

# What Must Semantics Do Now To Advance Drug Discovery?

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This presentation contains "forward-looking statements" as that term is defined in the Private Securities Litigation Reform Act of 1995. These statements are based on management's current expectations and involve risks and uncertainties, which may cause results to differ materially from those set forth in the statements. The forward-looking statements may include statements regarding product development, product potential or financial performance. No forward-looking statement can be guaranteed and actual results may differ materially from those projected. Merck undertakes no obligation to publicly update any forward-looking statement, whether as a result of new information, future events, or otherwise. Forward-looking statements in this presentation should be evaluated together with the many uncertainties that affect Merck's business, particularly those mentioned in the risk factors and cautionary statements in Item 1A of Merck's Form 10-K for the year ended Dec. 31, 2007, and in any risk factors or cautionary statements contained in the Company's periodic reports on Form 10-Q or current reports on Form 8-K, which the Company incorporates by reference.



# About Merck

- Merck is a global **research-driven pharmaceutical company** dedicated to putting patients first.
- Established in 1891, Merck has a long-standing tradition of developing **innovative new medicines and vaccines** to improve the health and well-being of patients around the world.
- Merck also strives to improve the world's health through programs that **help ensure patients have access** to our products.



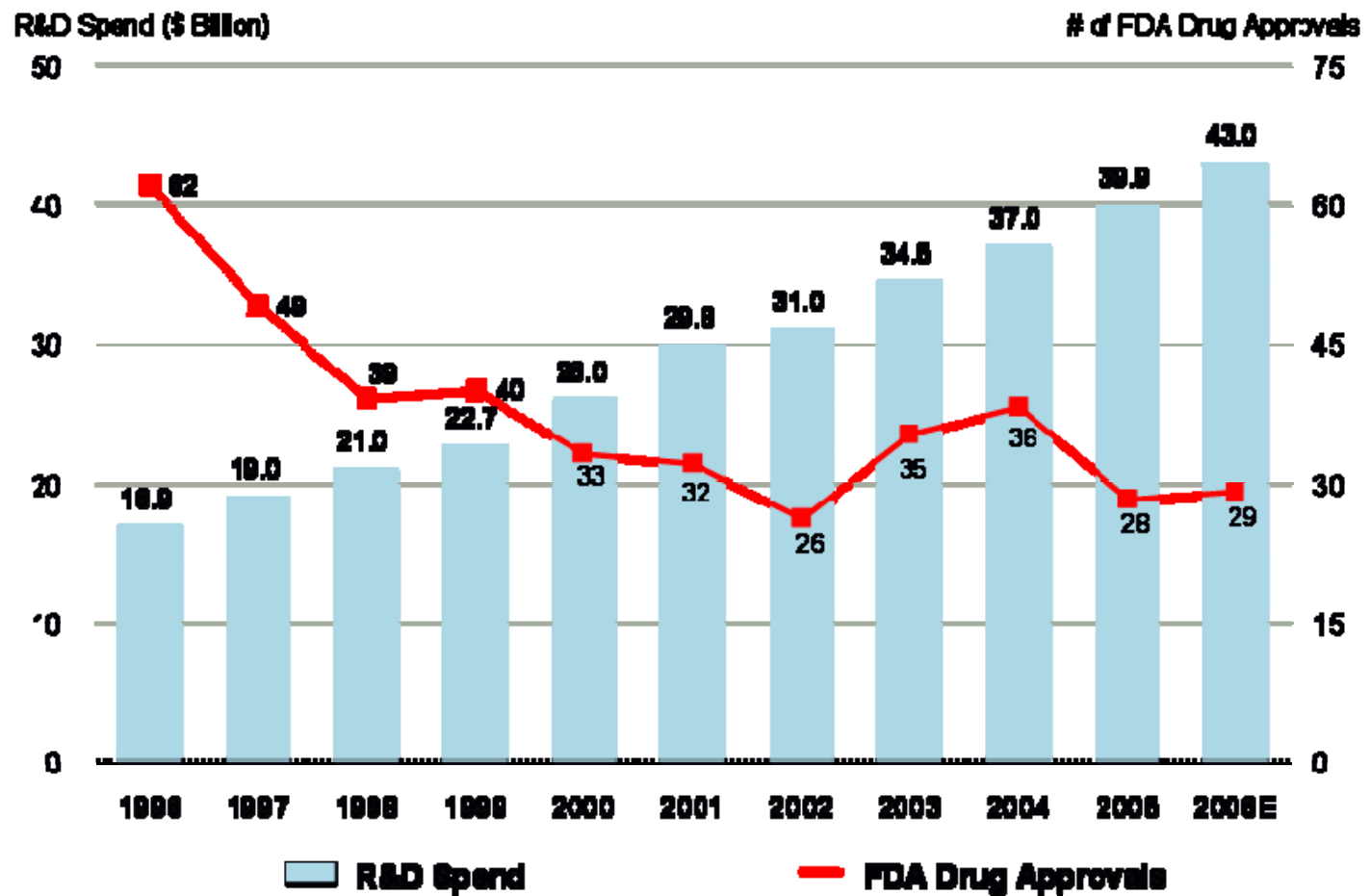
# Our Medicines and Vaccines

- Merck's focus on discovering and developing medicines and vaccines has resulted in **products that have helped millions of patients** around the world.
- Key products include:
  - **SINGULAIR**, for asthma and indoor and outdoor allergies
  - **GARDASIL**, a vaccine for cervical cancer
  - **JANUVIA** and **JANUMET**, for type 2 diabetes
  - **COZAAR** and **HYZAAR**, for high blood pressure
  - **VYTORIN** and **ZETIA** (in partnership with Schering-Plough), for high cholesterol
  - **ISENTRESS**, for HIV infection
  - Additional medicines for **infectious diseases**
  - Numerous adult and child **vaccines**



# BioPharma R&D Productivity

**BioPharma R&D Spend<sup>1</sup> and FDA Drug Approvals<sup>2</sup> (1996-2006)**



Source: Pharma, FDA  
 1. Includes company-financed R&D by PhRMA member companies  
 2. Includes new therapeutics and other new biologics



# Patent Expiry Pressure

## Drugs Losing US Patent Protection Over 5 years from 2007 to 2012 Comprise a Large Percentage of Many Pharmas' Revenues

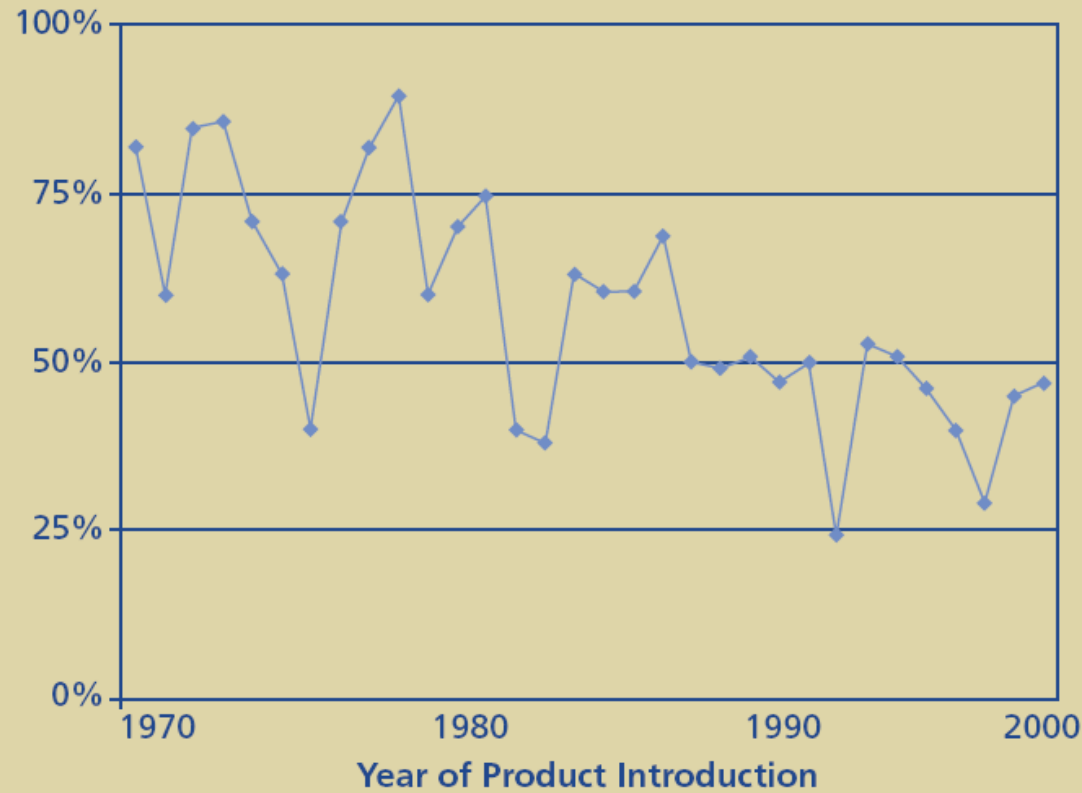
	2006 Total Revenue	Drug Portfolio Impacted by Expiry		US Drug Revenue as Percent Total Revenue
		2006 US Drug Revenue	2006 Global Drug Revenue	
<b>Pfizer</b>	48,371	13,966	23,531	28.87%
<b>GlaxoSmithKline</b>	42,966	10,959	16,098	25.51%
<b>Sanofi-Aventis</b>	37,451	7,493	14,227	20.01%
<b>Novartis</b>	36,749	3,906	6,858	10.63%
<b>AstraZeneca</b>	26,475	7,289	13,430	27.53%
<b>Merck</b>	22,636	5,701	9,876	25.19%
<b>Wyeth</b>	20,350	4,214	5,517	20.71%
<b>Bristol-Myers Squibb</b>	17,914	3,302	4,354	18.43%
<b>Eli Lilly</b>	15,691	2,106	4,363	13.42%

Source: RegentAtlantic Capital, LLC / Fiduciary Network, LLC Research  
Analysis based on 2006 Revenues



# Trends Indicate In-House Originated Products Are Declining

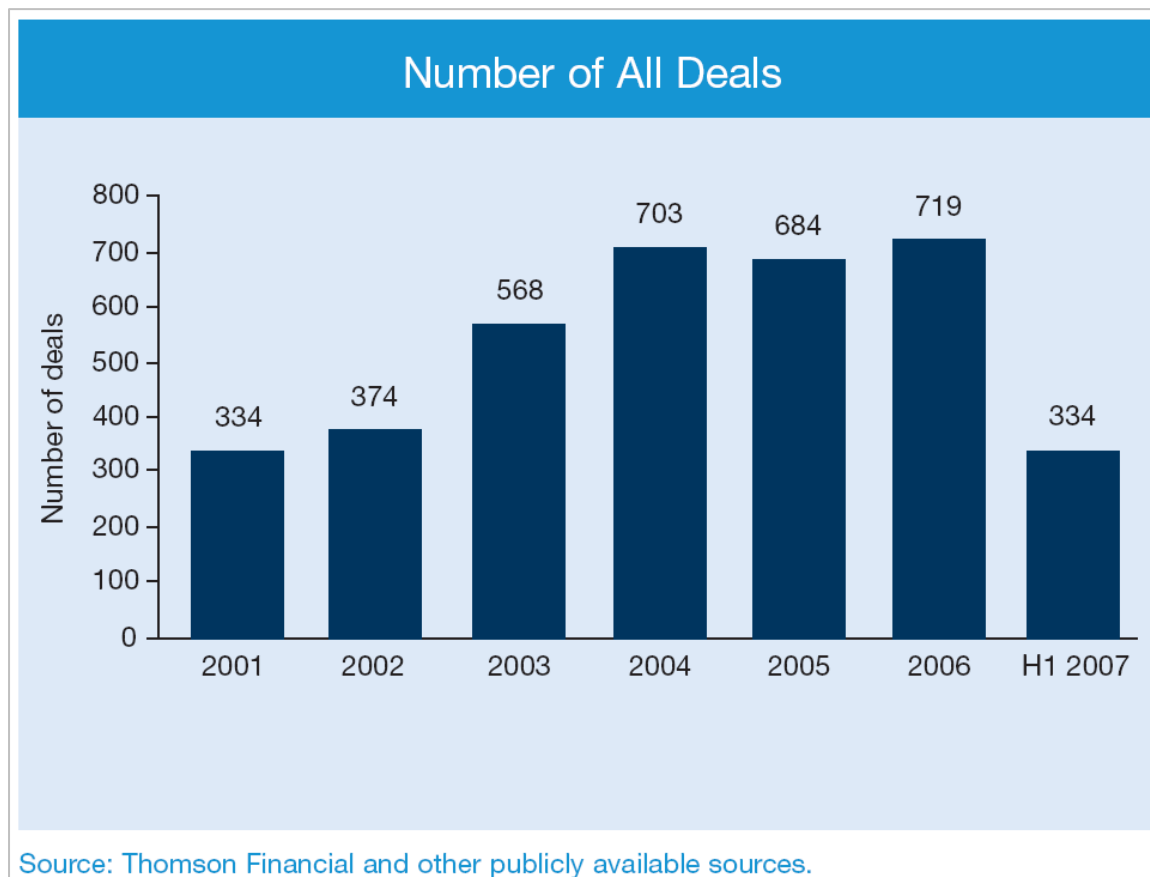
## Percentage of Pharma Products Originated In-house



Sources: Evaluate Pharma; ISO Healthcare; The Cooperative, Competitive Future of Pharma R&D, In Vivo, July, 2003

# External Deals Are A Reality

## Pharma Deals (M&A) 2001 to H1 2007



# Collaborations Are A Reality

St. Petersburg Times

News | Tampa Bay

Print | Email story | Comment | Email editor

## Moffitt, Merck join forces

### One of the world's largest drugmakers forms a research venture with the Tampa institute to adapt cancer treatments to individuals.

By BILL VARIAN and KRIS HUNDLEY  
Published December 19, 2006

TAMPA - The H. Lee Moffitt Cancer Center & Research Institute is joining hands with the world's second-largest drugmaker in a Tampa venture aimed at cutting-edge research to tailor cancer treatments to individual patients.

Under terms of the deal, Moffitt and Merck & Co. Inc. will form M2GEN, a for-profit Moffitt subsidiary at a still-to-be-determined location near the University of South Florida campus, Gov. Jeb Bush announced Monday.

The state, Hillsborough County and the city of Tampa will provide more than \$15-million in financial incentives to build a 50,000-square-foot headquarters for M2GEN. The deal is expected to be finalized in the coming weeks.

In return, Moffitt and Merck pledge to create 165 new jobs in the next three to five years to run the startup, conduct research and apply it to patients. Jobs will average \$80,000, and most will be in Hillsborough County.

Merck will make a "substantial" financial investment in the project, according to Moffitt officials, but they did not disclose the amount.

With two weeks left in Bush's term, the deal places a final punctuation mark on an eight-year tenure in which the governor has emphasized diversifying the state's economy in part by luring bioscience companies to Florida. "We've known as a place to visit," said Bush, addressing employees and others at Moffitt on Monday. "But we're also known as an exciting place where the intersection of entrepreneurship and discovery is taking place."

It also marks one of the first major scores for Hillsborough County commissioners, who have watched other regions of Florida land prominent bioscience companies. The county has the biggest financial stake in the project, pledging \$20-million in cash, as well as land for the new business.

Commission Vice Chairman Ken Hagan said the county is entering an "exciting new realm" of economic development. Hillsborough competed with Pasco County for the project.

In addition to the county, the state is pledging \$15-million. Tampa has pledged \$500,000.

Several aspects of the deal must still win approval from various government agencies, though Monday's announcement appears to signal that is a formality. The deal comes in Moffitt's 27th anniversary year. "We have so much to be proud and so much to be thankful for," said Moffitt, the former state House speaker who pushed for creation of the cancer center, introducing Monday's news conference.

Source: St. Petersburg Times

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## Wyeth BioPharma Announces Research Collaboration With Dublin City University

June 22, 2005

Philadelphia, PA – Wyeth BioPharma, the biopharmaceutical business unit within Wyeth Pharmaceuticals, a division of Wyeth, announced at the annual Biotechnology Industry Organization (BIO) meeting in Philadelphia that it has entered into a four-year research agreement with Dublin City University (DCU) in Ireland to generate scientific knowledge that will facilitate the creation and industrialization of biopharmaceutical production.

"Biopharmaceutical production is complex and the market is projected to grow exponentially over the next few years. Unfortunately, current technology is not expected to be sufficient to meet the production capacity requirements of the exciting pipeline of biopharmaceuticals currently in development," says Bob Adamson, Ph.D., Vice President, Development Network, Wyeth BioPharma. "Through our research, we will harness a deeper understanding of cell biology and its applications to deliver first- and best-in-class protein therapeutics to meet significant medical needs."

Scientists at Wyeth BioPharma's campuses at Grange Castle in Dublin, Ireland and Andover, Mass. and the National Institute for Cellular Biology at DCU will use Wyeth's proprietary Chinese Hamster Ovary (CHO) cell technology and gene expression profiling to examine cell performance under industrial production conditions.

In this unique partnership, DCU, with support of €4 million from Science Foundation of Ireland (SFI), will provide research personnel and expertise, proteomics and full-length gene cloning technology. Wyeth will make a comparable commitment in the form of research personnel and expertise, proprietary CHO cell lines, cell culture process and CHO chip technologies, and gene sequencing. Both groups will contribute to the mRNA expression profiling, bioinformatics, and functional evaluation aspects of the joint research program.

"The greatest challenge facing the biopharmaceutical industry is the ability to produce these therapeutic proteins in sufficient quantities. It is estimated that the industry must increase cell culture capacity by five or six times to meet future demands" says Dr. Maurice Treacy, Director of Biotechnology, SFI. "This precedent setting collaboration between DCU and Wyeth should generate new solutions to complex biological and technical problems that could benefit the entire industry. This program fits in with priority to stimulate breakthroughs in investigative applied science."

Wyeth's Grange Castle Campus is one of the world's largest and most biopharmaceutical development and manufacturing facilities.

Source: BioResearch Online



# Industry Pressures

- Pipeline Productivity
- Cost
- Patent Expiry
- Regulatory

## ***Resulting in:***

- M&A
- Partnerships
- Collaborations

# What Can We Learn From Other Industries?

Auto

Semi Conductors

**Aerospace**

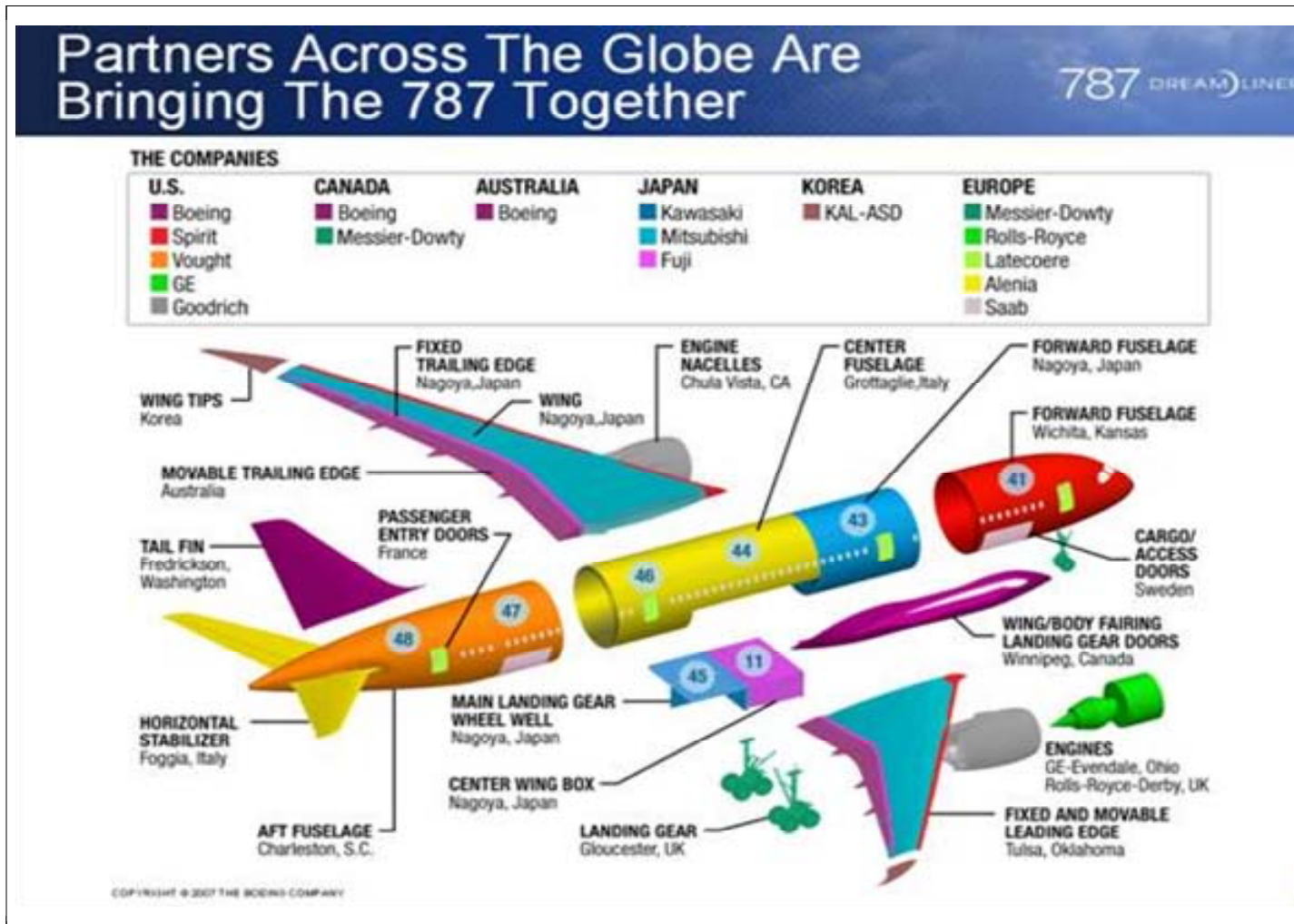
Consumer Products

Defense

Gas & Oil



# Aerospace: A “Networked” Product Lifecycle

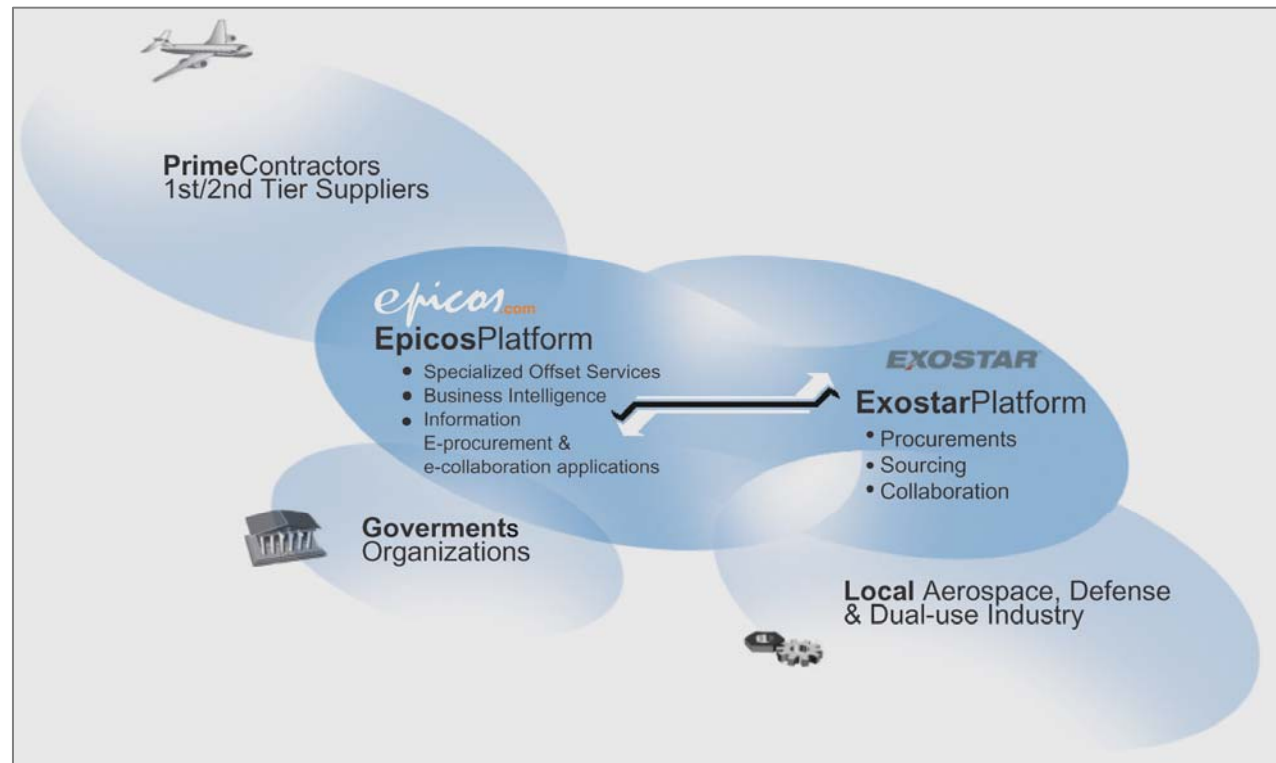


Source: Boeing

# Aerospace: Their response 10 years ago

- An industry-wide shared infrastructure and standards

Exostar:  
Formed as an independent company through partnership of Boeing, Lockheed Martin, Raytheon, and others in 2000



**EXOSTAR**® The Trusted Workspace for Global Partner Networks

epicos.com



# *How Does It Fit In?*

# Gartner Semantic Web Recommendations ...

## Recommendations

Consider using semantic technologies when one or more of the following criteria apply.

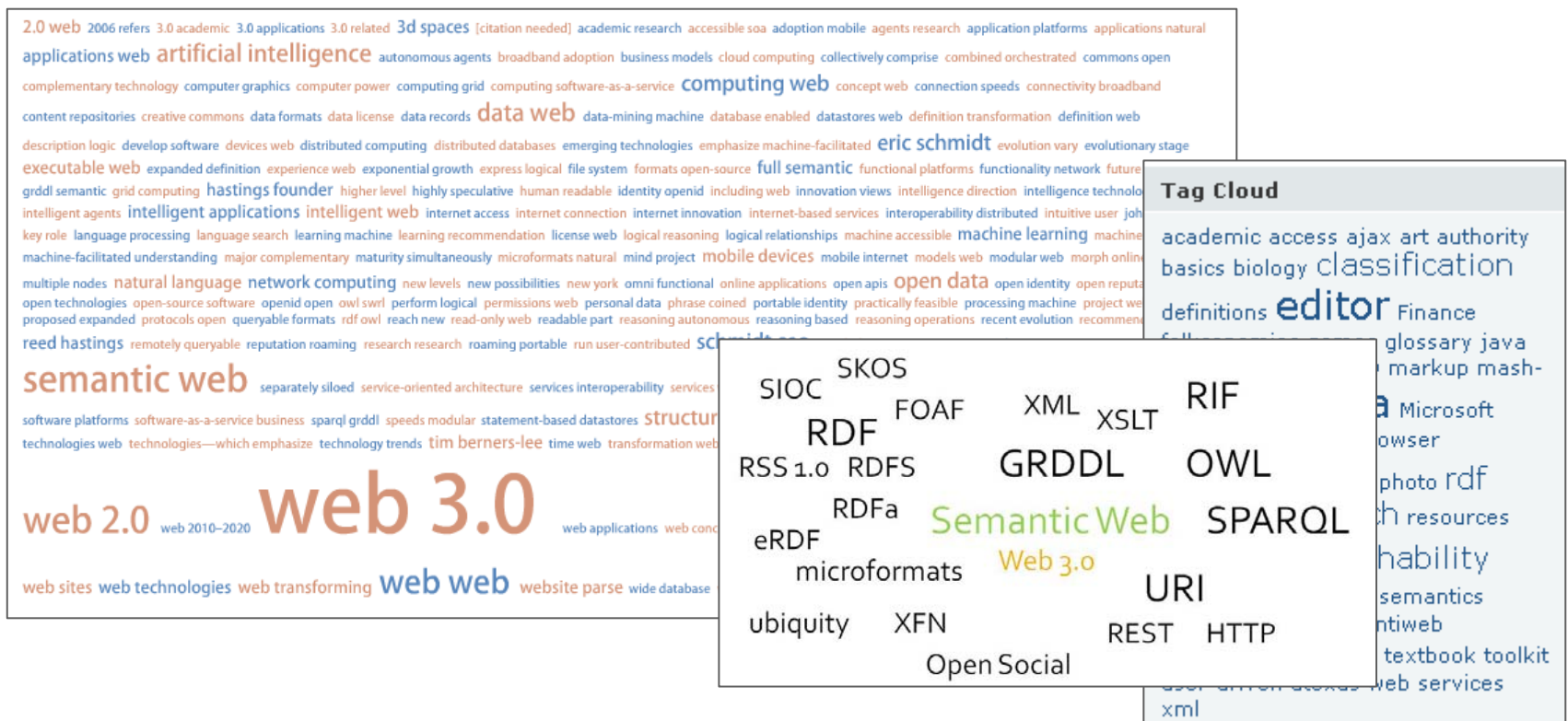
- Common semantic models are widely adopted in your industry.
- Human experts are very few or very expensive.
- There are expensive and recurring data quality issues.
- You have massive volumes of data needing categorization.
- Content security issues present a risk to your company.

## Did Gartner miss one?

- ***The Business Model is becoming “Networked”***

# Semantic Web on the Web

Searching across the www yields technical and scientific depth, but little business information or insight on how to exploit

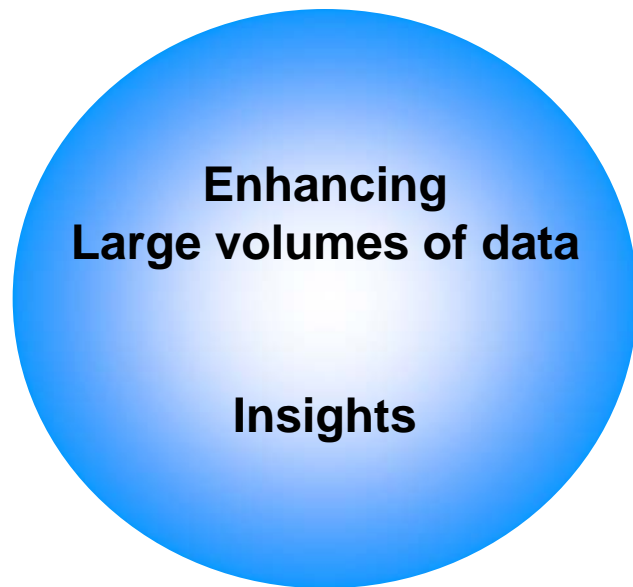


Sources: <http://manyeyes.alphaworks.ibm.com/manyeyes/visualizations/web-30-tag-cloud-3>  
<http://tivrious.wordpress.com/>  
[http://courses.ischool.utexas.edu/Turnbull\\_Don/2008/fall/INF\\_385T-SW/blog/](http://courses.ischool.utexas.edu/Turnbull_Don/2008/fall/INF_385T-SW/blog/)

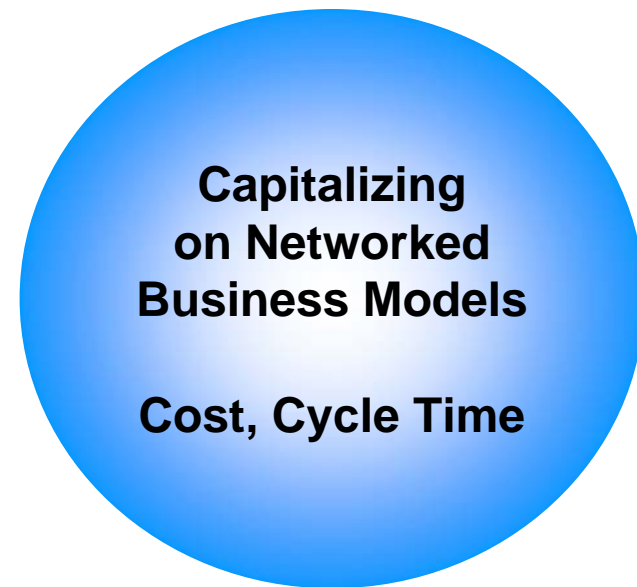


# The Semantic Web Potential

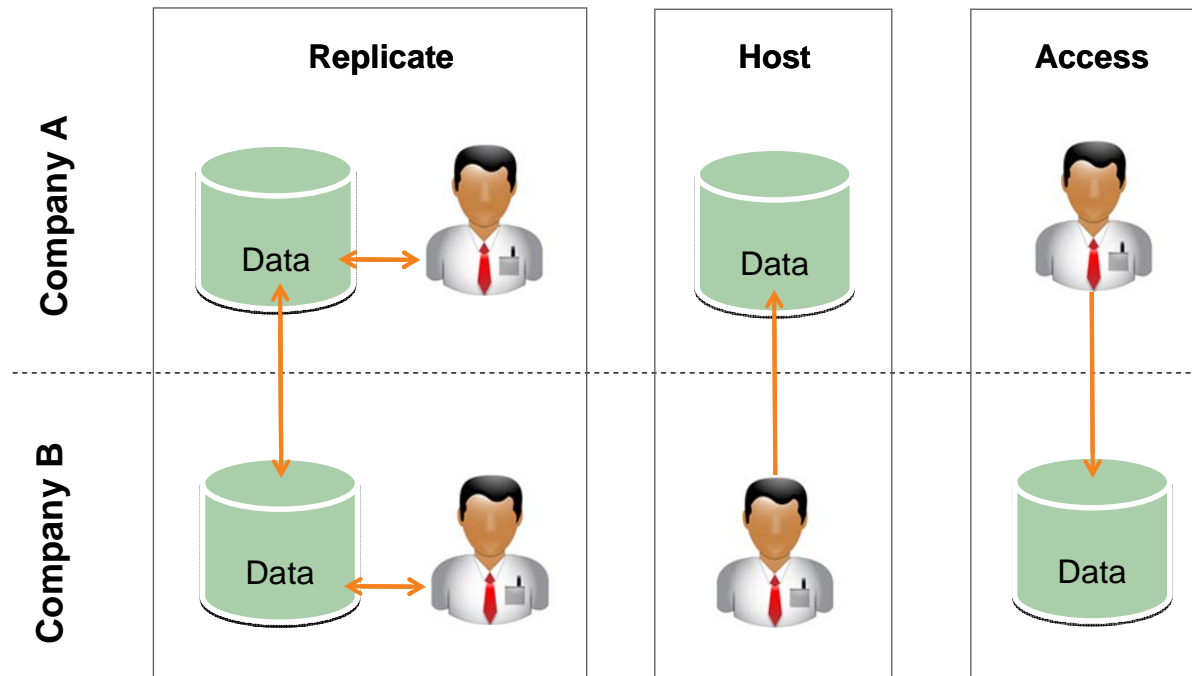
**Current Focus:  
Technology & Science**



**Tomorrow?  
Business of Science**



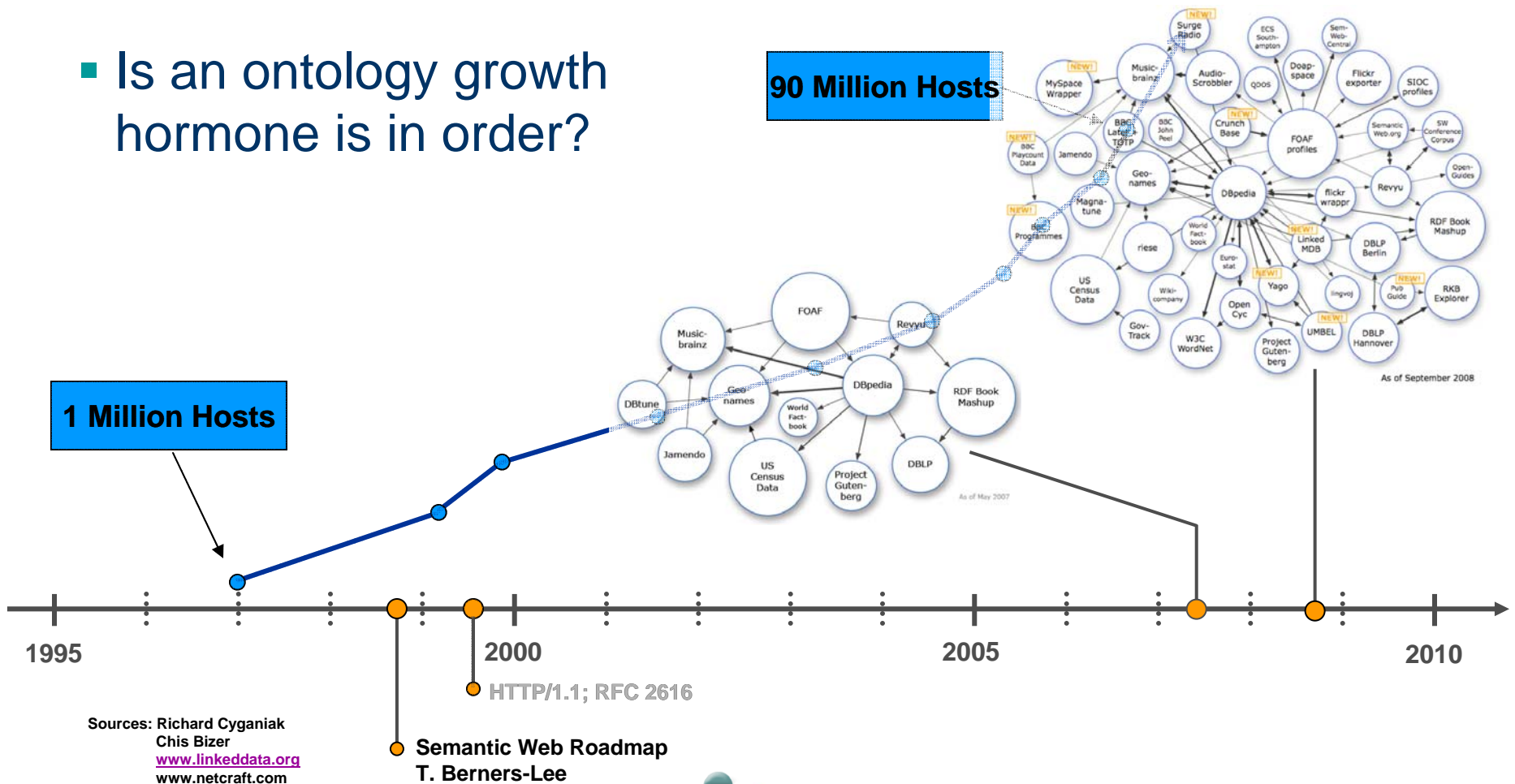
# The problem: If only it were this simple ...



- Transformation / integration of data, applications, and systems is costly and takes far too much time
- In the end ... it's all about the data!

# The ontology timeline

- A decade later (that's ten years)!
- Is an ontology growth hormone is in order?



Sources: Richard Cyganiak  
 Chis Bizer  
[www.linkeddata.org](http://www.linkeddata.org)  
[www.netcraft.com](http://www.netcraft.com)



# Is the balance of focus right?

SIOC SKOS  
 RDF FOAF XML XSLT RIF  
 RSS 1.0 RDFS GRDDL OWL  
 eRDF RDFa SemanticWeb SPARQL  
 microformats Web 3.0 URI  
 ubiquity XFN REST HTTP  
 Open Social

**technology**



**people**

**Information architecture**



trust?  
 privacy?  
 origin?  
 ...



ontologies,  
 ontologies,  
 ontologies  
 quality?  
 timeliness?  
 intended use?  
 ...



# Practical Example

- Leverage existing data
- Leverage existing tools / user interfaces
- Solve an immediate problem

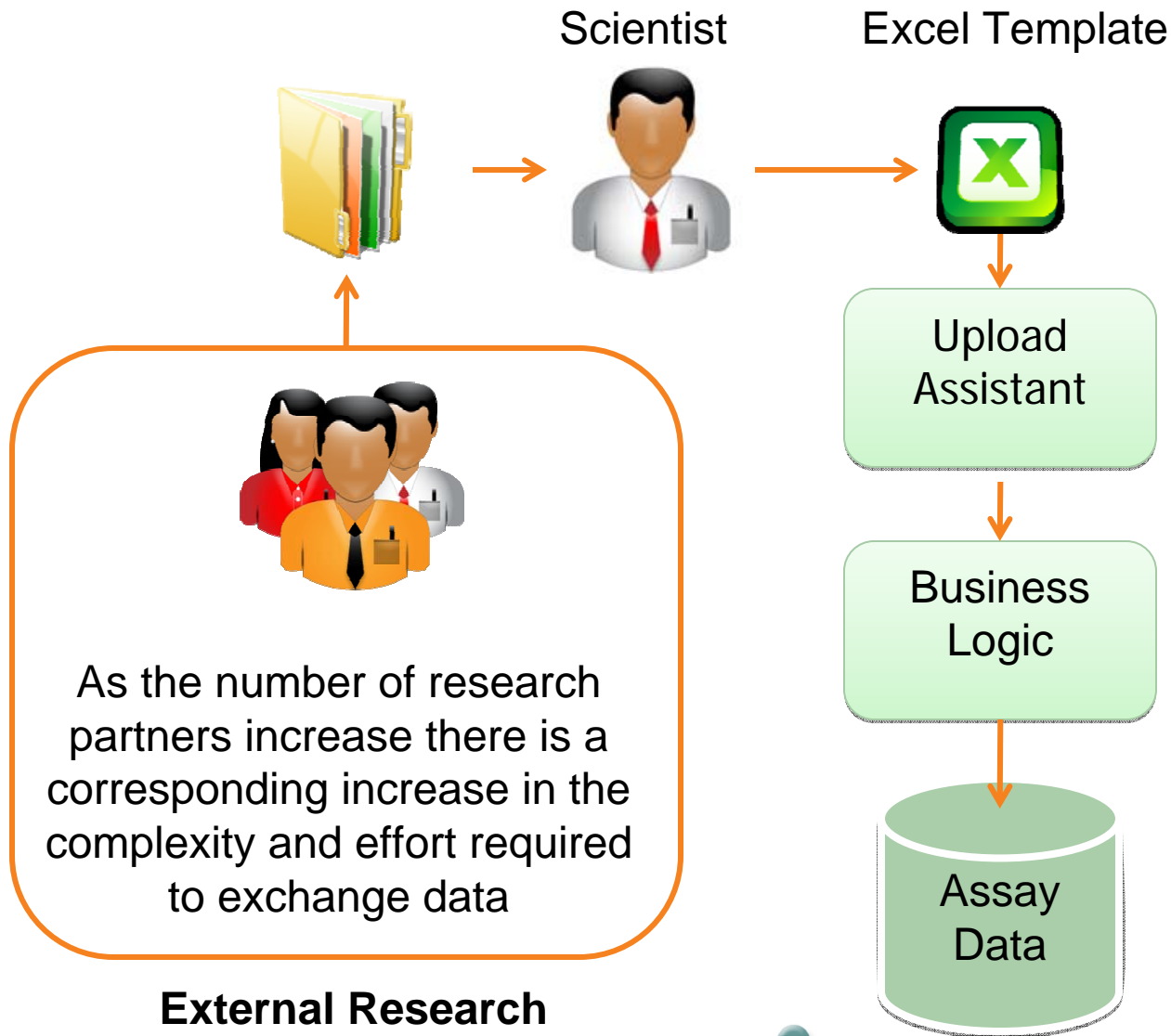
*An Innovation Experiment in collaboration with:*



REALIZING THE POTENTIAL

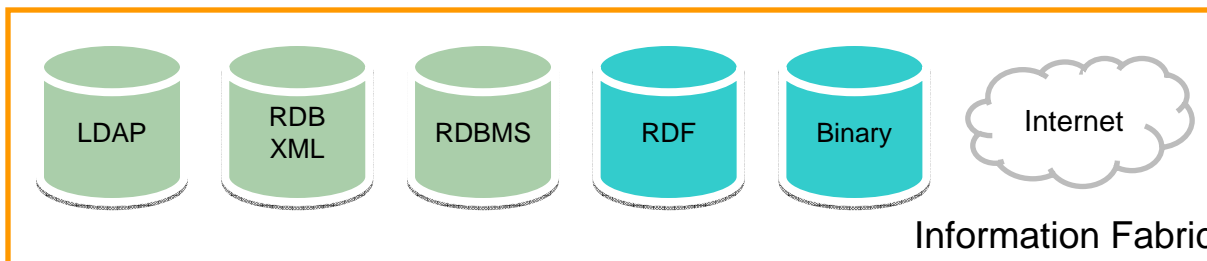
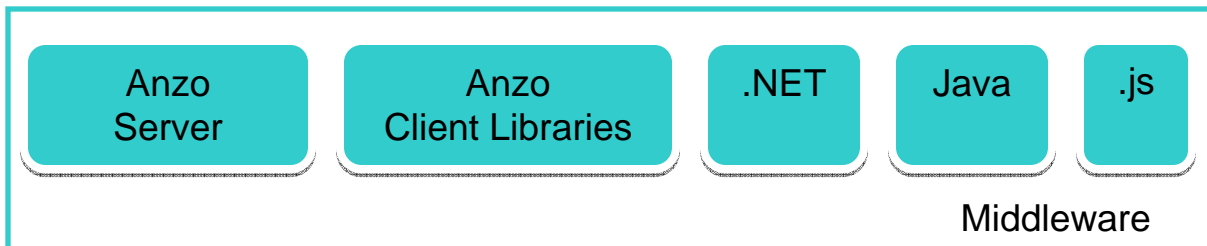
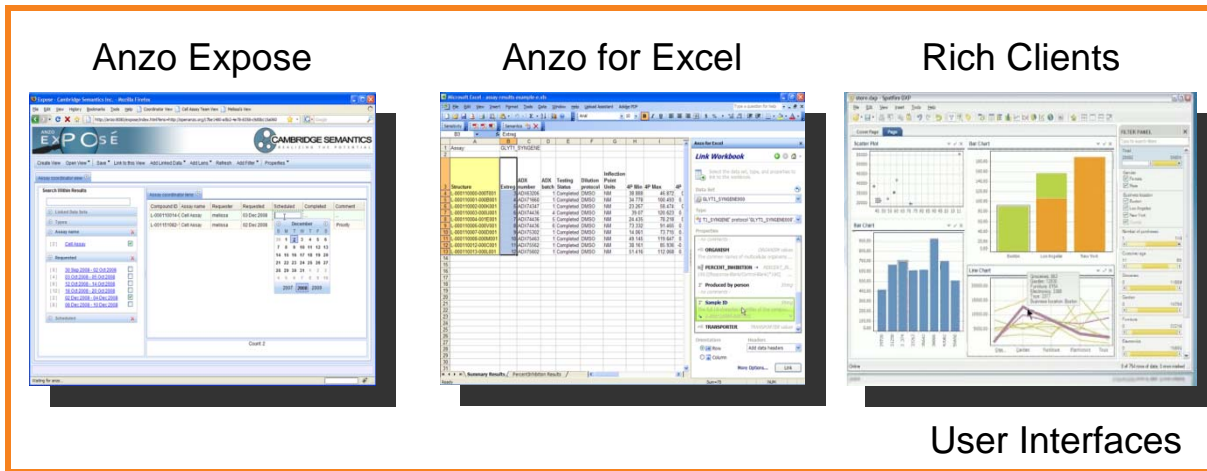


# Assay Data Upload Use Case ... $n^2$ problem



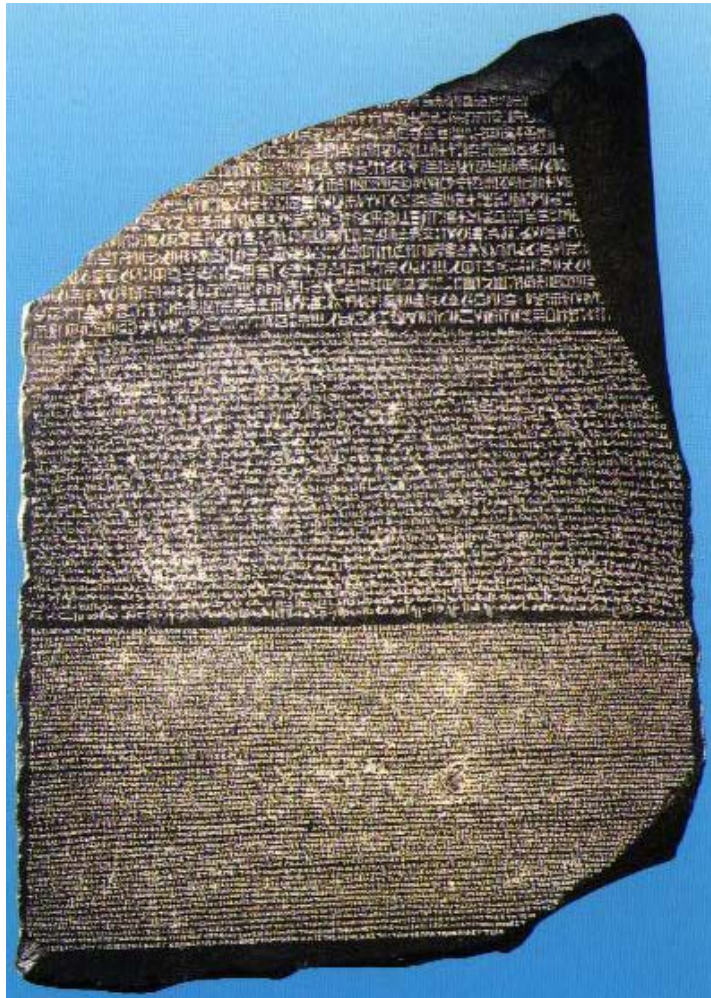
- Custom template needs to be created to format data for upload
- Limited ability for ad-hoc collaboration between teams
- No automated capability for collecting data with external parties

# Anzo Semantic Integration



- Flexible data models to enable research – No change to native data formats required
- “Information Fabric “ to facilitate integration and transformation of data
- Overlay architecture to extend capabilities and leverage investments for existing systems
- Removes data silos and enables collaboration

In closing ...



*Questions?*