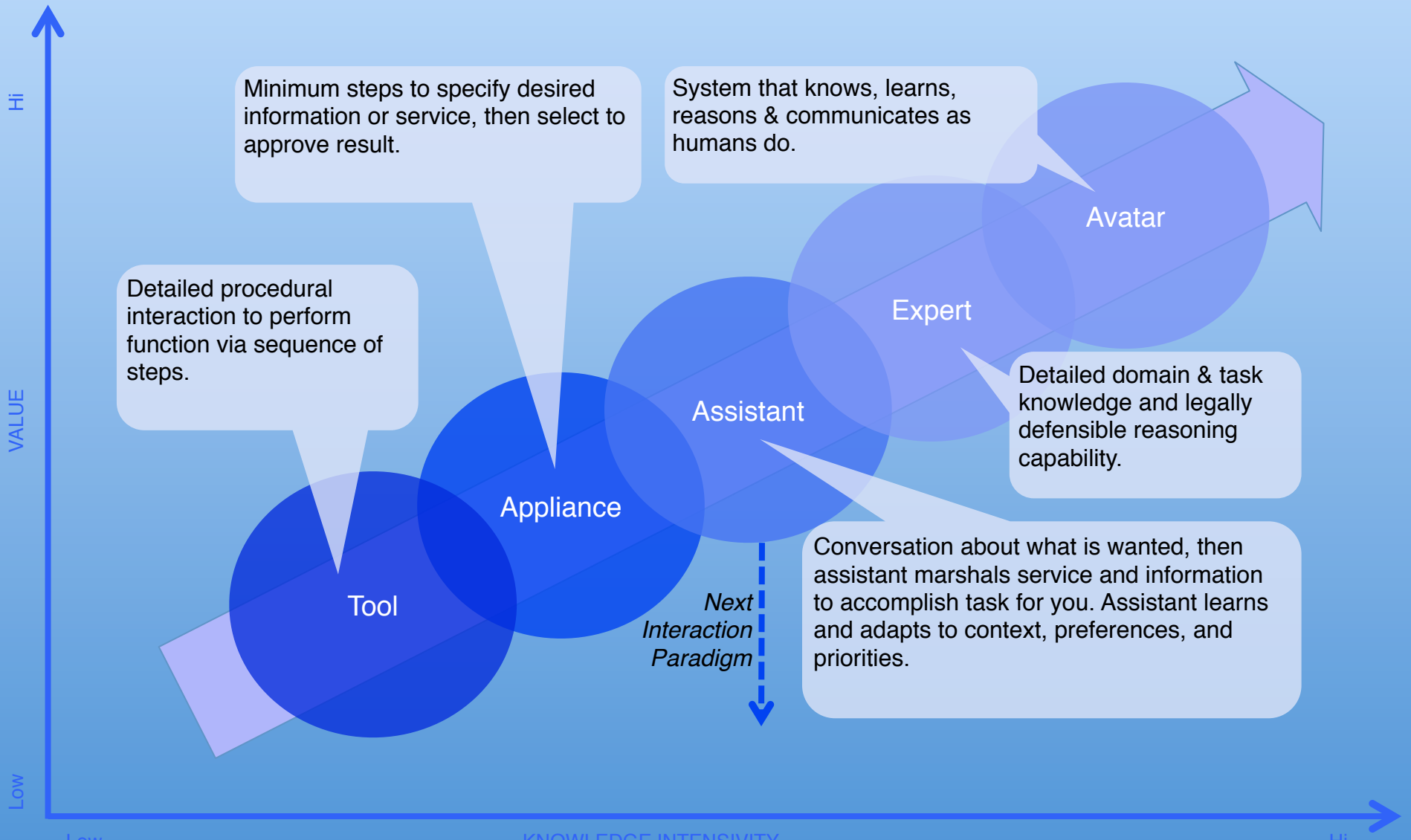
BENEFITS

- 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%.


Make my digital life
easier, more useful,
and more fun.
Smart
User Experience
10x

Smart User Experience



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.”

Siri

A Virtual Personal Assistant

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.

Will we see this in our lifetimes?

Brilliant Interfaces: The Senses

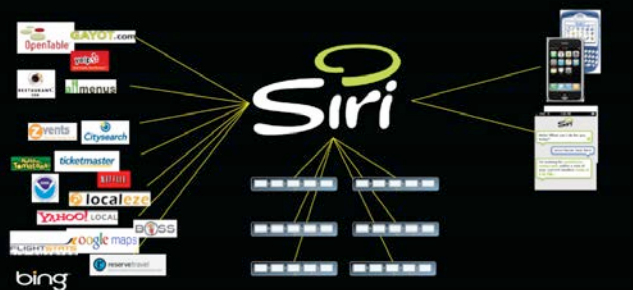
- Touch: Multitouch
- Hearing: Sound in and out
- Sight: Cameras
- Proprioception: GPS, accelerometer
- Taste: tasteful ☺

- Brain?

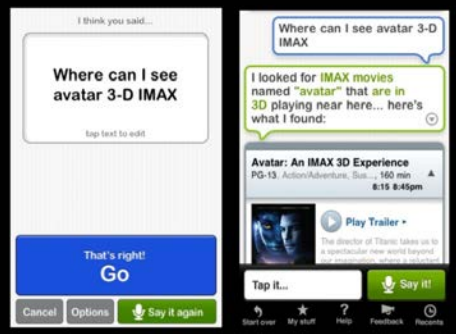
The Phase Transition:

TIRED	WIRED
keywords	➢ Language as Interface
typing	➢ Sensory Awareness
browsing	➢ Problem Solving
information	➢ Personal Services

Bringing the Big Think to the Small Screen



Speech + Semantics + APIs

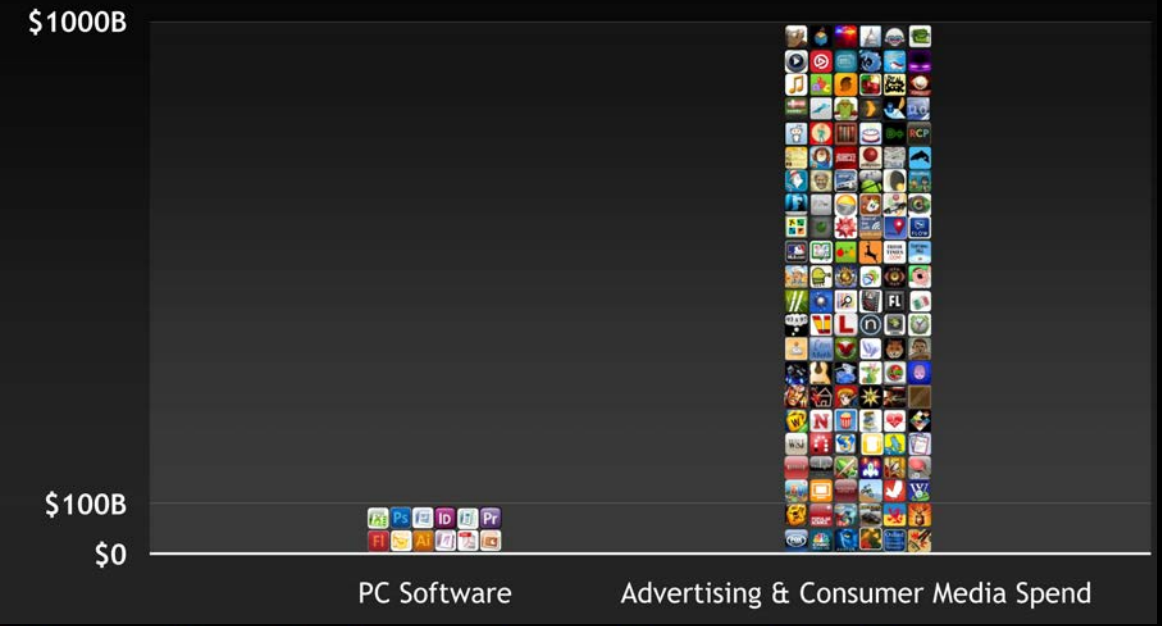


10X

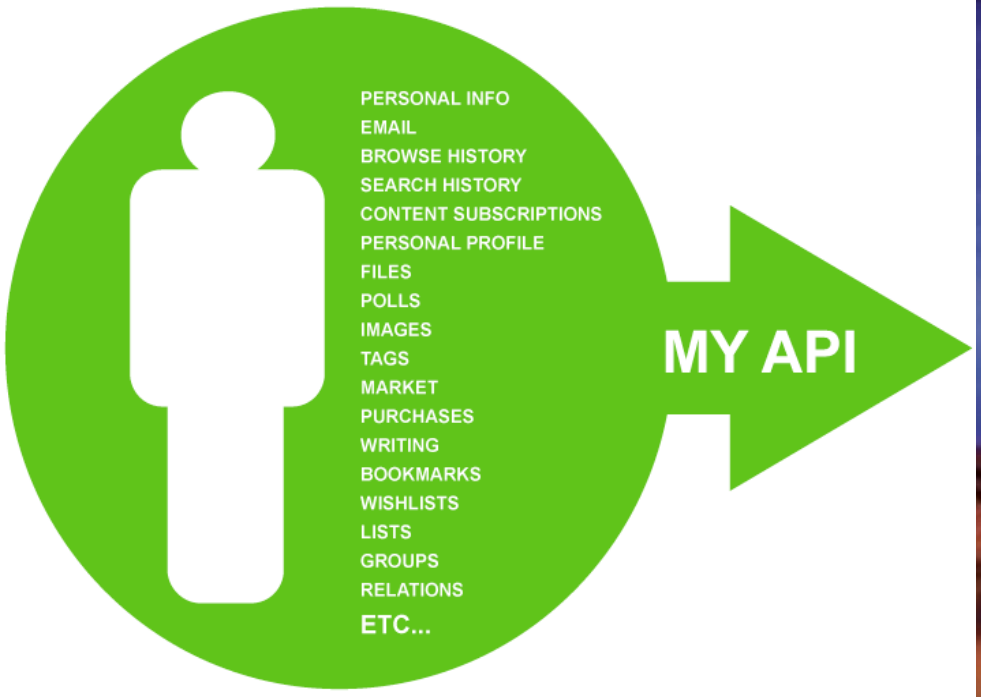
** SIRI acquired by Apple Computer in 2010 for ~$200 million*

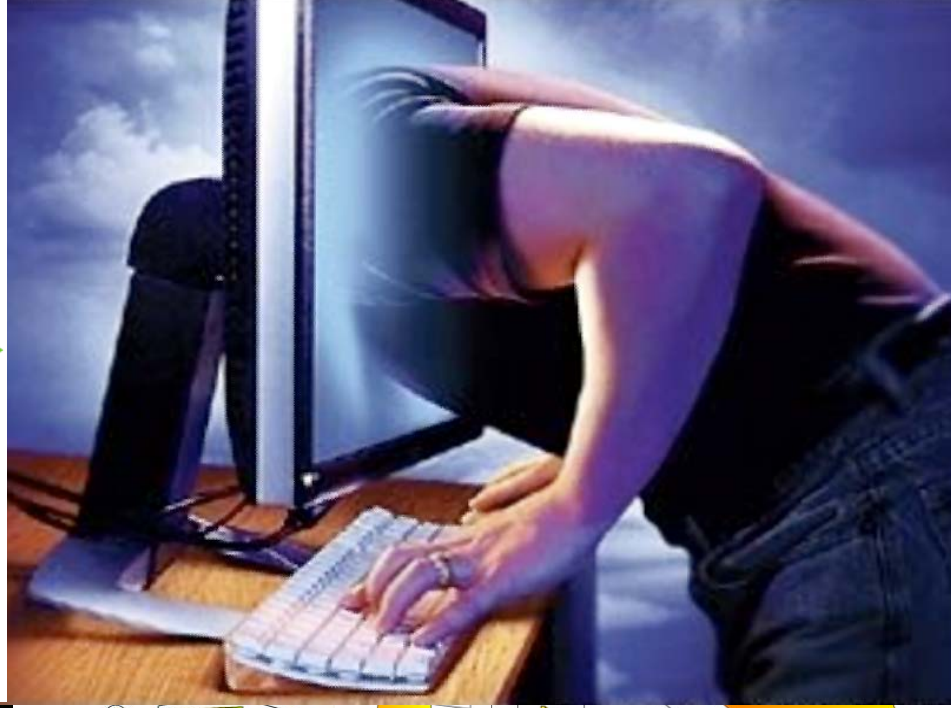
$1,000B Media Fuel for Mobile

Movie, Games, Magazines, News, Cable, TV, Books

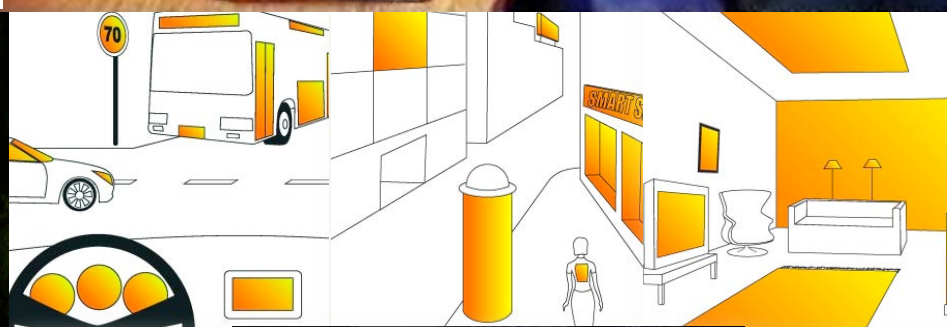


More Media Requires More Performance


PERSONAL INFO
EMAIL
BROWSE HISTORY
SEARCH HISTORY
CONTENT SUBSCRIPTIONS
PERSONAL PROFILE
FILES
POLLS
IMAGES
TAGS
MARKET
PURCHASES
WRITING
BOOKMARKS
WISHLISTS
LISTS
GROUPS
RELATIONS
ETC...
MY API

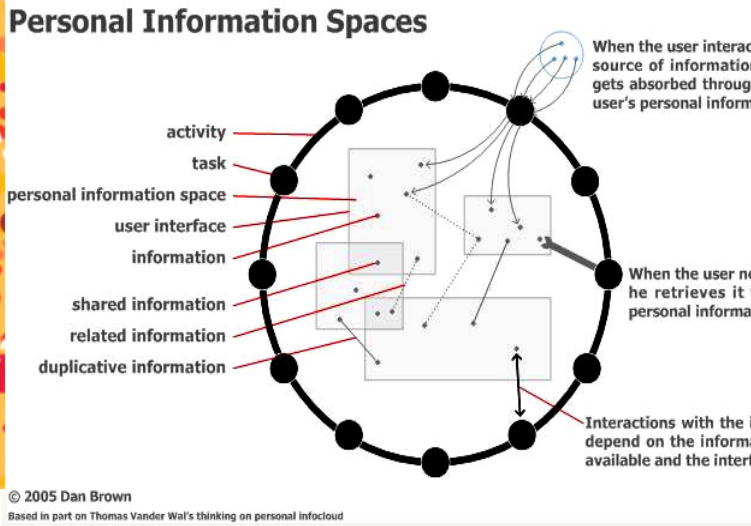


10
Billabong


70

Mobile Augmented Reality
•Combines camera, GPS and orientation sensors
•Enables mass market augmented reality
•3G phones can embed these components

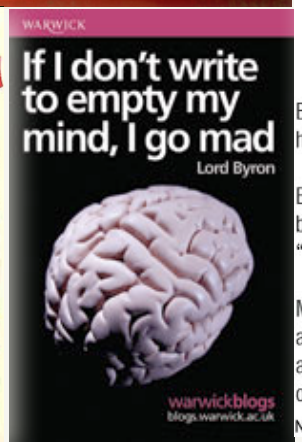
:-)
smail

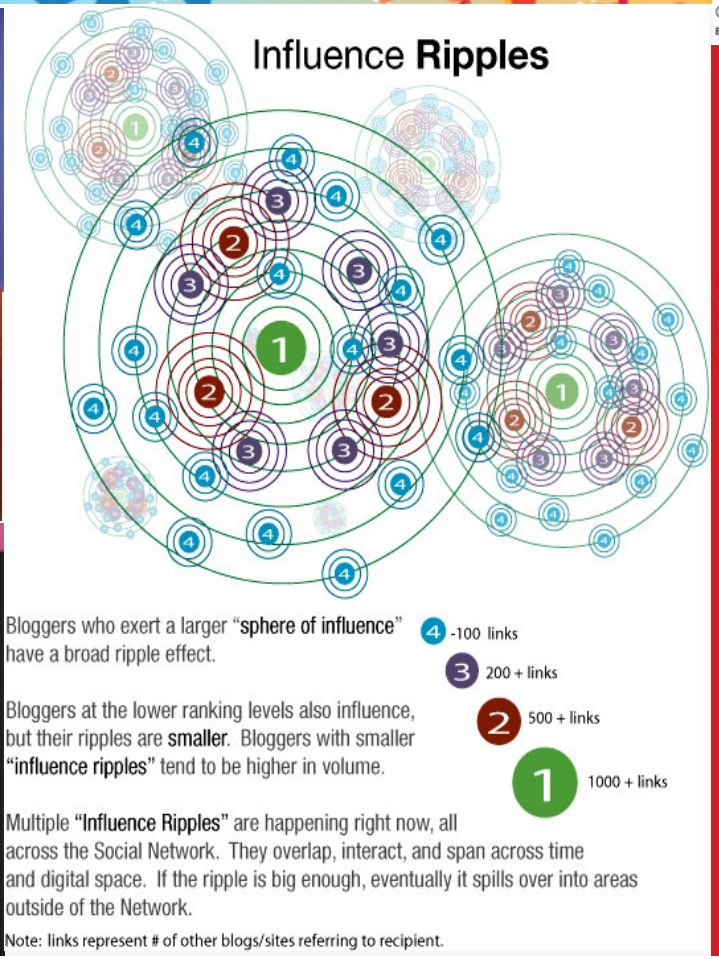

Personal Information Spaces
activity
task
personal information space
user interface
information
shared information
related information
duplicative information
When the user interac
source of information
gets absorbed throug
user's personal inform
When the user n
he retrieves it
personal informa
Interactions with the
depend on the inform
available and the inter
© 2005 Dan Brown
Based in part on Thomas Vander Wal's thinking on personal infocloud

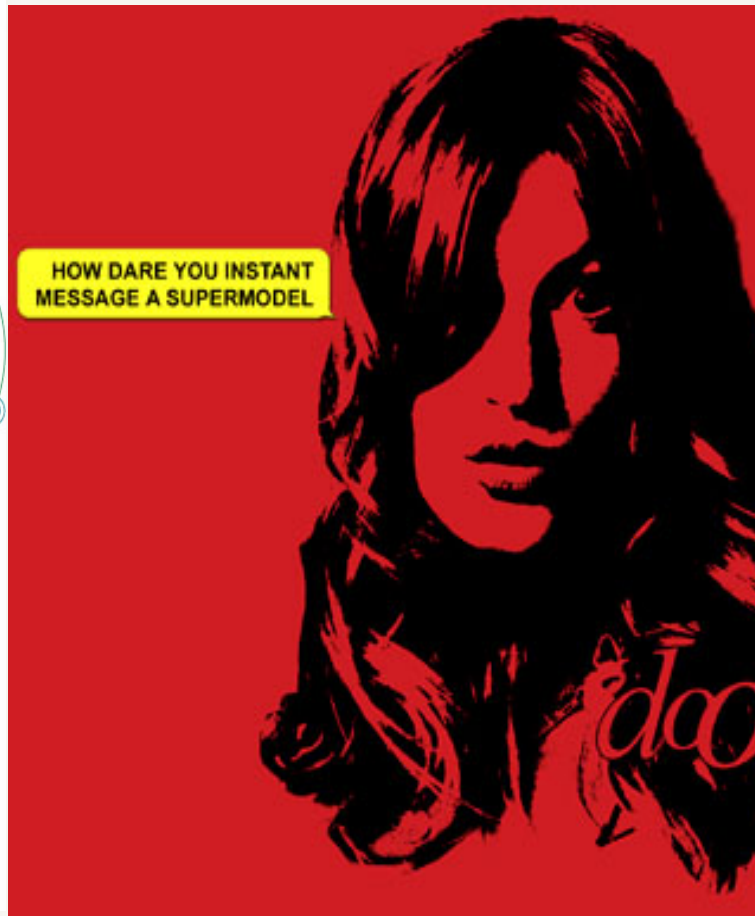
GOOD STUFF
Blogger's
ADSENSE INVITATION

I'm Feeling Lucky
California
BLOGGER
Google

RUCTABLE!
HING CAN STOP IT!
10


WARWICK
If I don't write to empty my mind, I go mad
Lord Byron
warwickblogs
blogs.warwick.ac.uk

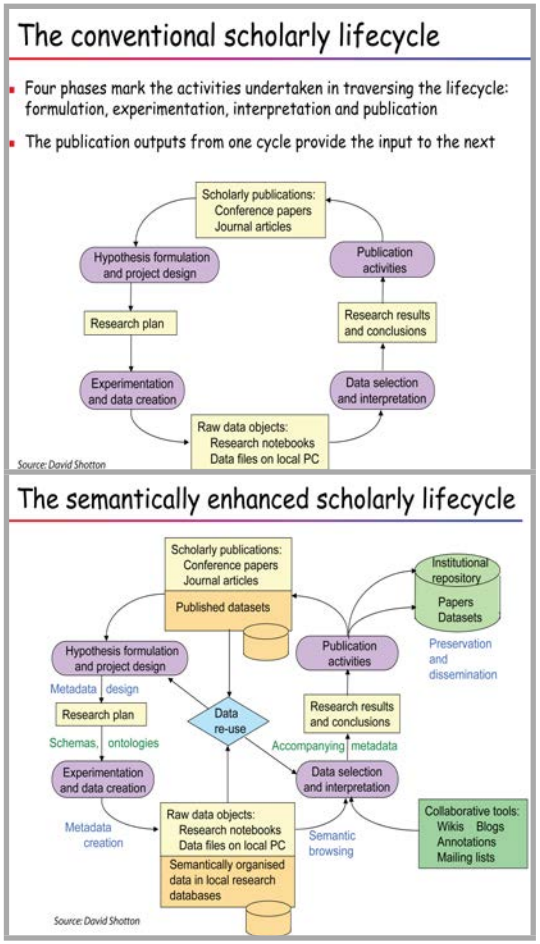

Influence Ripples
Bloggers who exert a larger "sphere of influence" have a broad ripple effect.
4 -100 links
3 200 + links
2 500 + links
1 1000 + links
Bloggers at the lower ranking levels also influence, but their ripples are smaller. Bloggers with smaller "influence ripples" tend to be higher in volume.
Multiple "Influence Ripples" are happening right now, all across the Social Network. They overlap, interact, and span across time and digital space. If the ripple is big enough, eventually it spills over into areas outside of the Network.
Note: links represent # of other blogs/sites referring to recipient.


HOW DARE YOU INSTANT MESSAGE A SUPERMODEL

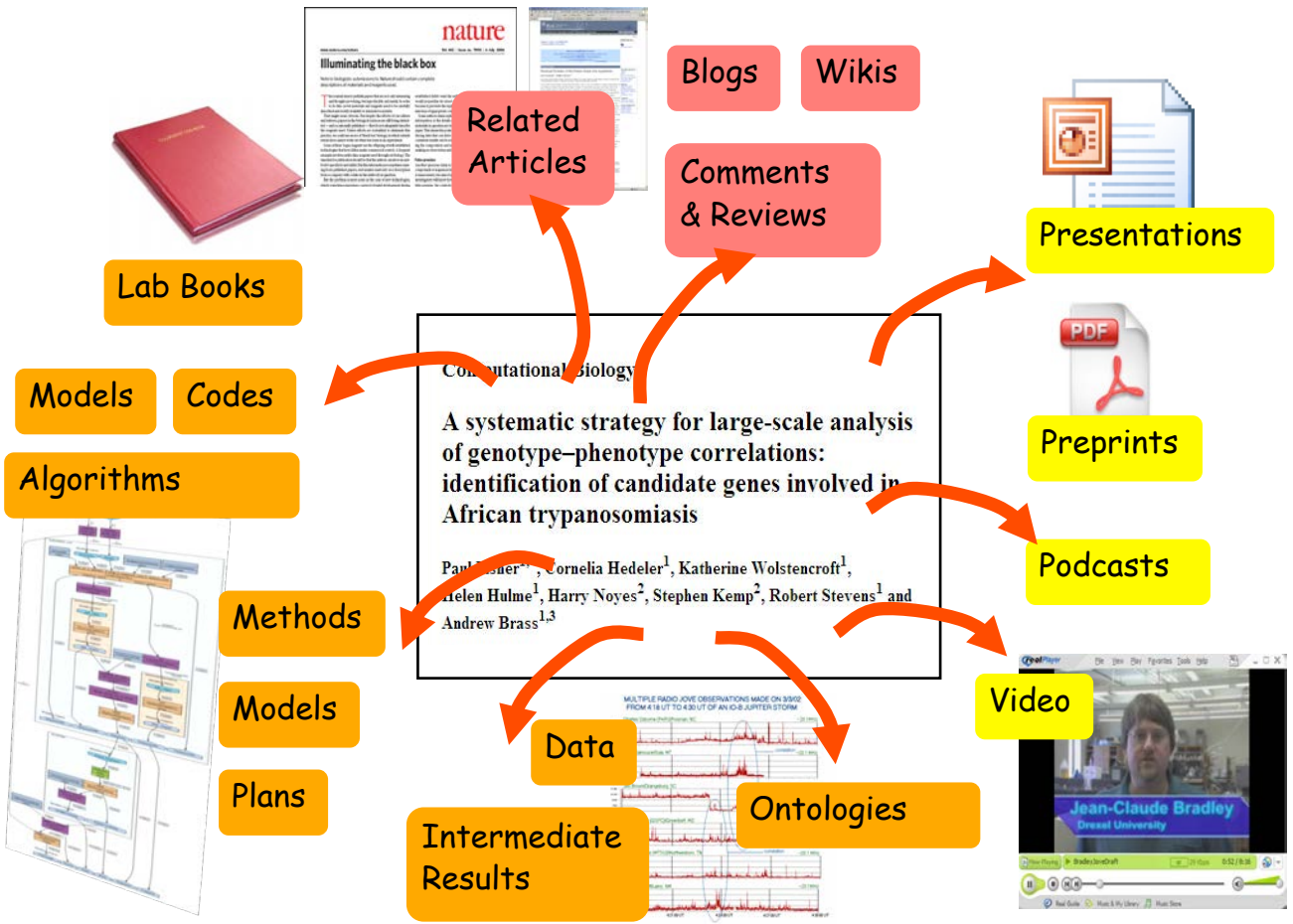
Semantic Collaboration

MediaWiki	**Semantic MediaWiki**	**SMW+ Semantic MediaWiki+**	**Future Semantic Wikis**
Wikipedia Read/Write	Dbpedia Linked Data	Desktop import Ontology mgmt Semantic search Semantic apps	Natural language Transemiotics Machine learning Multi-agent apps

Semantic publishing is interchange of composite digital components that are both human & machine interpretable



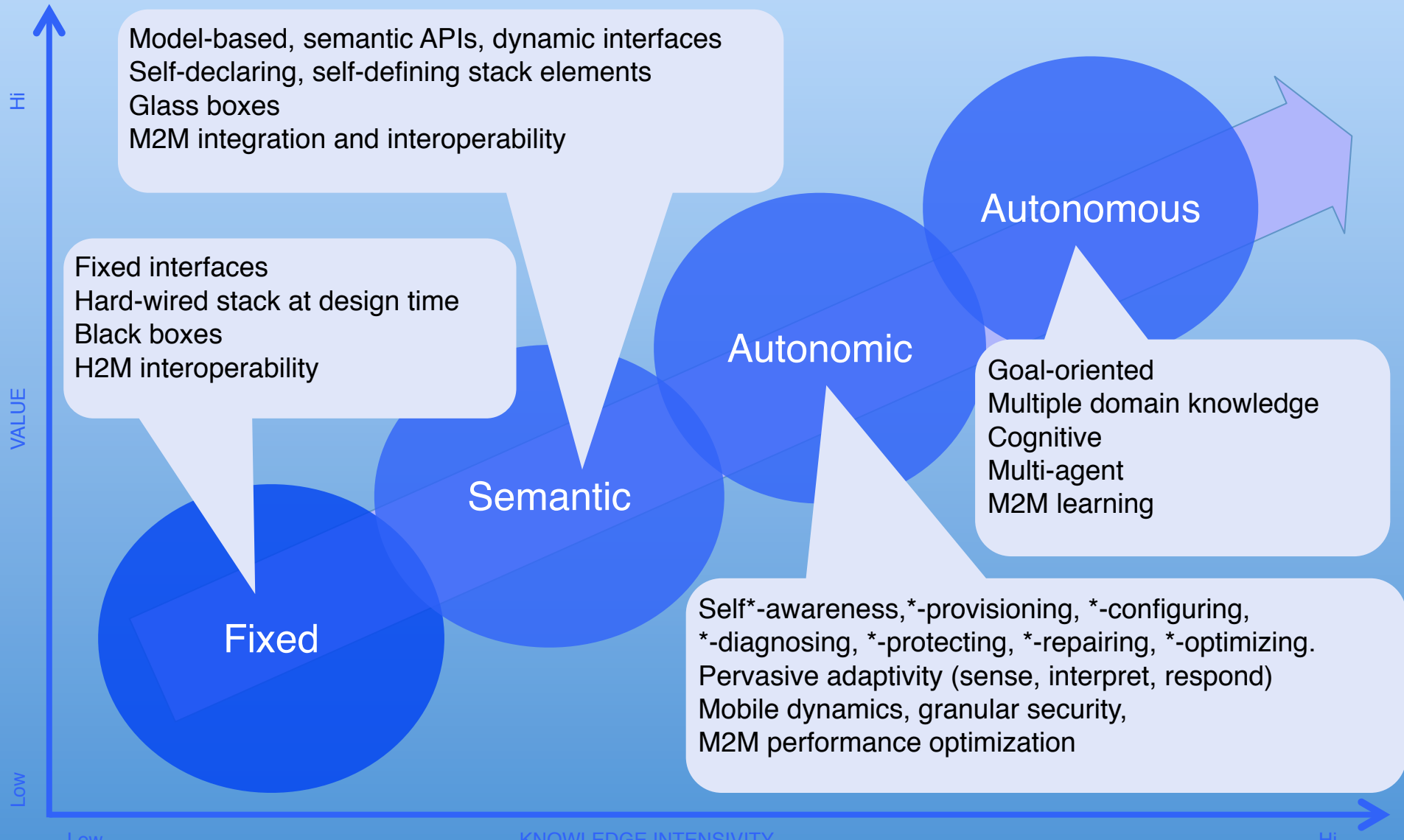
Source: Semantic Publishing, David Shotton



Source: Future of Research, Carol Goble

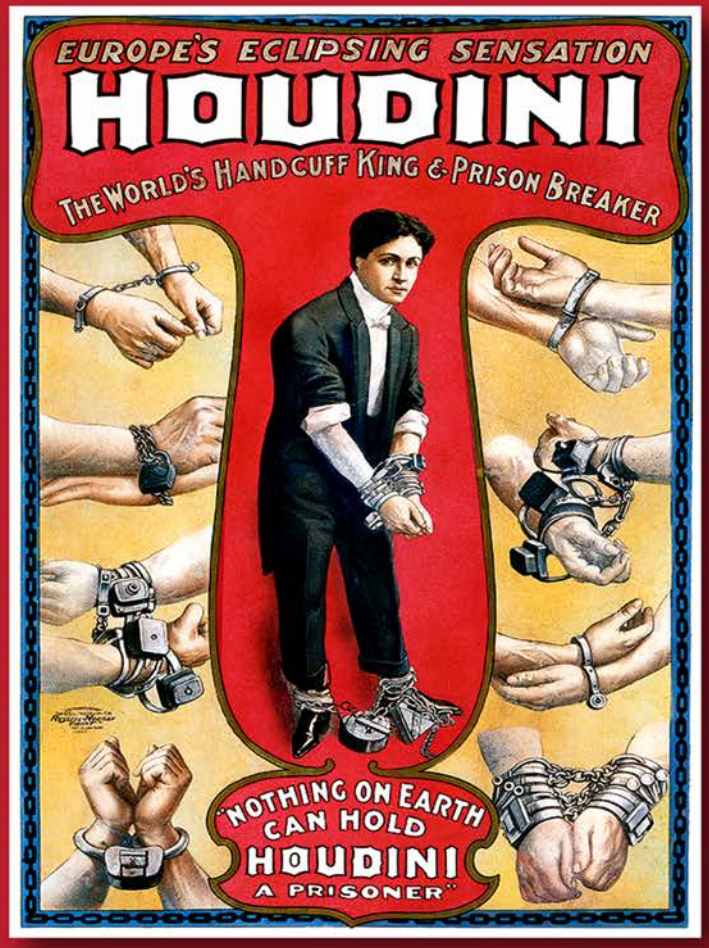
Autonomic
Infrastructure

Autonomic Infrastructure



CAN YOU ESCAPE YOUR LEGACY SYSTEMS?

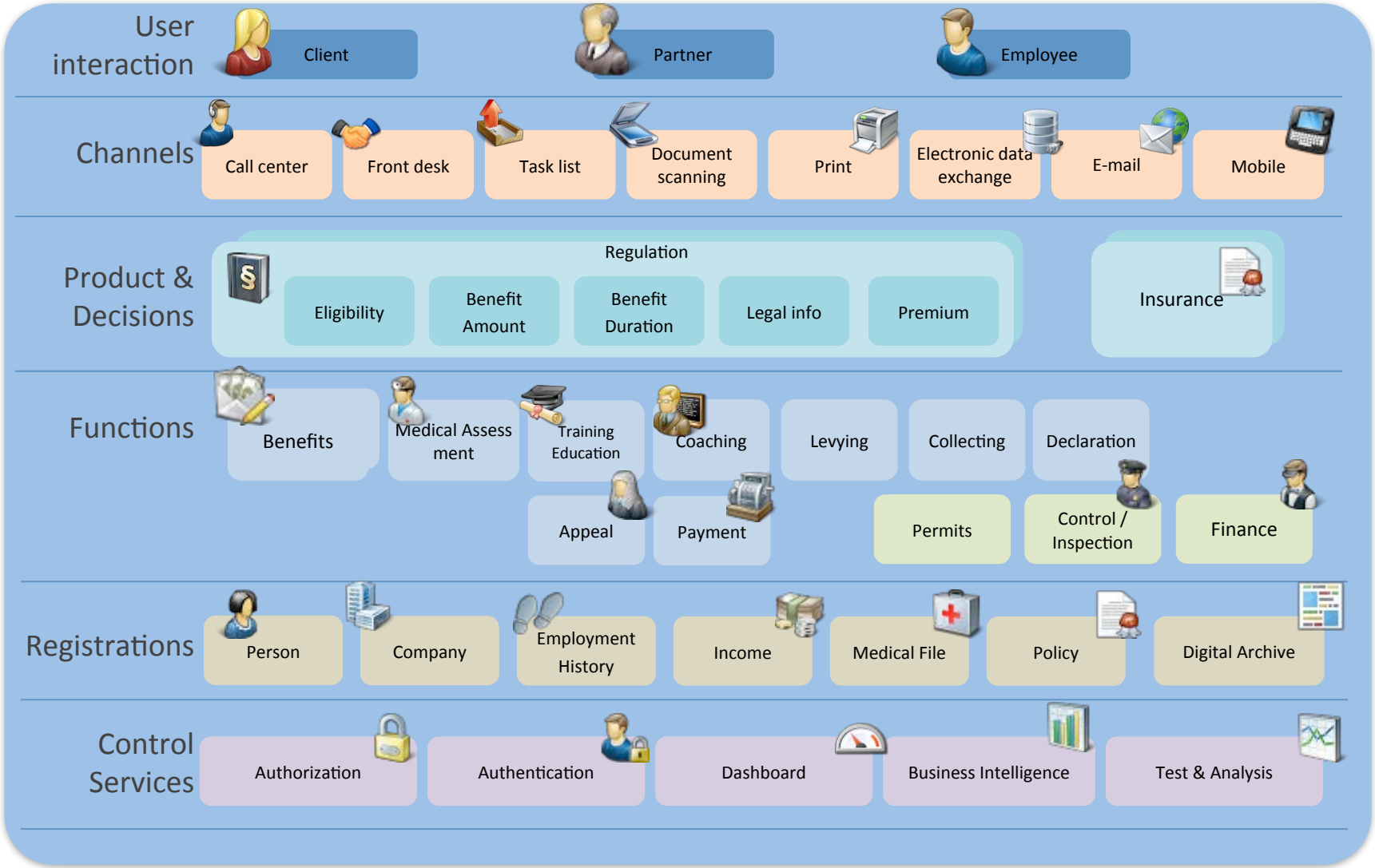
BUSINESS IS COMPLEX, BUT IT DOESN'T NEED TO BE COMPLICATED!



KNOWLEDGE MODELS INTEGRATE SYSTEMS & DATA NON-INVASIVELY.

USE ABOVE THE LINE ARCHITECTURE.
STANDARDIZE AT A HIGHER LEVEL.
TRANSFORM INCREMENTALLY. INTERCEPT THE FUTURE.

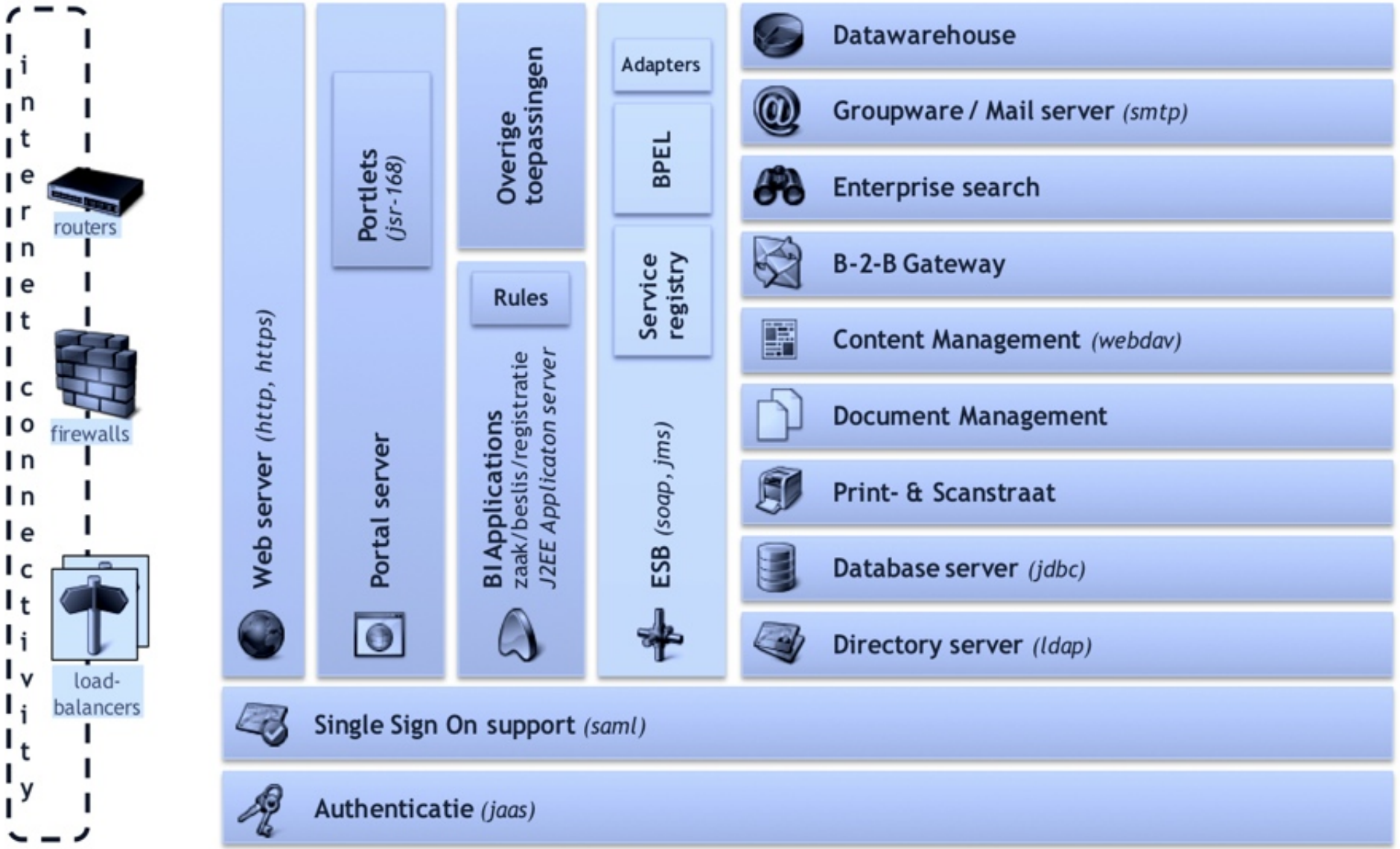
Above the Line Knowledge Models



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



SECURITY

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