Large Volumes, Big Data and Advanced Analytics in Exploration and Production

Wilfredo Lee / AP

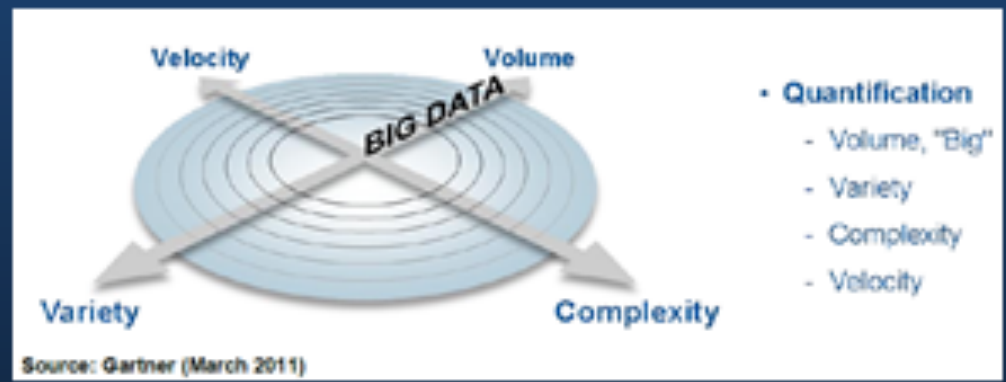
Chevron is considering a $40 million investment to produce 3 billion barrels of oil.

The Oil Industry is High Tech

Big Data Challenges are More Than Data Size

And require new technologies like MapReduce

The Four Axes of Big Data



- **Quantification**
  - Volume, "Big"
  - Variety
  - Complexity
  - Velocity

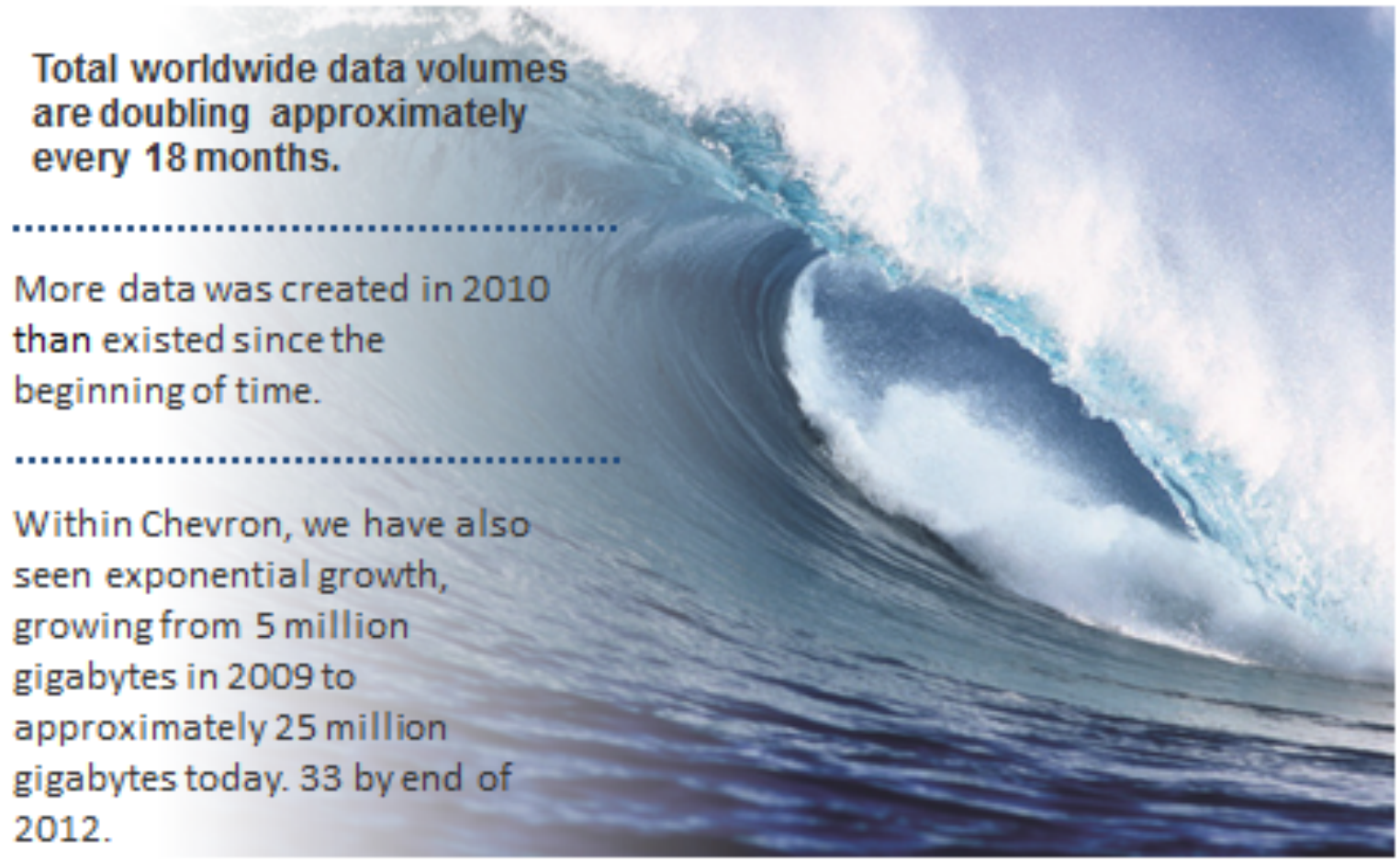
"CIOs face significant challenges in addressing the issues surrounding big data…

New technologies and applications are emerging (examples include Hadoop and MapReduce)

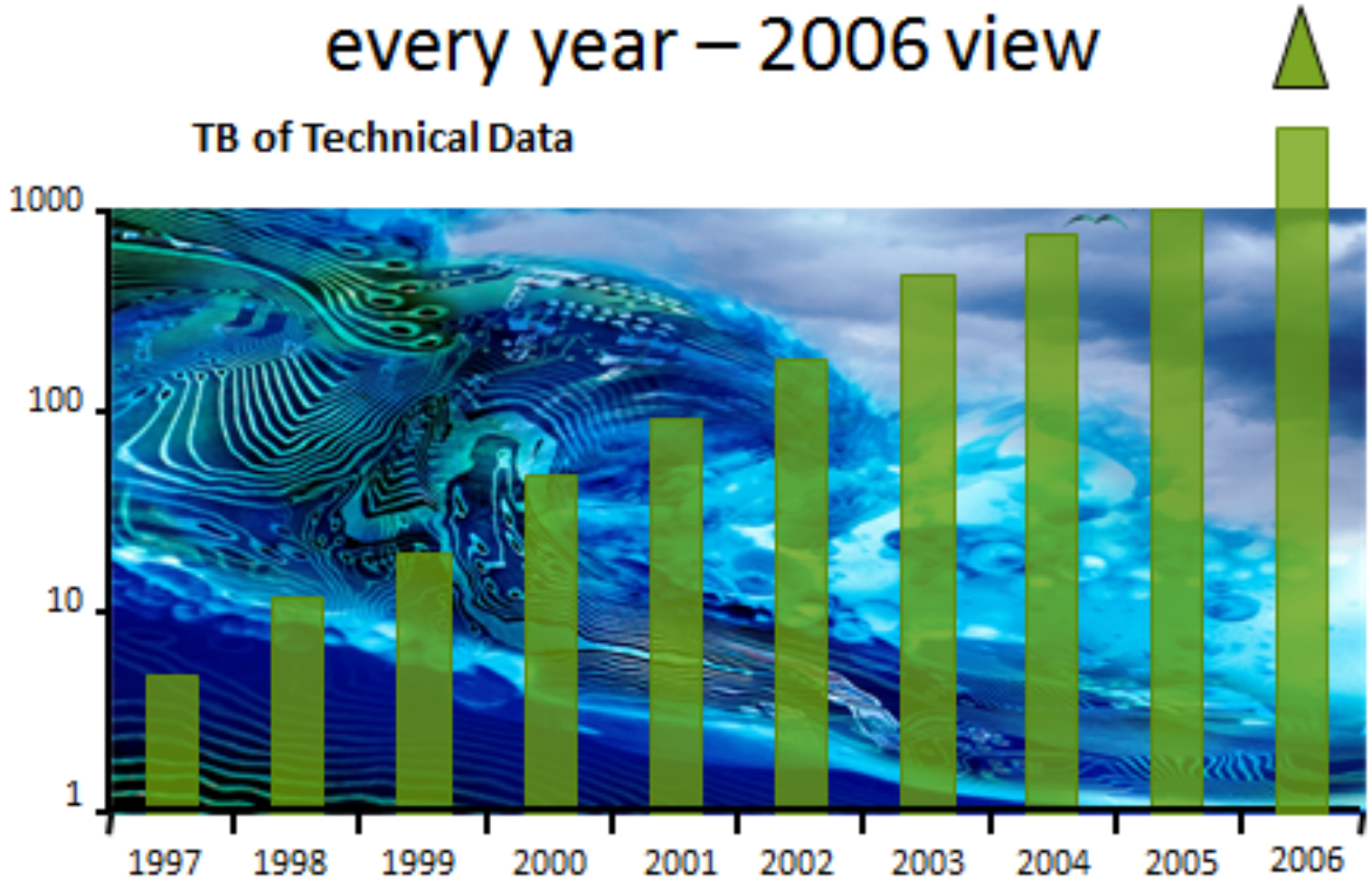
and should be investigated to understand their potential value."

Source: CEO Advisory: 'Big Data' Equals Big Opportunity, Gartner, 31 March 2011.

Digital Deluge

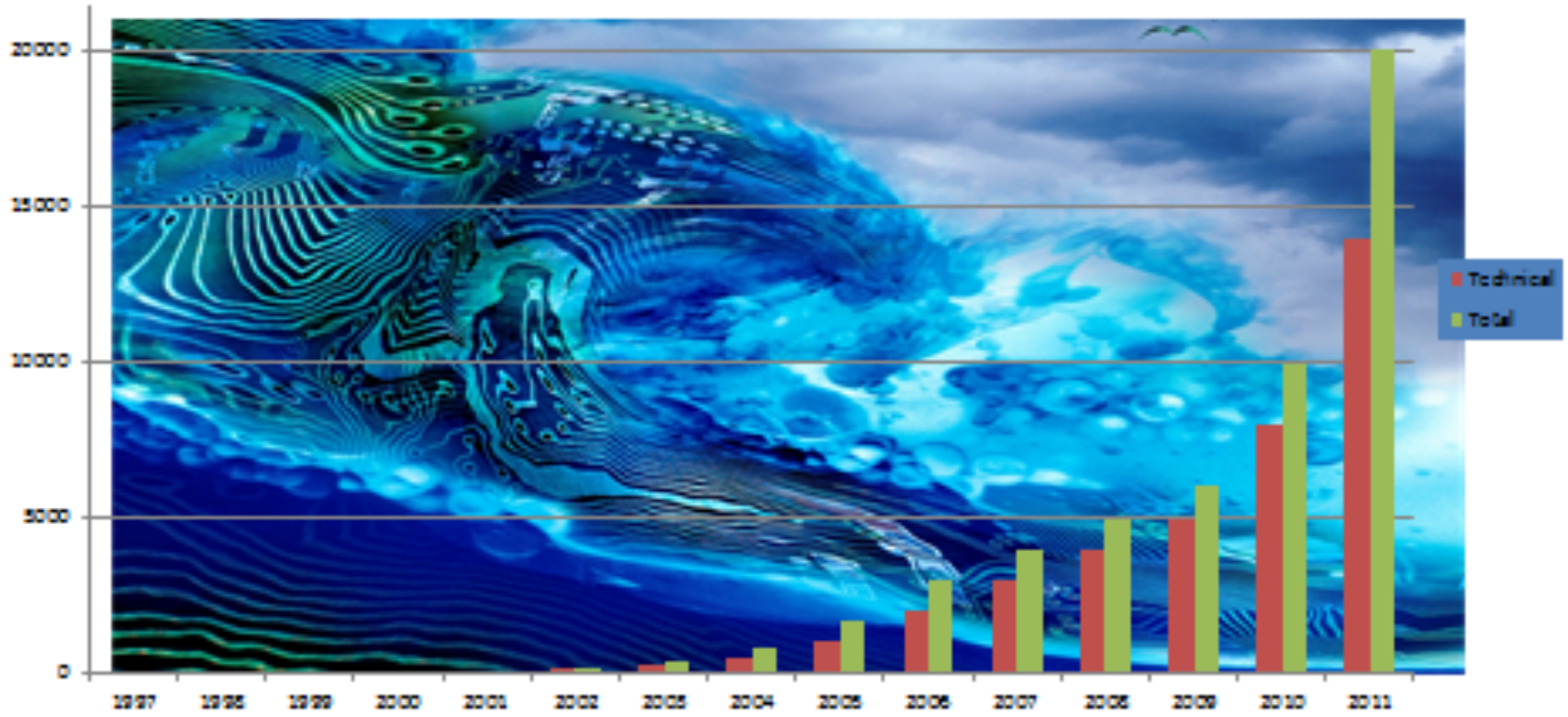


Chevron's data storage is doubling every year – 2006 view

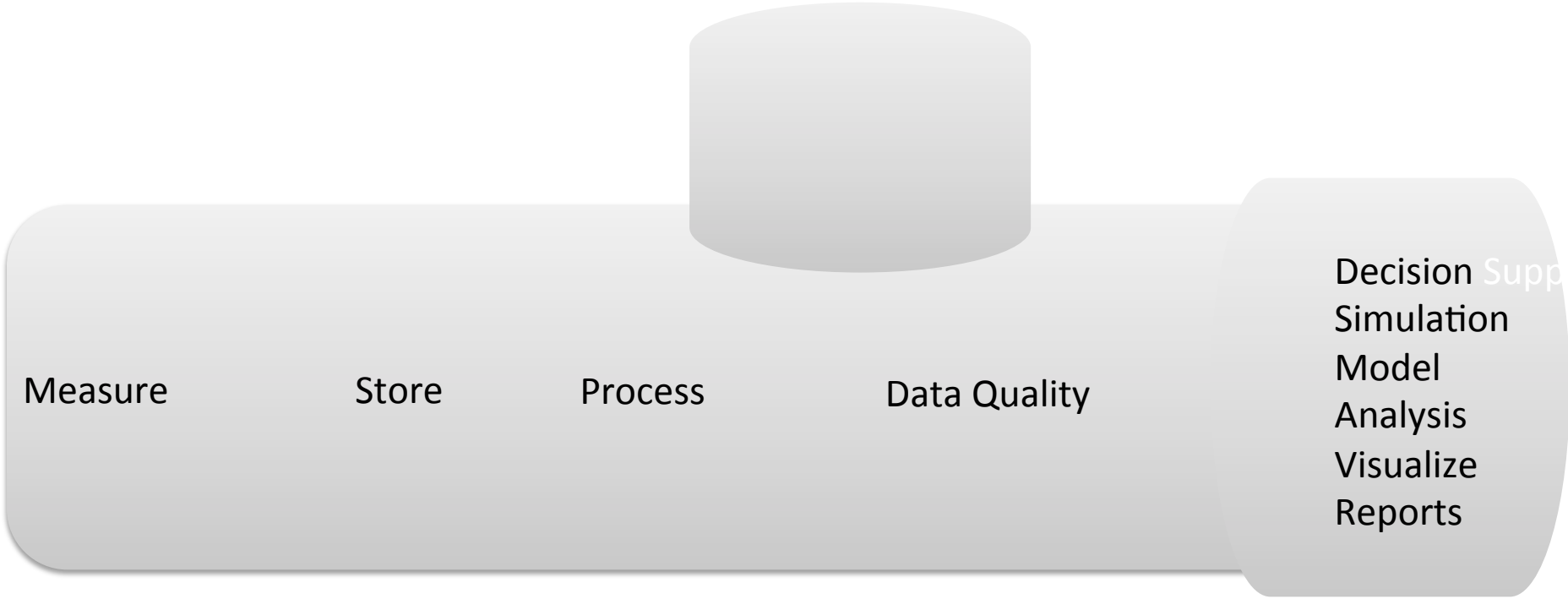


Total Data Volumes (rough estimate)

Grown about 10x since 2005, back to doubling yearly

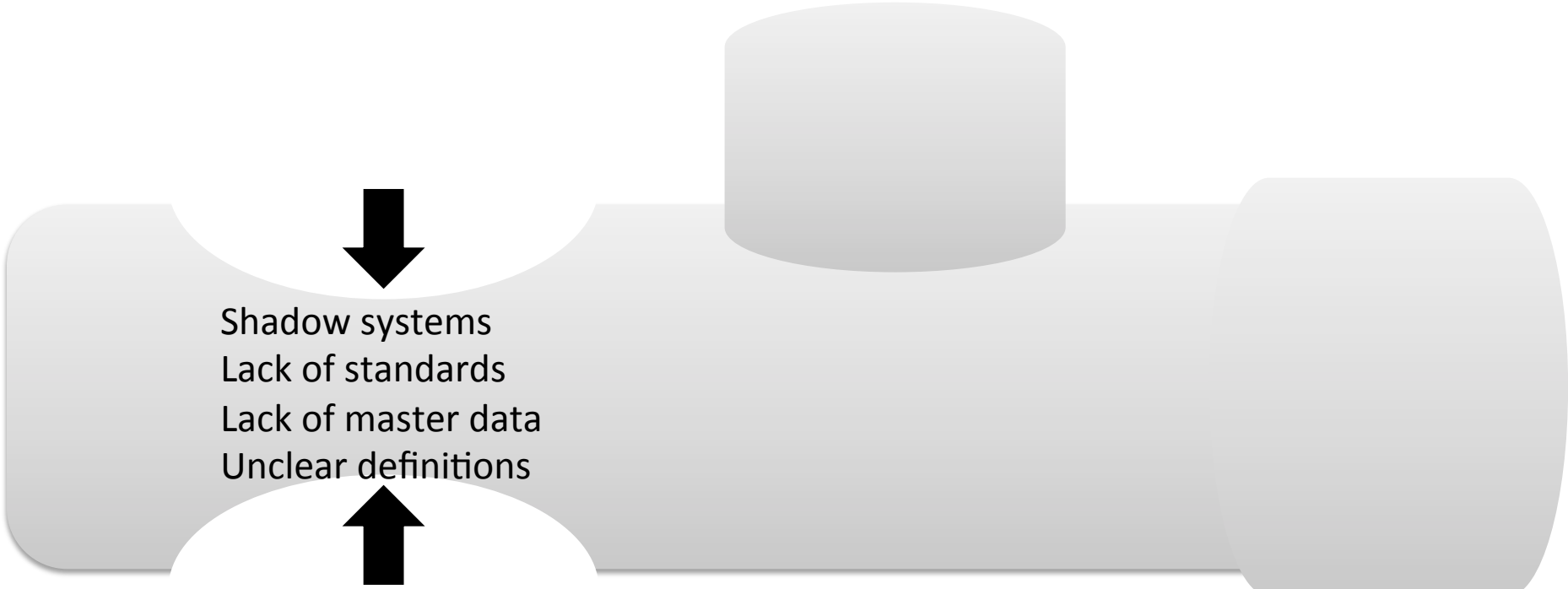


The Information Pipeline



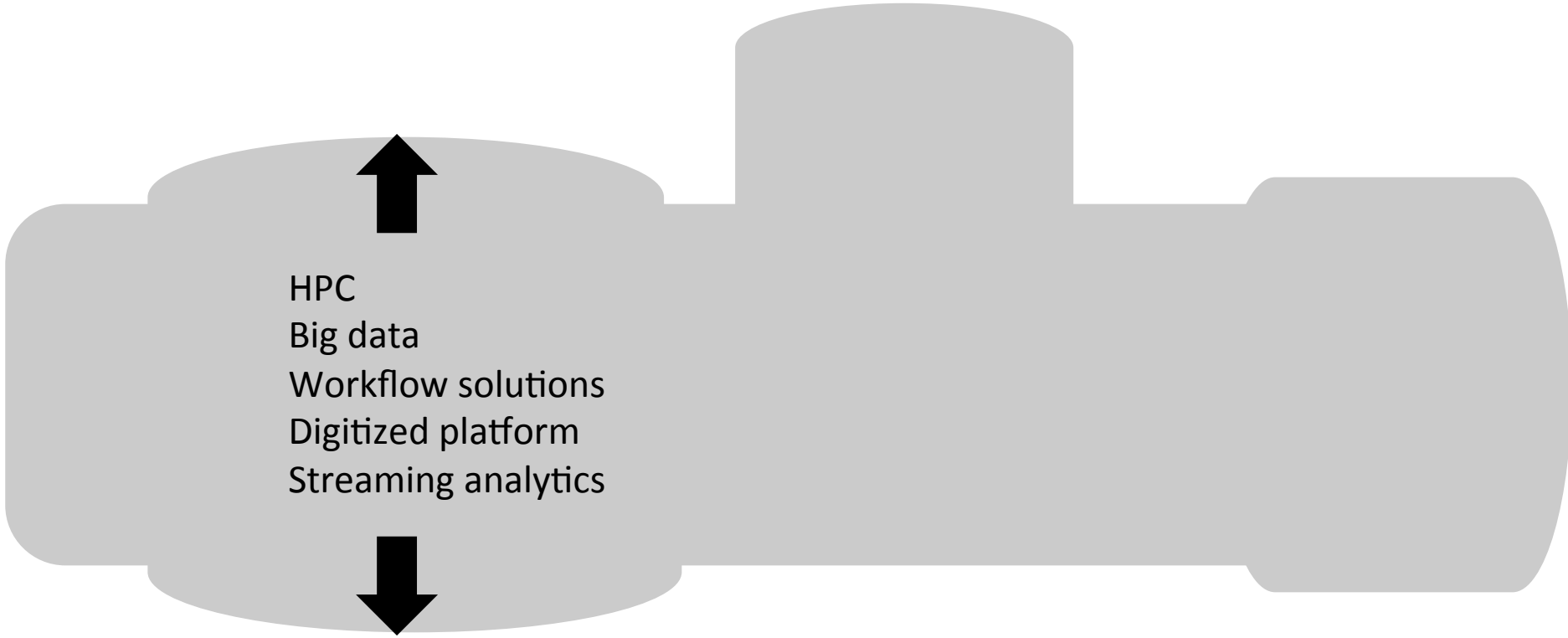
Fully Instrumented Facility

Barriers To Information Flow

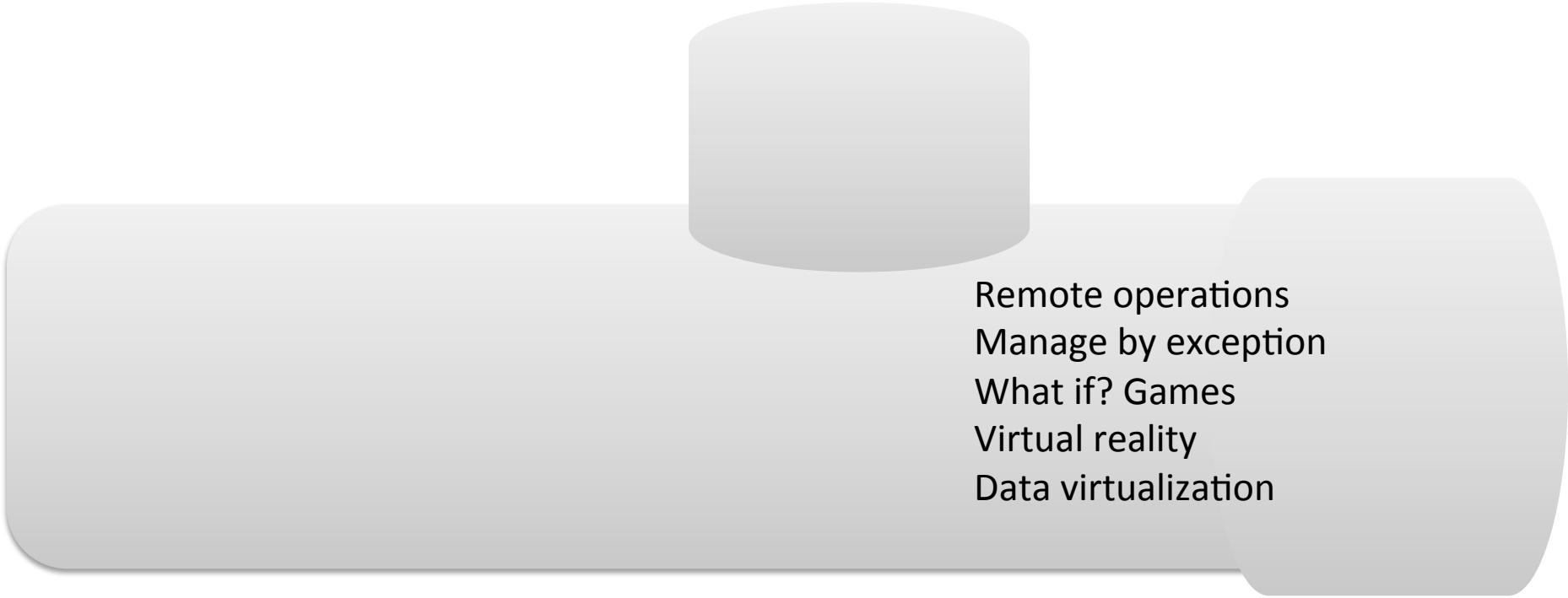


Where do you go to find information?

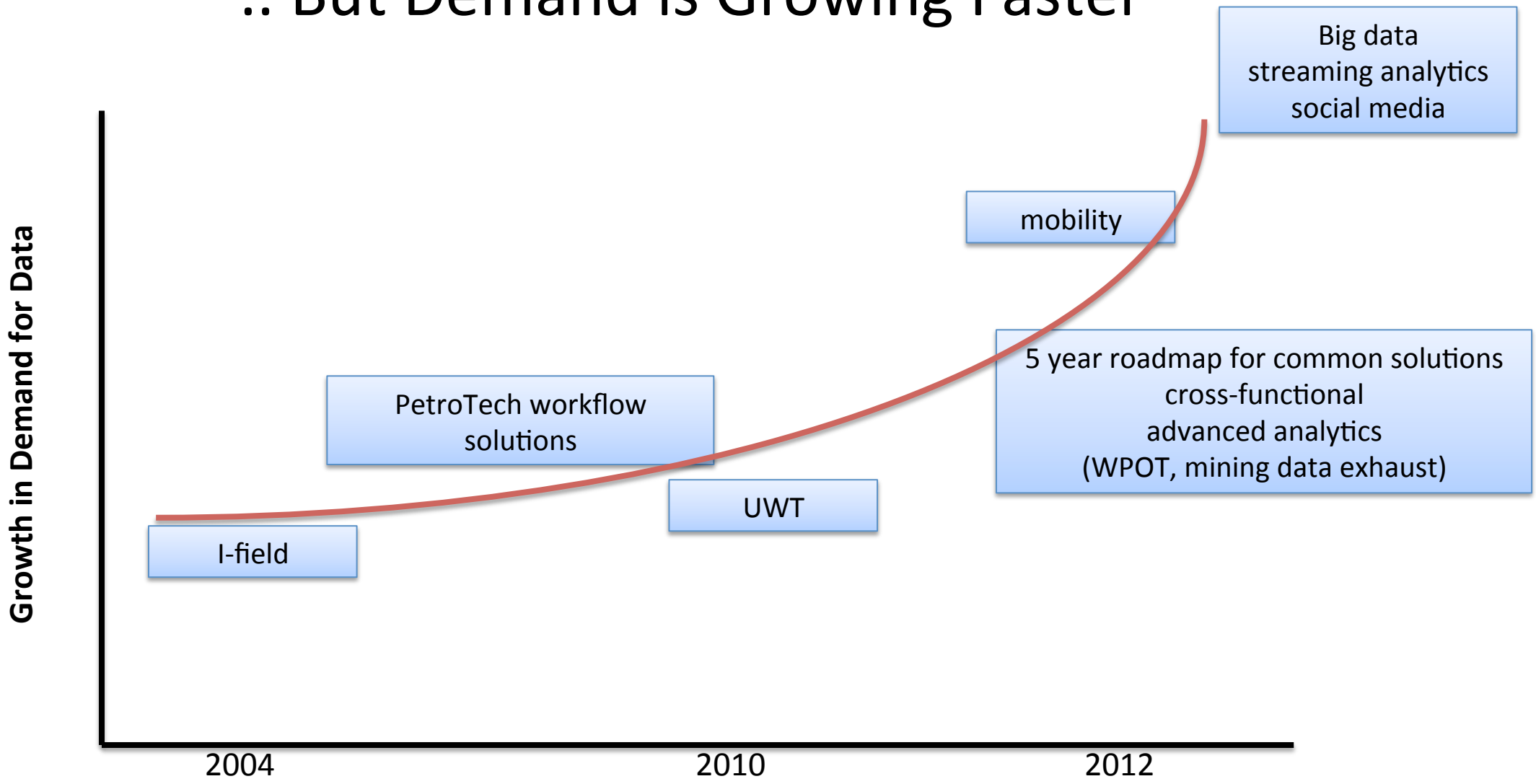
High Performance Computing



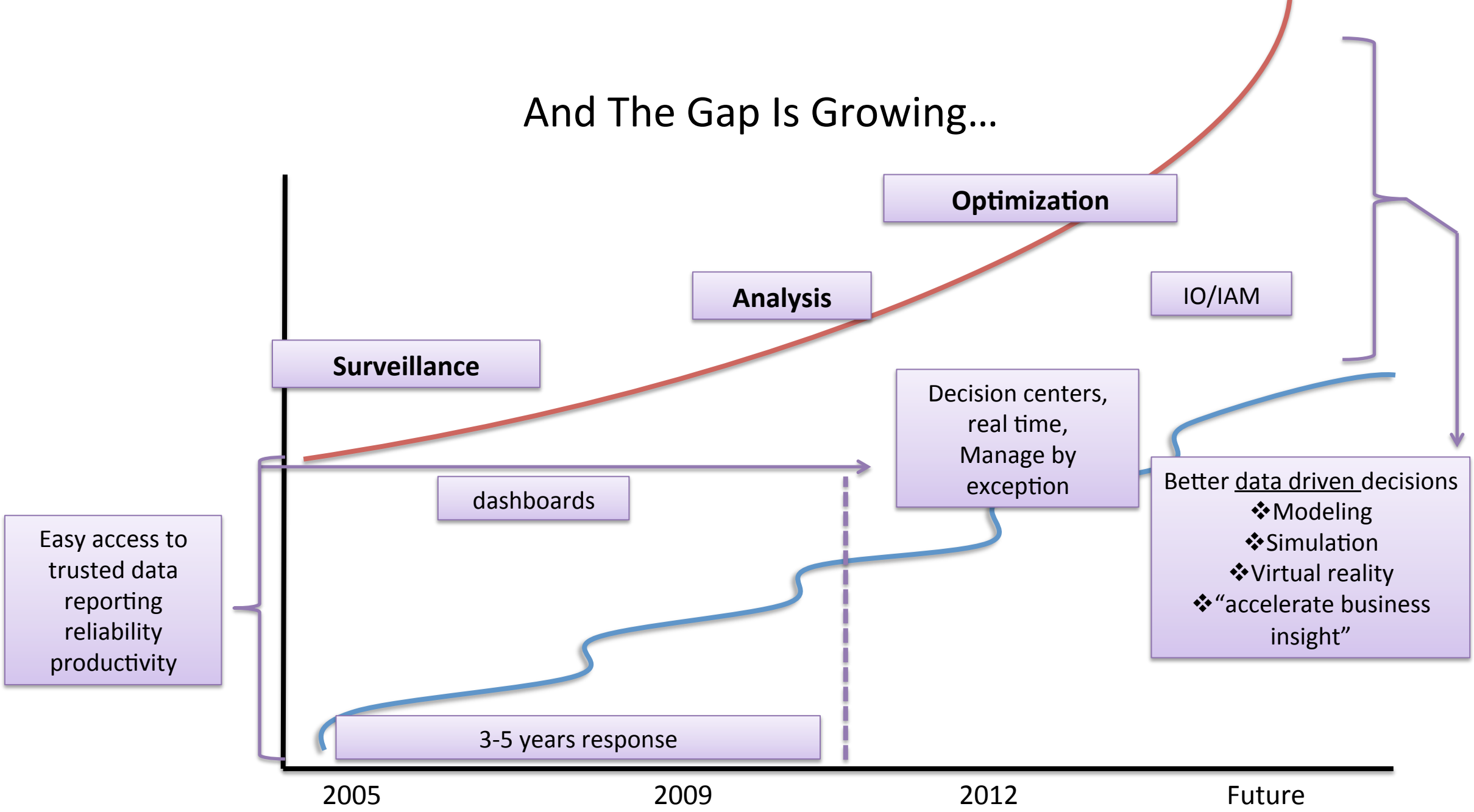
What Will The Future Bring?



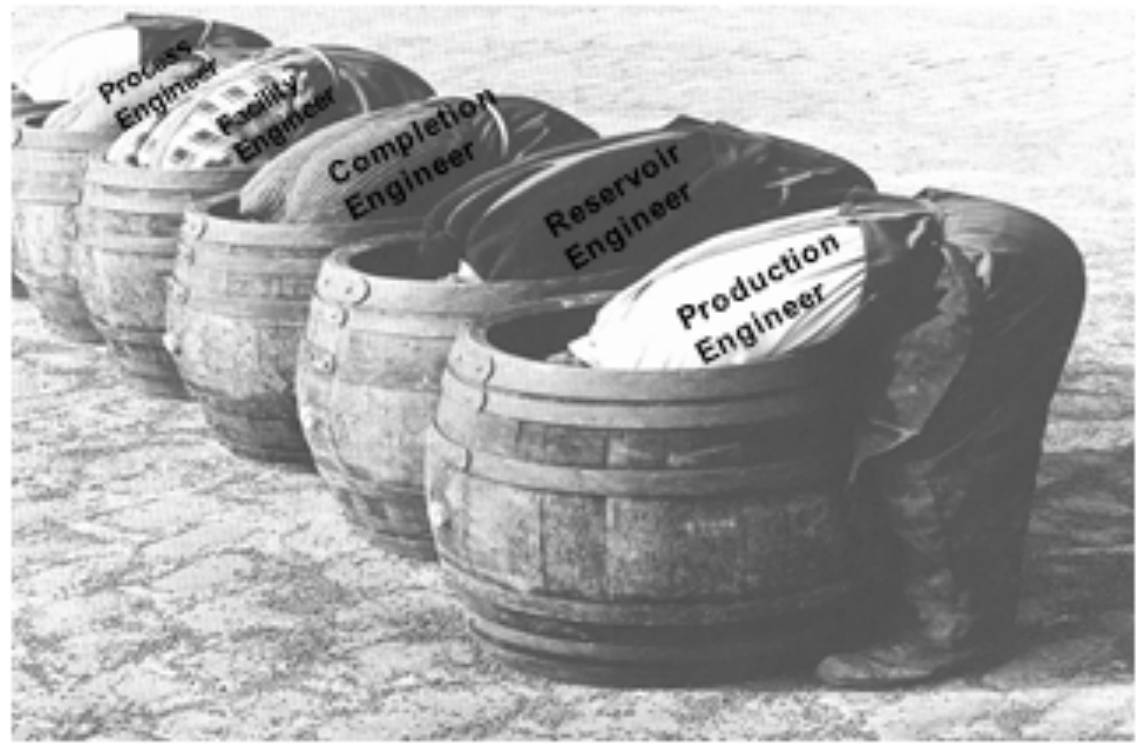
.. But Demand is Growing Faster



And The Gap Is Growing…



Work Process Change
The Challenge of Integration

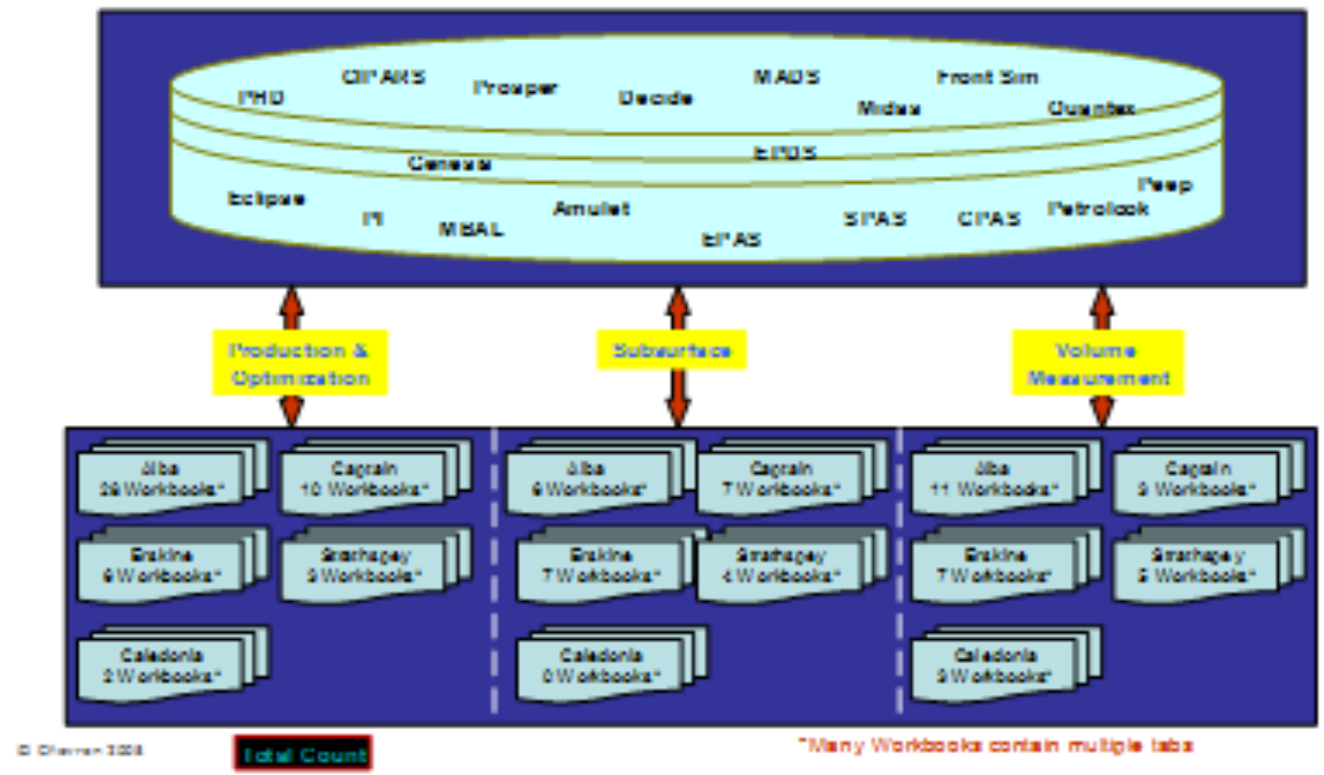


Tearing down the fences between professions is only possible if the technological barriers are removed

Adapted from Adolfo Henriquez

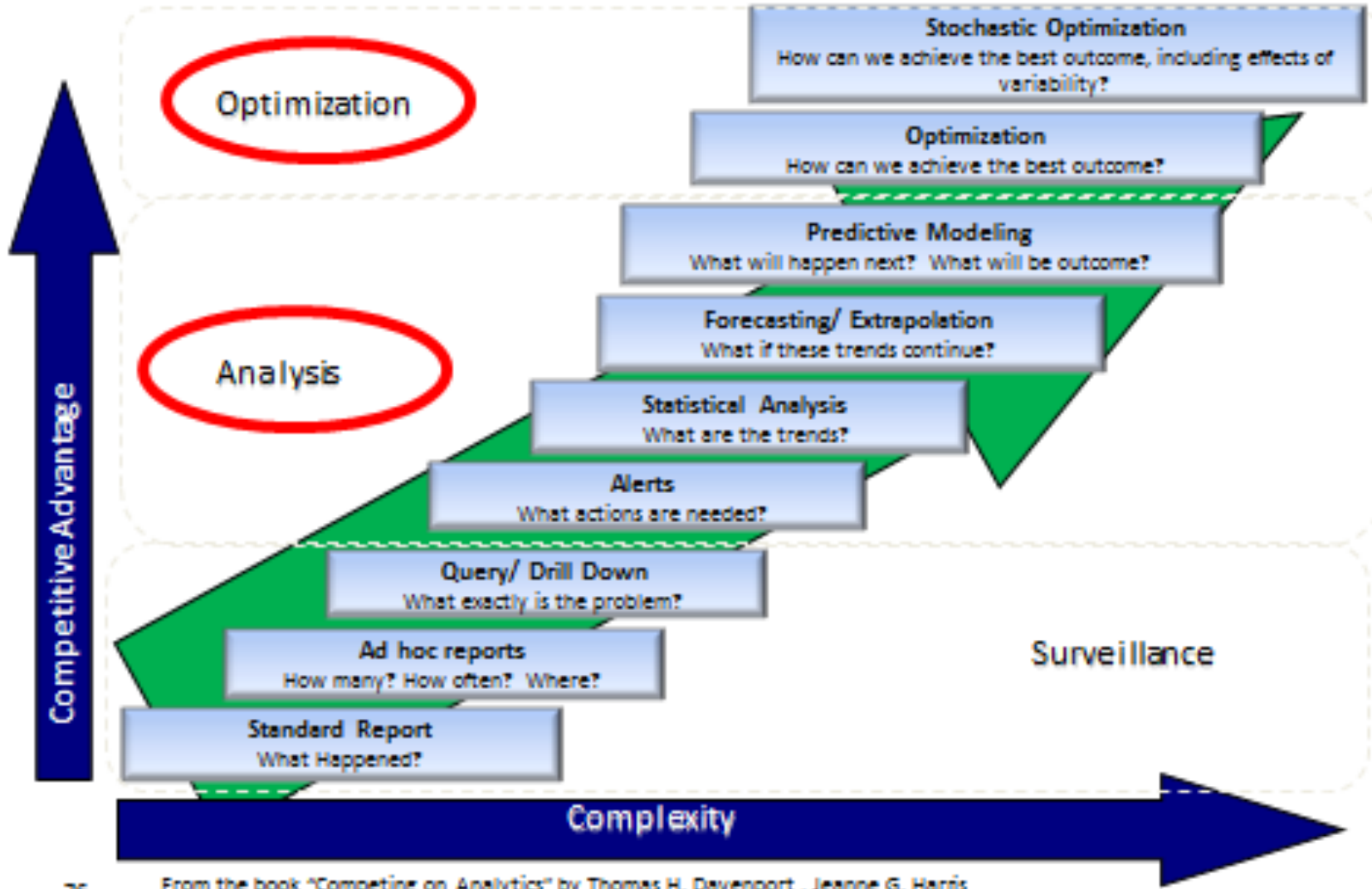
The Whole Truth

Current Environment – World of Excel



What is Modeling and Analytics?

When is Modeling and Analytics applied?



From the book "Competing on Analytics" by Thomas H. Davenport , Jeanne G. Harris

Analytics – Current State at Chevron

Stage 1: Analytically Impaired

Organization lacks one or several of the prerequisites for serious analytical work, such as data, analytical skills, or senior management interest

Stage 2: Localized Analytics

There are pockets of analytical activity within the organization, but they are not coordinated or focused on strategic targets

Stage 3: Analytical Aspirations

The organization envisions a more analytical future, has established analytical capabilities, and has a few significant initiatives under way, but progress is slow – often because some critical DELTA factor has been too difficult to implement

Stage 4: Analytical Companies

The organization has the needed human and technological resources, applies analytics regularly, and realizes benefits across the business. But its strategic focus is not grounded in analytics, and it hasn't turned analytics to competitive advantage.

Stage 5: Analytical Competitors

The organization routinely uses analytics as a distinctive business capability. It takes an enterprise-wide approach, has committed and involved leadership, and has achieved large-scale results. It portrays itself both internally and externally as an analytical competitor

Three Analytical Camps in Upstream

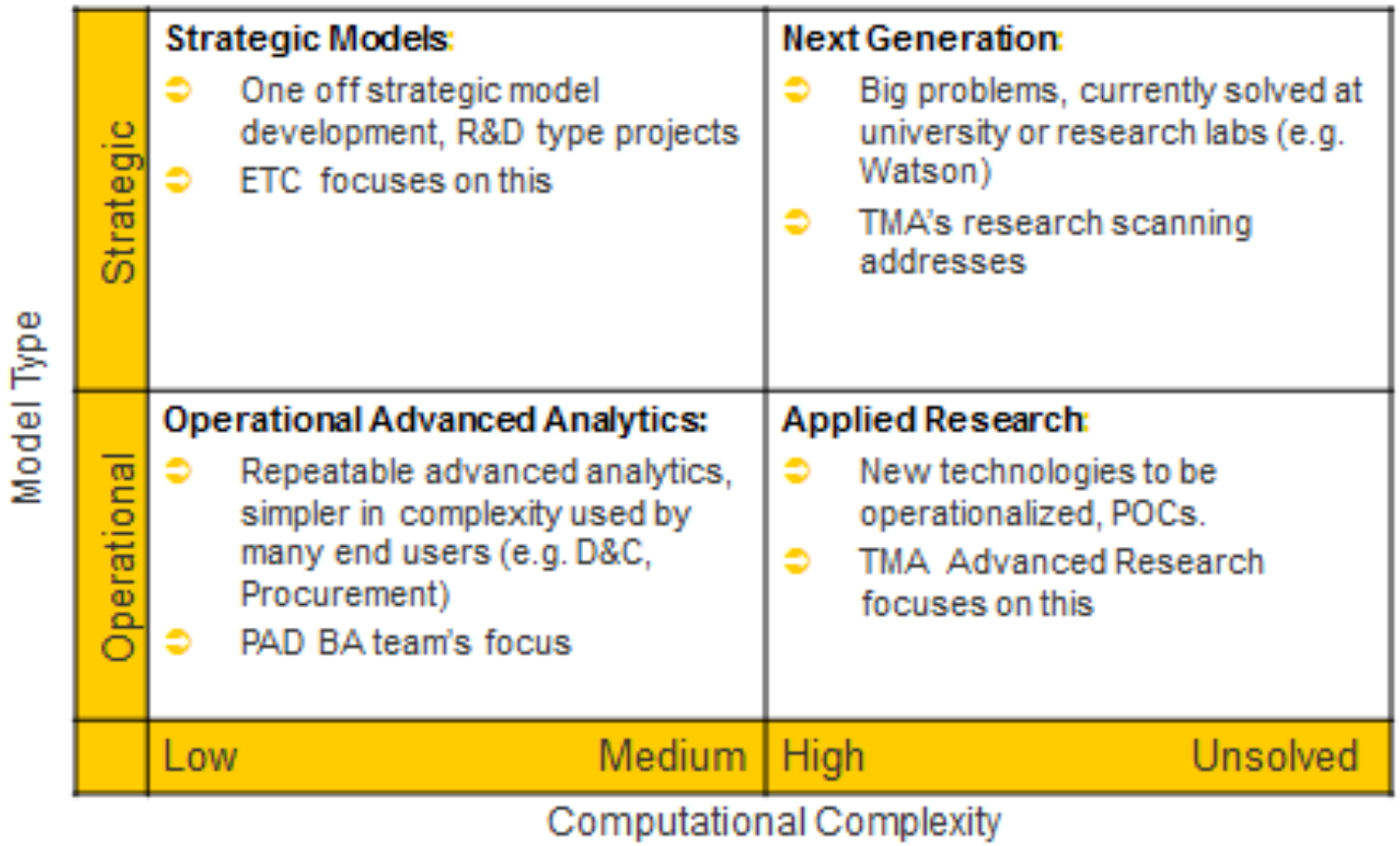
- The "Wizards": physics 1st principle based (D'Arcy's Law, Mass Balance; Chears, Eclipse, Intersect, Hysis)
- The "Statisticians": data driven proxy models (SmartSignal)
- The "Analysts": skip the models, drive right to the specific analysis (Bubble Maps for waterflood pattern analysis)

Business Challenges

Applications of Modeling and Analytics

- Predicting equipment failures
- Mining volumes of data for insights
- Scheduling:
  - Rigs
  - Drill ships
  - Tankers
- Planning:
  - Portfolio optimization
  - Facilities Usage Planning
  - Water Injection Planning
- Blending

Role and Space Definition for Advanced Analytics @ Chevron



Digital Exhaust –

Digital Information created as a result of doing something.

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01100101 01100001 01110010
00100000 01101100 01100101
01100001 01100100 01100101
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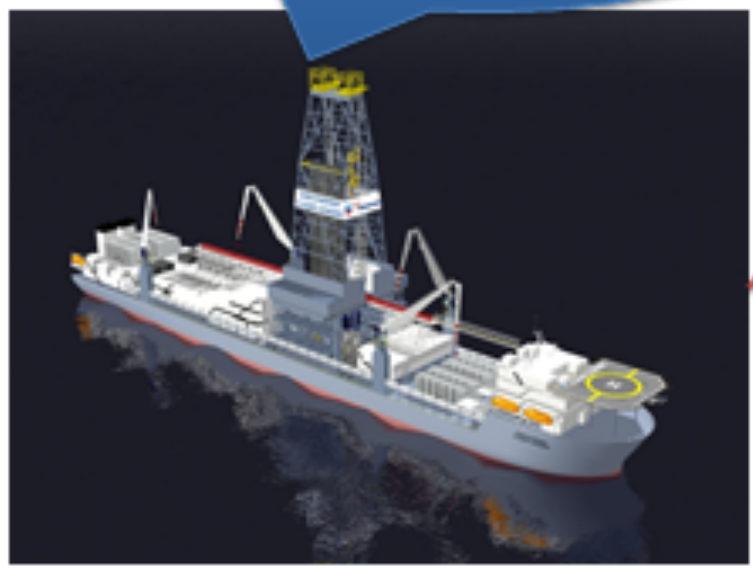

Digital Asset

Physical Asset

Analytics in Exploration & Production

- Seismic
- Drilling Complex Wells
- Production Optimization (Heavy Oil)
- Advanced Process Control
- Common Earth Model/ Reservoir Simulation
- Integrated Operations

Digital Oil Field: The "Fourth Paradigm"

- Thousand years ago science was empirical: describing natural phenomena
- Last few hundred years theoretical branch: using models, generalizations
- Last few decades a computational branch" simulating complex phenomena
- Today: data explosion (eScience) unify theory, experiment and simulation
  - Data captured by instruments or generated by simulator
  - Processed by software
  - Information/knowledge stored in computer
  - Scientist analyses database/files using data management and statistics