FORUM PA 2012

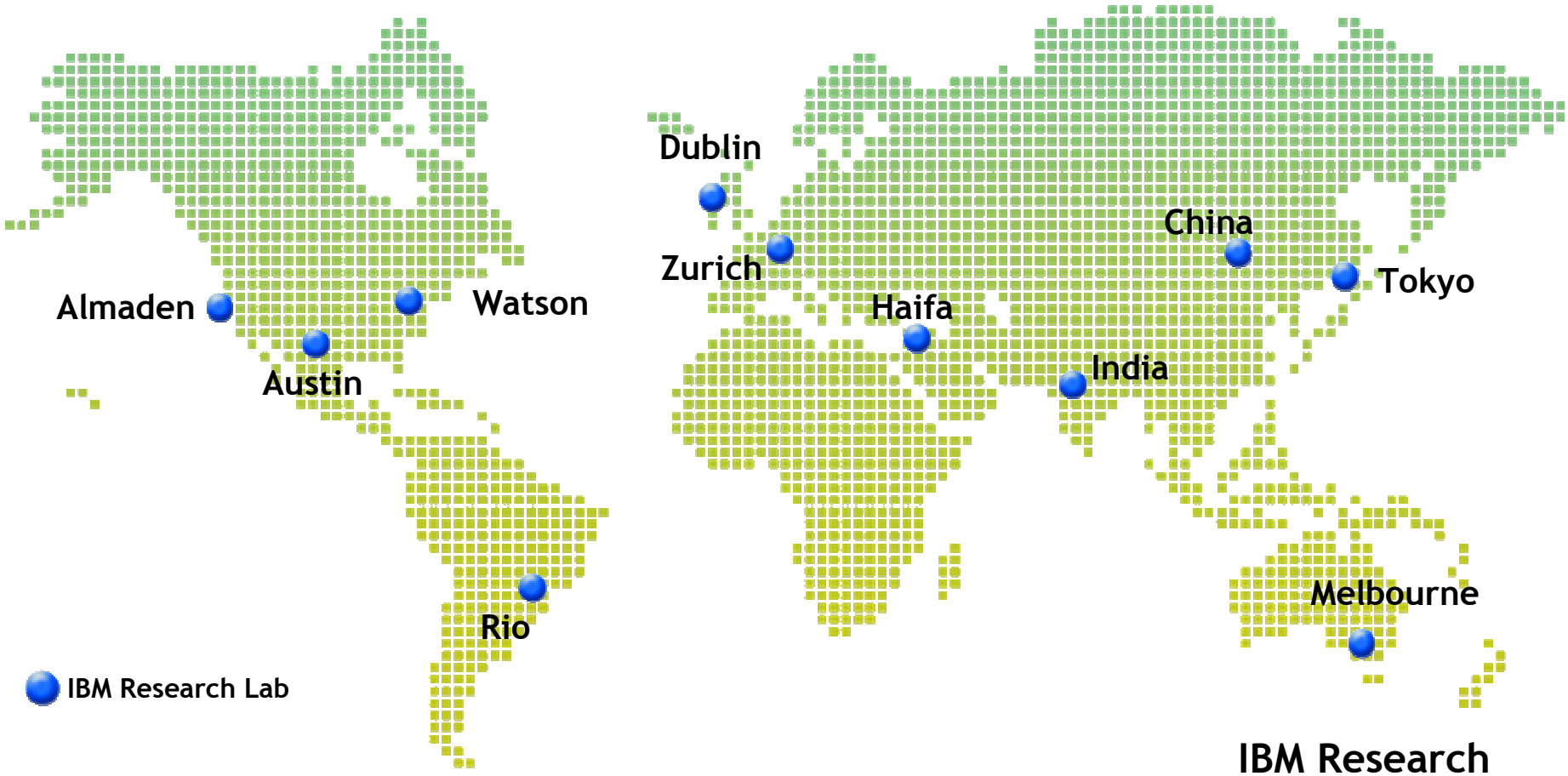
Roma, 16 - 19 maggio

UN PIANETA PIÙ INTELLIGENTE IN AZIONE

Agenda Digitale, percorsi di innovazione per la crescita

Giuseppe Radicati
IBM Research

UN PIANETA PIÙ INTELLIGENTE IN AZIONE



IBM Research

Largest IT research organization worldwide
More than 3,000 scientists and engineers at 11 labs in 9 countries
Almost $6B on R&D in 2010

Delivering a Culture of Innovation

5 Nobel Laureates

Scanning Tunneling Microscope

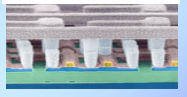
High Temperature Superconductivity

Electron Tunneling Effect

9 US National Medals of Technology

Copper Chip Technology

Silicon-on-Insulator



SiGe

DRAM

5 National Medals of Science

Nuclear Magnetic Resonance Techniques

Basis for MRI today

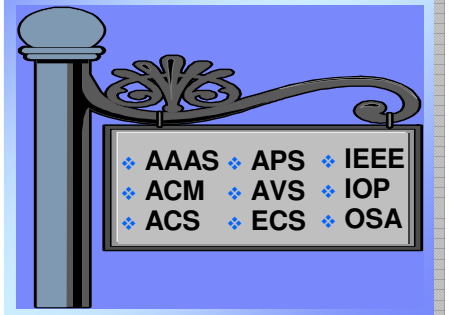
6 Turing Awards

High Performance Computing

First woman recipient in the history of this prestigious ACM award

22 Members in National Academy of Sciences

Over 400 Professional Society Fellows

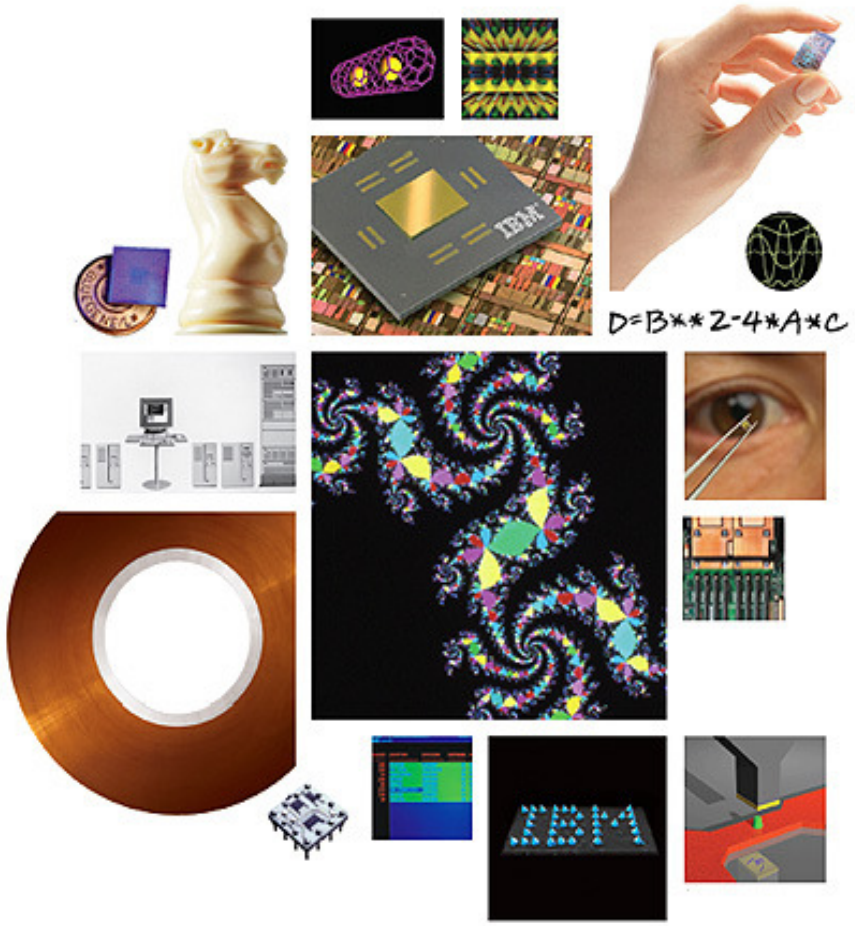


64 Members in National Academy of Engineering

11 Inductees in National Inventors Hall of Fame

Laser-etched hair based on excimer laser surgery - foundation for LASIK surgery

A legacy of world-class research

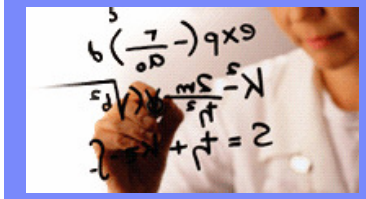


2011	Watson
2009	Nano MRI
2008	World's First Petaflop Supercomputer
2007	Web-scale mining
2006	Core XML Standards
2006	Services Science (SSME)
2005	Cell
2004	Blue Gene/L
2003	Carbon Nanotubes
2000	Java Performance
1997	Copper Interconnect Wiring
1997	Secure Internet Communication (HMAC & IPsec)
1997	Deep Blue
1994	Design Patterns
1994	Silicon Germanium (SiGe)
1990	Statistical Machine Translation
1987	High-Temperature Superconductivity
1986	Scanning Tunneling Microscope
1980	RISC
1971	Speech Recognition
1970	Relational Database
1967	Fractals
1966	One-Device Memory Cell
1957	FORTRAN
1956	RAMAC

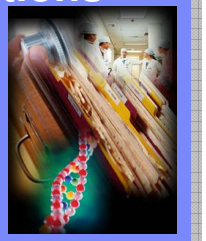
Research's Strategic Disciplines

Exploratory

Business Analytics & Math. Sciences

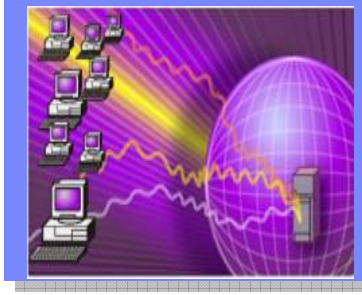


Industry Solutions

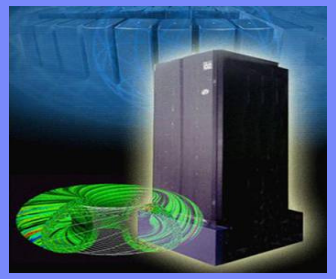


Services

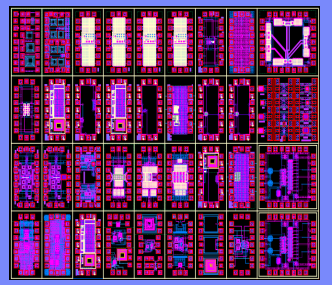
Software



Systems



Technology

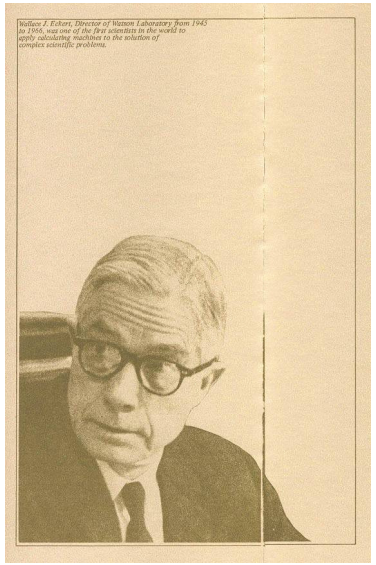


1945: Opening the Watson Scientific Computing Laboratory at Columbia University

- equipped with IBM machines to "*serve as the world center for the treatment of problems … whose solution depends on the effective use of applied mathematics and mechanical calculations*."

"carry out scientific research where the efforts are dictated by the interest in the problem, and not by any external considerations."

Wallace J. Eckert, director of IBM Research

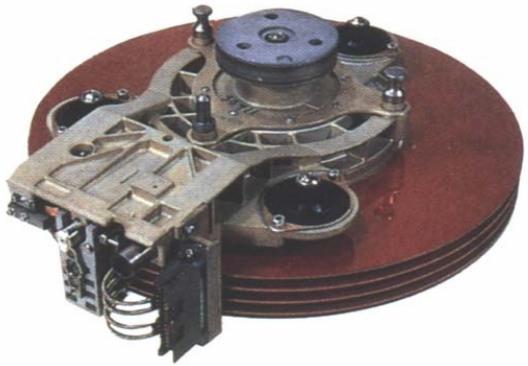


- *Basic research is performed without thought of practical ends….. though it may not give a complete specific answer to [a large number of important practical problems]. The function of applied research is to provide such complete answers.*
  Science The Endless Frontier, a Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945

1945-1970: Science-driven innovation: anticipate and create technological breakthroughs

- 1956 – Ramac developed at San Jose led to first magnetic disk drive
- 1966 – One-transistor memory cell (DRAM) invented by Robert H. Dennard.
- 1973 – "Winchester" disk becomes the industry standard for the next decade.

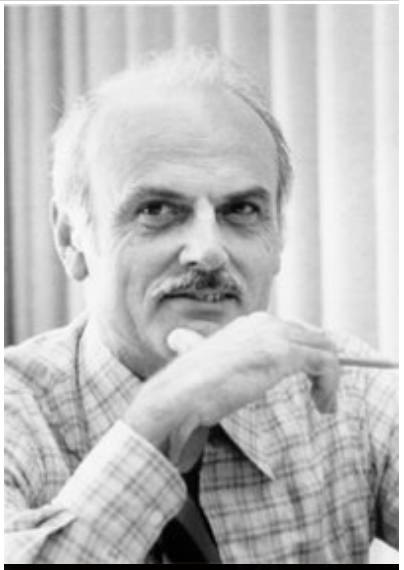
"Scientists mind the science, IBM developers take care of the rest."



The issue with R&D separation

"In such a dynamic industry, time to market is everything. The company that first markets a new product garners most of the profits. … Selling old IT hardware is like selling old fish."

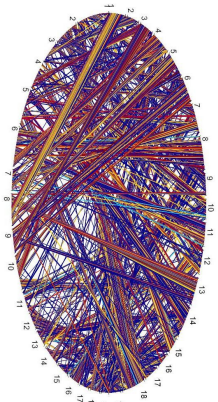
- 1970 – Relational databases – Edgar F. Codd
- 1980 – Reduced Instruction Set Computing (RISC) – John Cocke



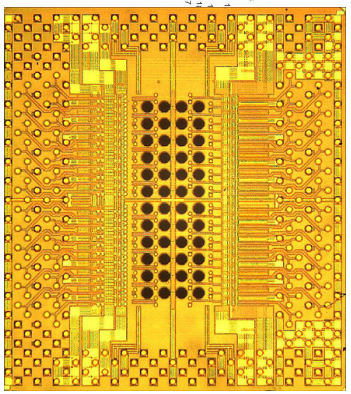
"the lesson learnt is that you don't isolate researchers"
Eric Schmidt, CEO Google.

IBM Research today

We don't just invent, we innovate.



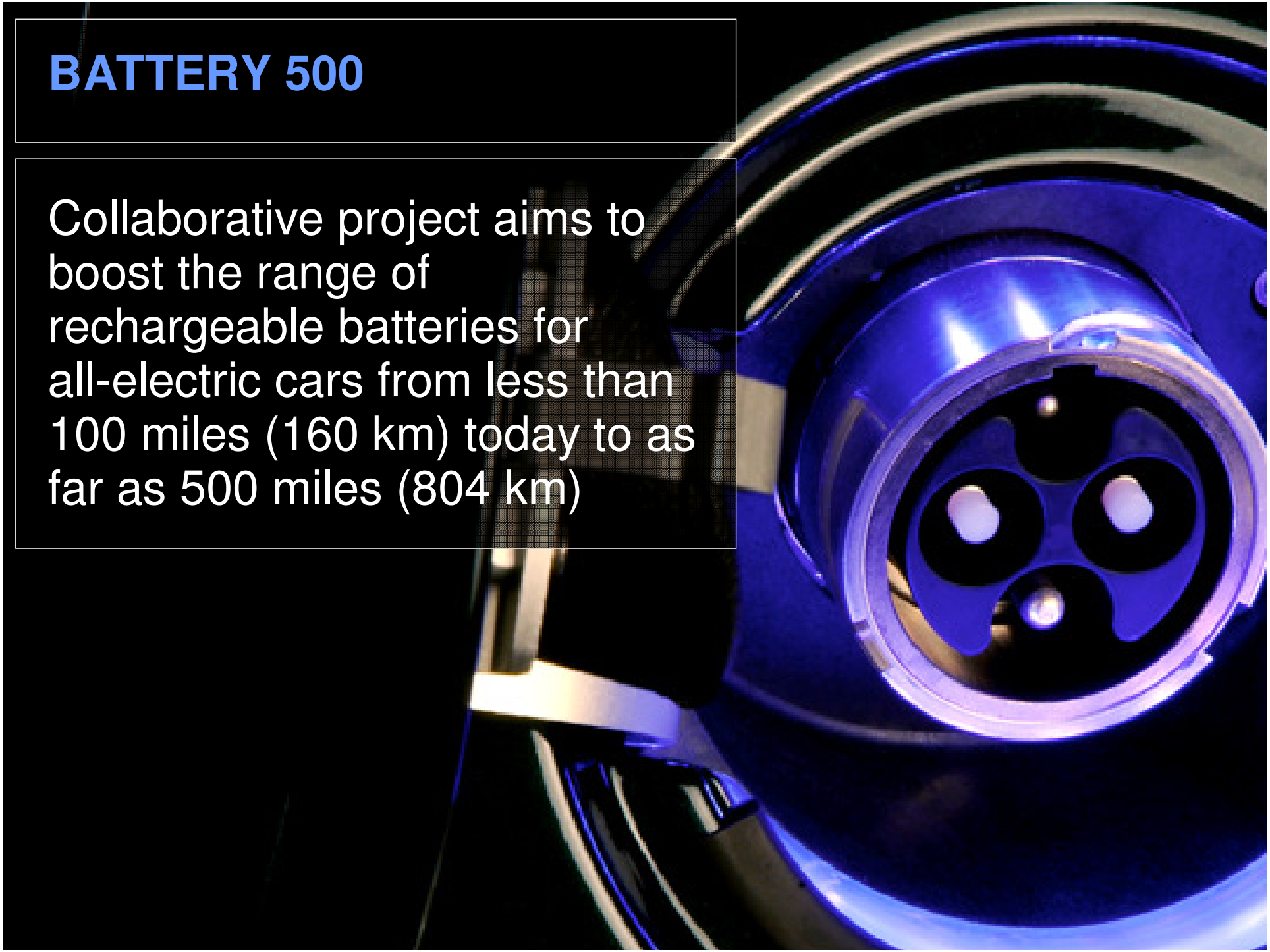
- Long term exploratory research – to understand the frontiers of science
- There is no technology handoff: Research participates actively in product development – to be fast to market
- Strategic consulting: informing decisions about technology choices, identifying directions for new business opportunities, and evaluating the intellectual assets of competitors and potential partners.

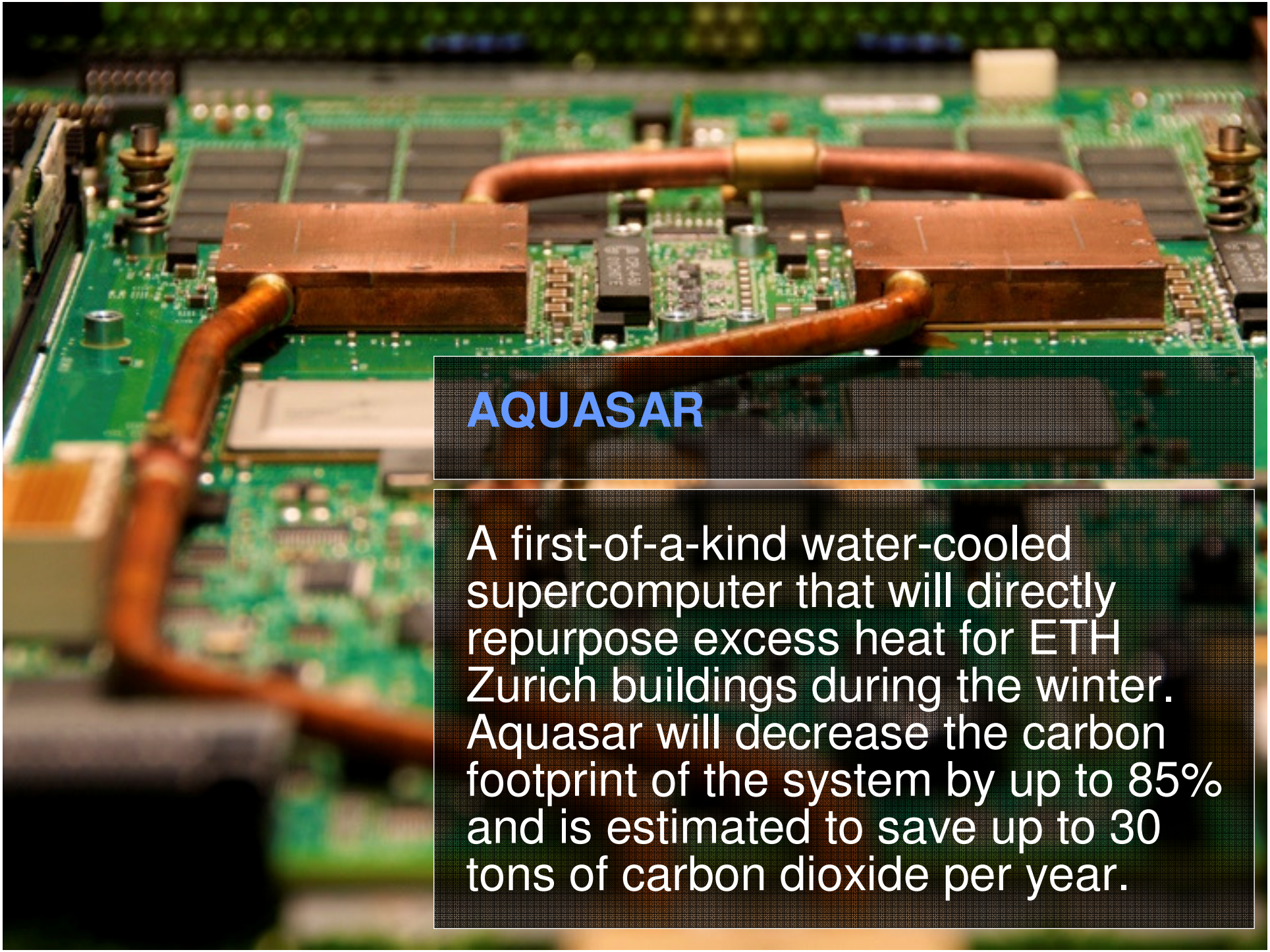


"To be first to market an organization does not always need to make the initial invention. But it must have deep knowledge of the frontiers of science.
Adapted from Paul Horn

BATTERY 500

Collaborative project aims to boost the range of rechargeable batteries for all-electric cars from less than 100 miles (160 km) today to as far as 500 miles (804 km)



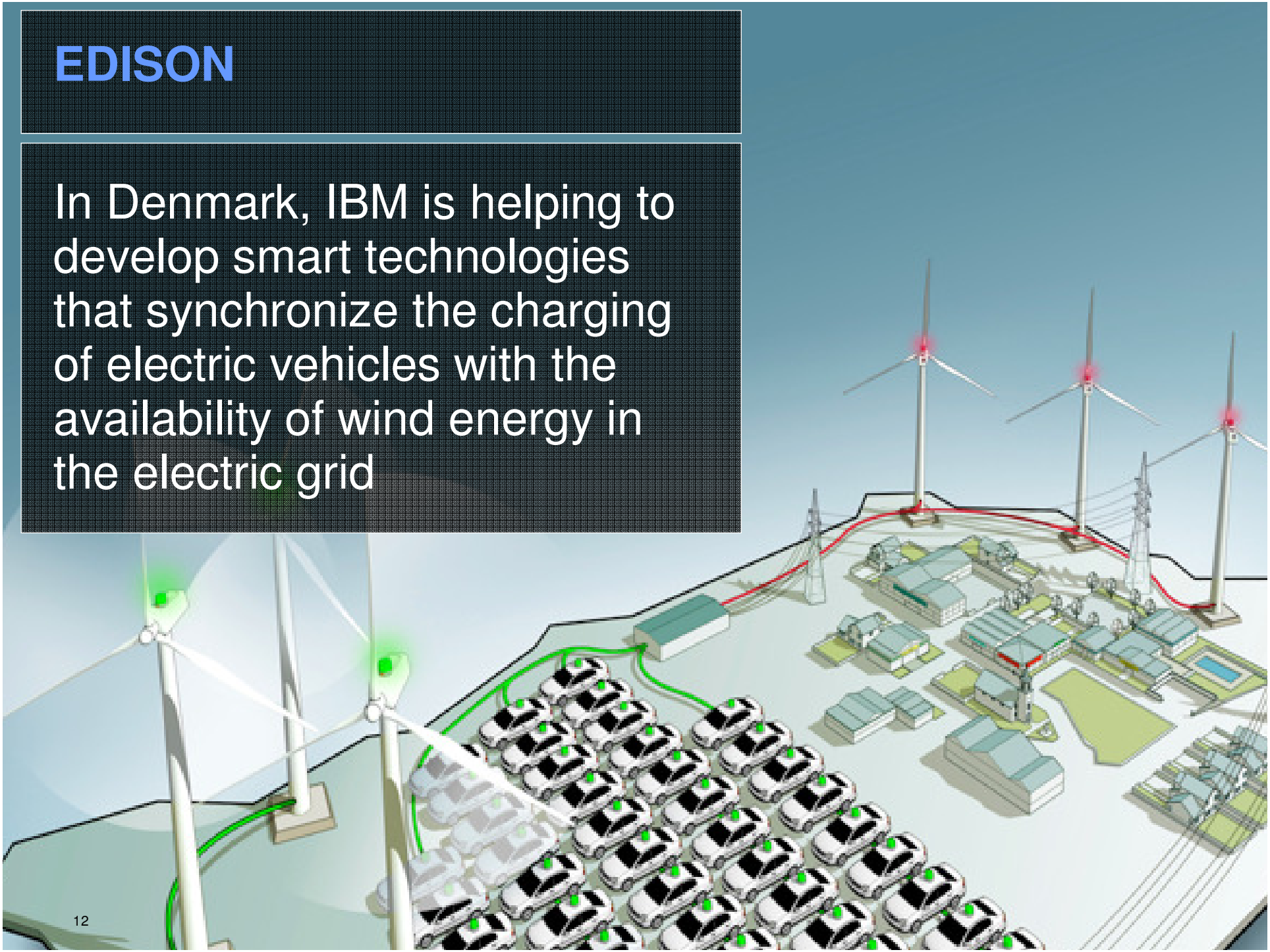


AQUASAR

A first-of-a-kind water-cooled supercomputer that will directly repurpose excess heat for ETH Zurich buildings during the winter. Aquasar will decrease the carbon footprint of the system by up to 85% and is estimated to save up to 30 tons of carbon dioxide per year.

EDISON

In Denmark, IBM is helping to develop smart technologies that synchronize the charging of electric vehicles with the availability of wind energy in the electric grid



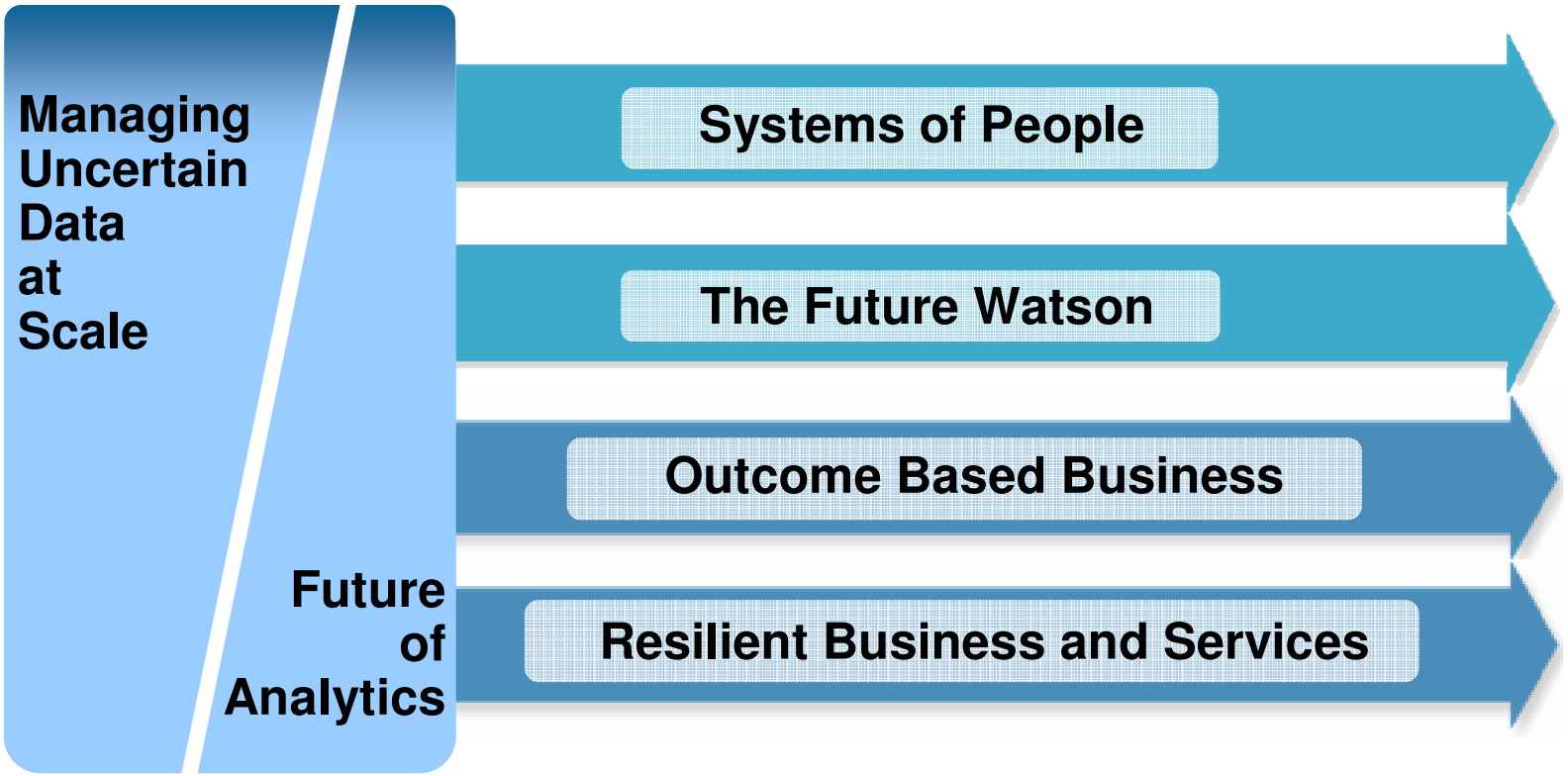
Global Technology Outlook 2012

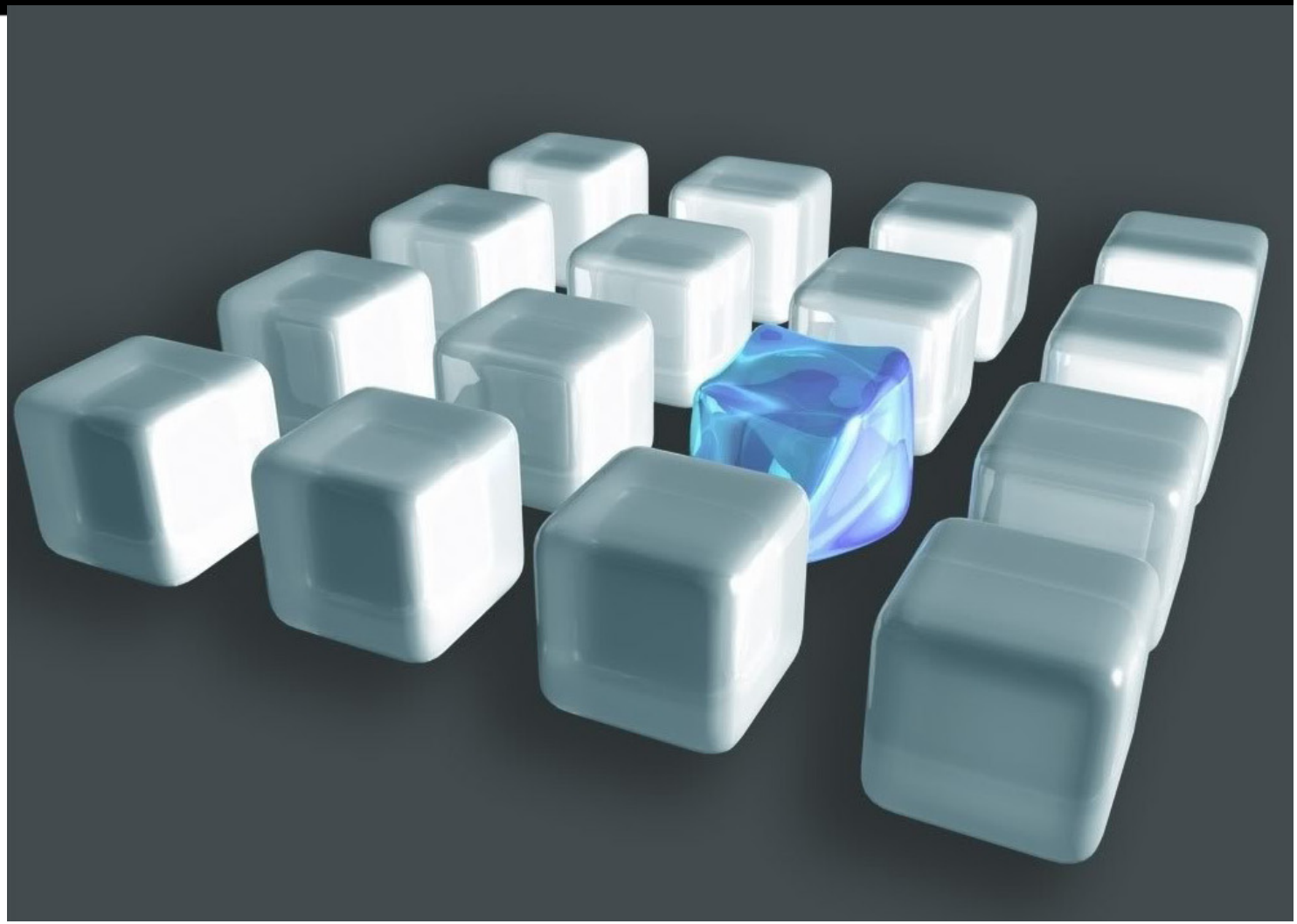
Global Technology Outlook Objectives

GTO identifies **significant technology trends** early. It looks for high impact disruptive technologies leading to **game changing products and services** over a **3-10 year horizon**.

Technology thresholds identified in a GTO **demonstrate their influence** on clients, enterprises, & industries and have **high potential to create new businesses**.

Global Technology Outlook 2012
Uncertain data and analytics are major themes

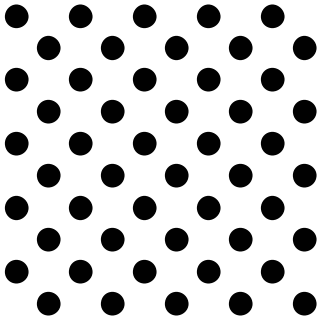




Managing uncertain data at scale

The fourth dimension of Big Data

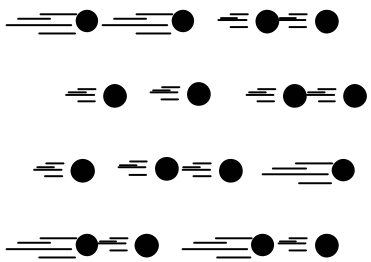
Volume



Data at Rest

Terabytes to exabytes of existing data to process

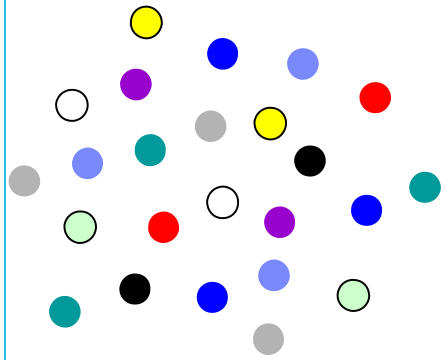
Velocity



Data in Motion

Streaming data, milliseconds to seconds to respond

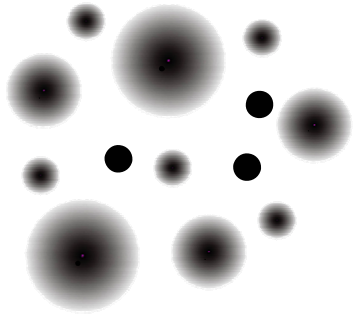
Variety



Data in Many Forms

Structured, unstructured, text, multimedia

Veracity*



Data in Doubt

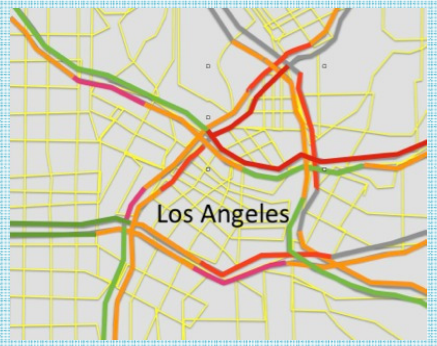
Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations

* Truthfulness, accuracy or precision, correctness

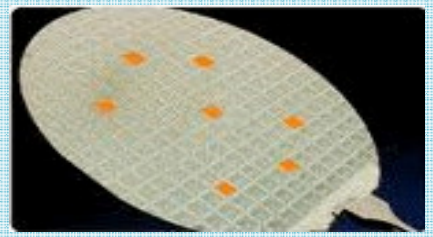
Uncertainty arises from many sources

Process Uncertainty

Processes contain "randomness"



Uncertain travel times

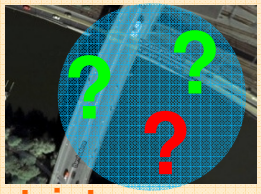


Semiconductor yield

Data Uncertainty

Data input is uncertain

Intended Spelling — Text Entry — Actual Spelling



GPS Uncertainty

Testimony

{Paris Airport}

Ambiguity

Contaminated?

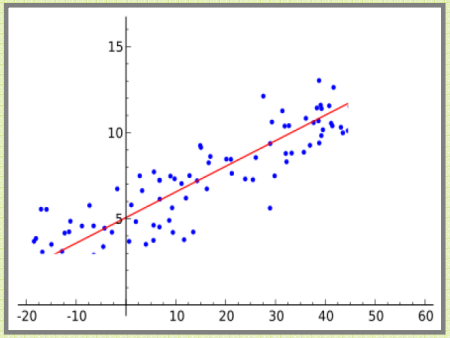
Rumors

{John Smith, Dallas}
{John Smith, Kansas}

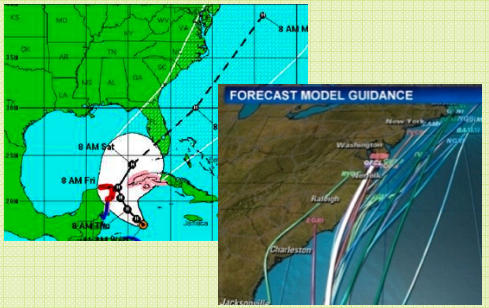
Conflicting Data

Model Uncertainty

All modeling is approximate

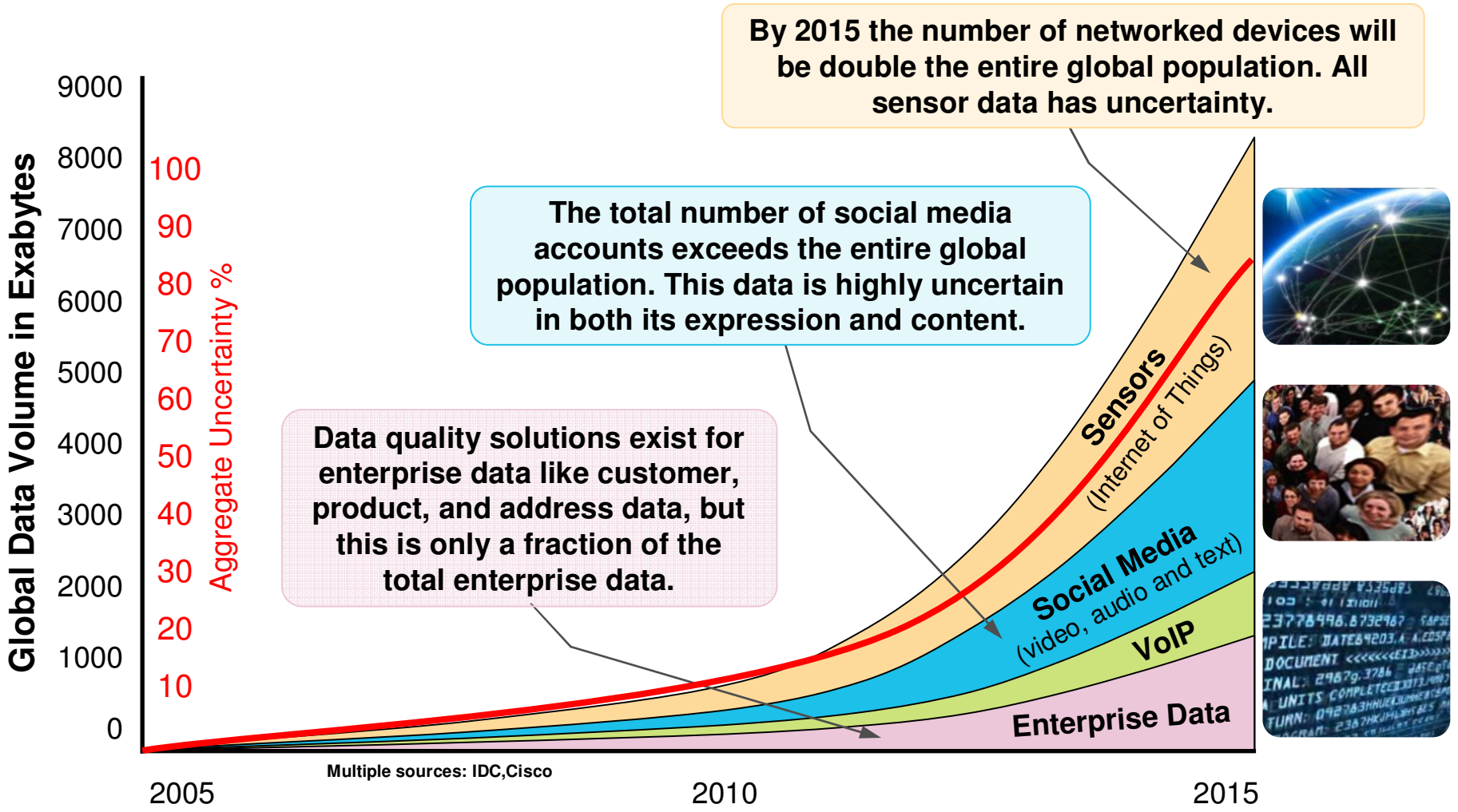


Fitting a curve to data



Forecasting a hurricane (www.noaa.gov)

By 2015, 80% of all available data will be uncertain



Examples: Uncertainty management presents many opportunities

Smarter Planet

System analytics predict maintenance

- Downtime costs $M in income loss
- Equipment maintenance needs unpredictable
- Customer contracts impose penalties

Energy

5% more oil platform production

30% less maintenance cost

Improvements obtained using statistical modeling that combine equipment sensor data with performance history to predict corrective maintenance activities

360° customer view

Creating profiles from many sources

- Many inconsistent data sources
- Intent hidden within social media
- Geospatial data is imprecise

Auto

35% more satisfied customers by analyzing agent notes

Telco

35% better churn prediction using customer SMS messages

IBM Research

Reduced time to determine lending risk from weeks to minutes

Supply chain

Process and forecast uncertainty

Modeling Uncertainties

- Demand, sales, production, shipment

Shipping Uncertainties

- Goods damaged
- Mistakes in shipped goods

IBM

80% lower price protection costs

30% less channel inventory

50% fewer returns

Reductions obtained using inventory replenishment model that accounts for uncertain price protection

Healthcare

More data from physician notes and tests

Structured medical records are incomplete

- "Golden" text notes must be interpreted
- Drug names
- Relationship types (mtr, sibs, m, paunt)
- Uncertainty in images

Healthcare

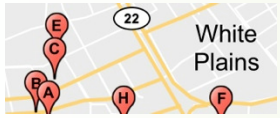
Able to identify:
- 40% more smokers found
- 15% more disease history

Mitral stenosis:
- 50% more diagnoses
- 35% misdiagnoses

Condensing data reduces uncertainty by constructing context

Michael
San Jose, CA

Influencers **Intent**

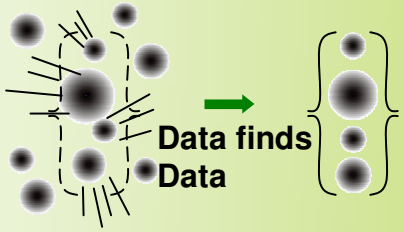


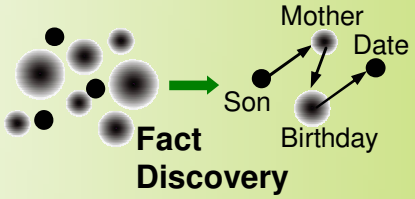
Customer at Mall

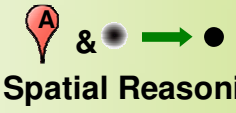
Customer in Store #42

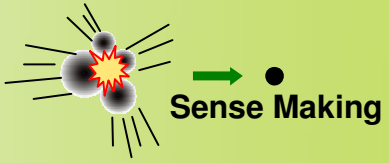
In-Store Pricing
And Discounts

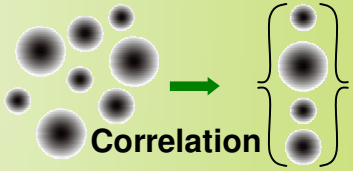
CONDENSE

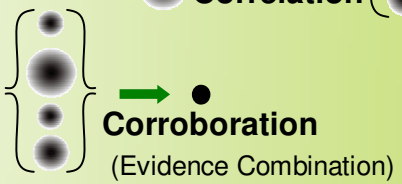












ETC.

Required: tight integration to maximize context discovery

Required: common practices followed by multiple standards for representing uncertain data and uncertainty of all types, provenance, and lineage and other metadata

Maximum Context
For
Minimum Uncertainty

Required: common APIs to enable sharing across the uncertainty management pipeline

No such common practices, standards or APIs exist today

UN PIANETA PIÙ INTELLIGENTE IN AZIONE

Systems of people

People-centric processes are at the core of a broad range of issues

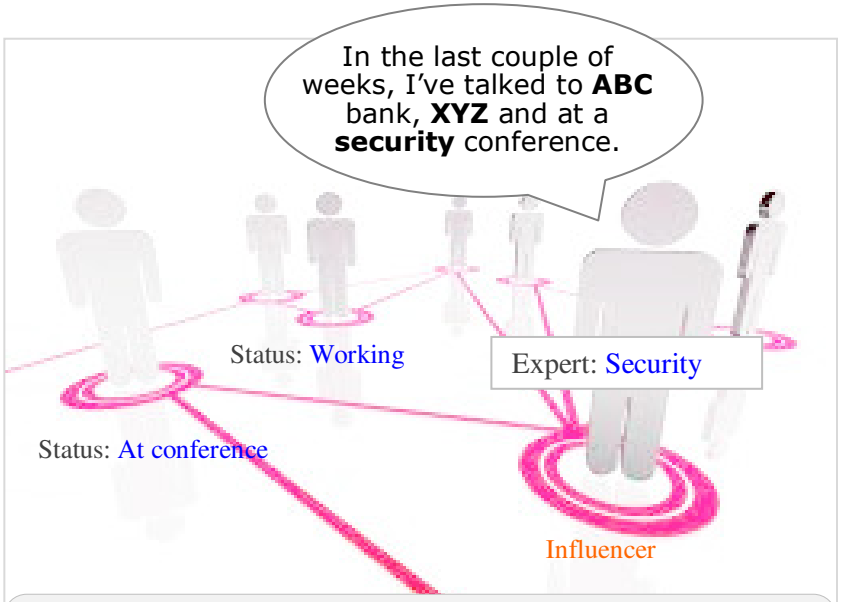
Differentiate for Growth
Create winning products, fast, by having the best and most productive knowledge workers

Drive Sales Productivity
Create superior sales force, drive sales enablement and seller/client alignment

Grow in Emerging Markets
Re-create organizational footprint in global markets

Transform Service Delivery
Further grow productivity and enable new delivery models

Optimizing people-centric processes is not the same as optimizing supply chains



"*Status updates alone on Facebook amount to more than ten times more words than on all blogs worldwide*" - David Kirkpatrick, *The Facebook Effect*

CRM	Claims	Delivery Records	Patents & Publications
– Clients served – Products sold – Sales patterns – Productivity	– Engagements worked – Team info	– Work specs – Tasks accomplished – Productivity	– Innovation – Products – Technical leadership

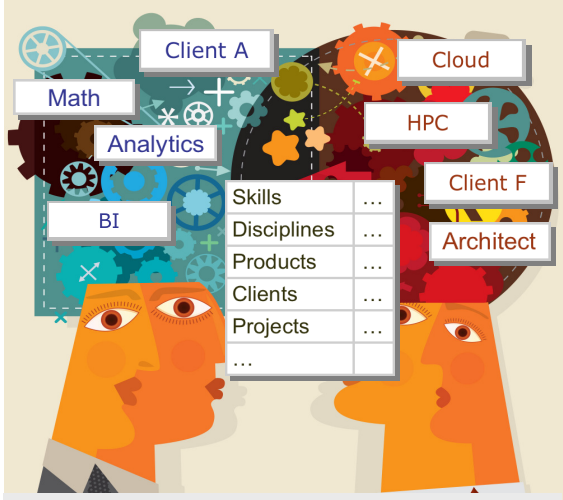
- Rich information (e.g. expertise, work patterns, response to incentives, digital reputation) is flowing through on-line collaboration and enterprise systems
- Capturing this information enables analytics to be applied to people-centric processes

Executing on Systems of People vision depends on three key capabilities

Incorporate capabilities that **adapt content** for situations and needs, and enhance communication **over many devices, across diverse pools of talent**

context-aware
cognitive load management
translation, transcription
text-to-speech, voice…

PEOPLE ENABLEMENT



Develop capabilities to **create a representation** of a person's skills, experiences, preferences, digital reputation…

In a **structured and organized way**, so it can be used **for the purpose of running a business**

PEOPLE CONTENT

Implement capabilities for people-centric process optimization **within an analytics platform for rapid, on-demand deployment**

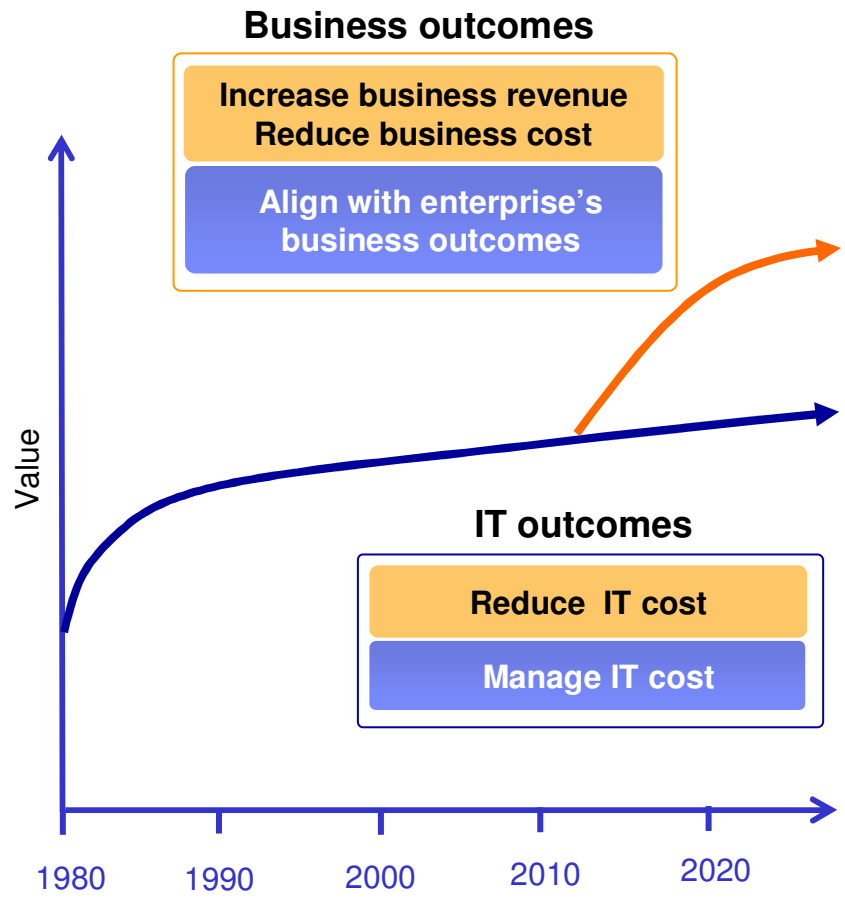
matching, talent cloud
crowdsourcing, predictive markets
simulation of workforce trends
performance analytics
behavior modeling…

PEOPLE ANALYTICS

UN PIANETA PIÙ INTELLIGENTE IN AZIONE

Outcome Based Business

A shift is taking place from delivering IT outcomes to delivering business outcomes



"From Cost Center to Profit Center"

The transformation of IT from a cost center to a profit center does not happen overnight. It requires a well thought out strategy and implementation.

Source: dynamicCIO.com, C R Narayanan, Dec 20, 2011

"IT Value Is Dead. Long Live Business Value."

Business outcomes from technology investments are all that really matter. The CIO's challenge is finding new ways to prove IT's worth.

Source: CIO.com, Stephanie Overby, May 12 , 2011

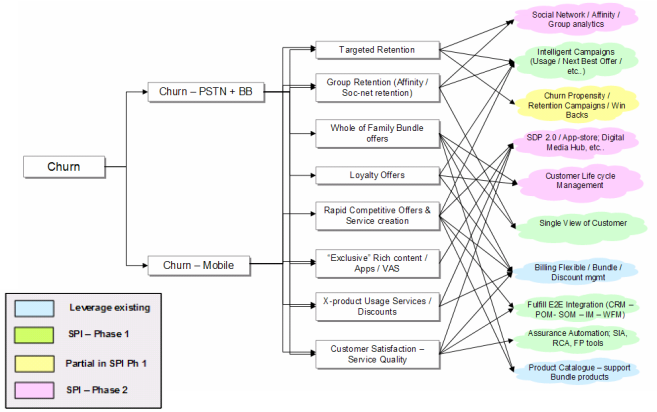
Top 10 Business Priorities 2014

Increasing enterprise growth	1
Improving Operations	2
Attracting and retaining new customers	3

Source: Gartner, 2011 CIO Survey

Customer churn: An example of how a business outcome approach has been used

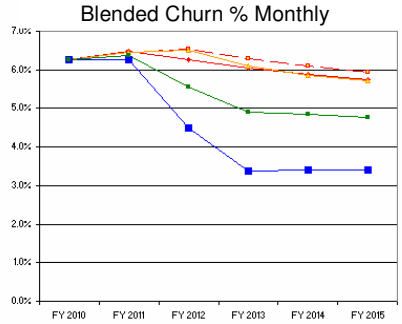
Operational models specify the business capabilities



Team used spreadsheets to analyze and create projections based upon past experience

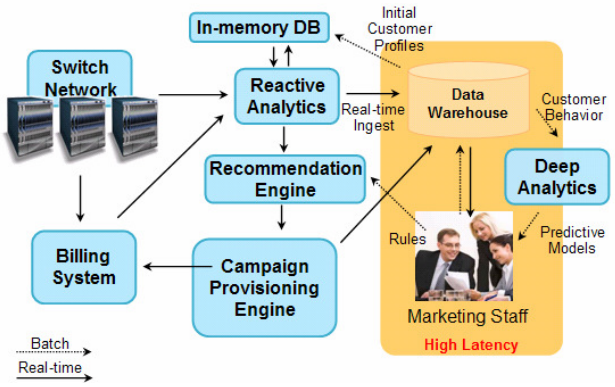
Existing assets are configured and deployed

Analysis projects the results



Comparison of alternatives

Integrated functional components support the business outcome



Potential Outcome Metrics

- Activations per annum
- Average revenue per user
- Value Added Services as % of revenue
- Call center FTEs/million

A deep understanding of the industry, supported by models and assets, is key to achieving success

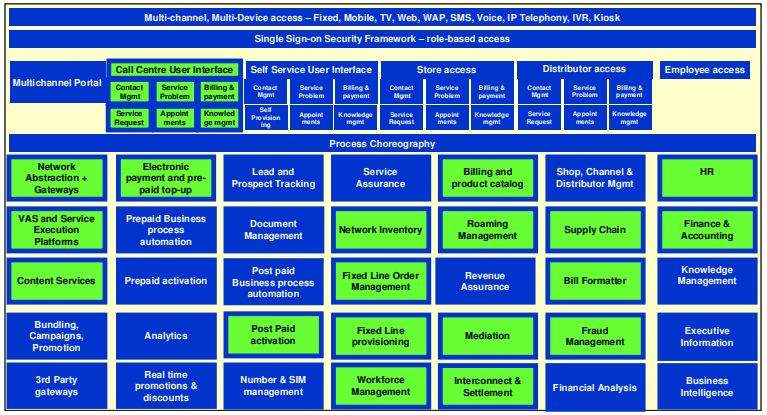
Key Attributes

- Deep understanding of the industry
- Models, analytics and optimization
- Integrated software and services assets
- Learning and assets from one engagement applied to the next

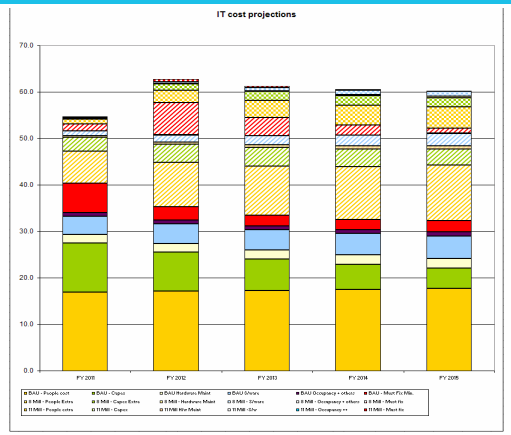
Features

- Enhanced margins
- Long-term contracts
- Asset reuse

Integrated Functional Component Assets in Telecom Industry



Models and Analysis



Other industries are using or proposing business outcome-based approaches

Industry	Solution	Outcome Metric
Healthcare	Patient Transition Care	Reduce patient re-admittance rate
	Clinical Trial	Reduce the time to launch a drug
	Fraud & Abuse Management System	Reduce suspicious Medicaid claims
	Watson	Improve diagnostic assistance
Government	Tax Audit System	Identification of tax fraud
Banking	Churn Reduction	Improve customer retention
Finance	Credit Loss Enhancement	Increase credit loss enhancement
Retail, Consumer Products	Multi-Channel Next Best Action	Increased sales through alternative channel actions
	Demand-Driven Business Analytics	Reduce out-of-stock incidents at retail stores

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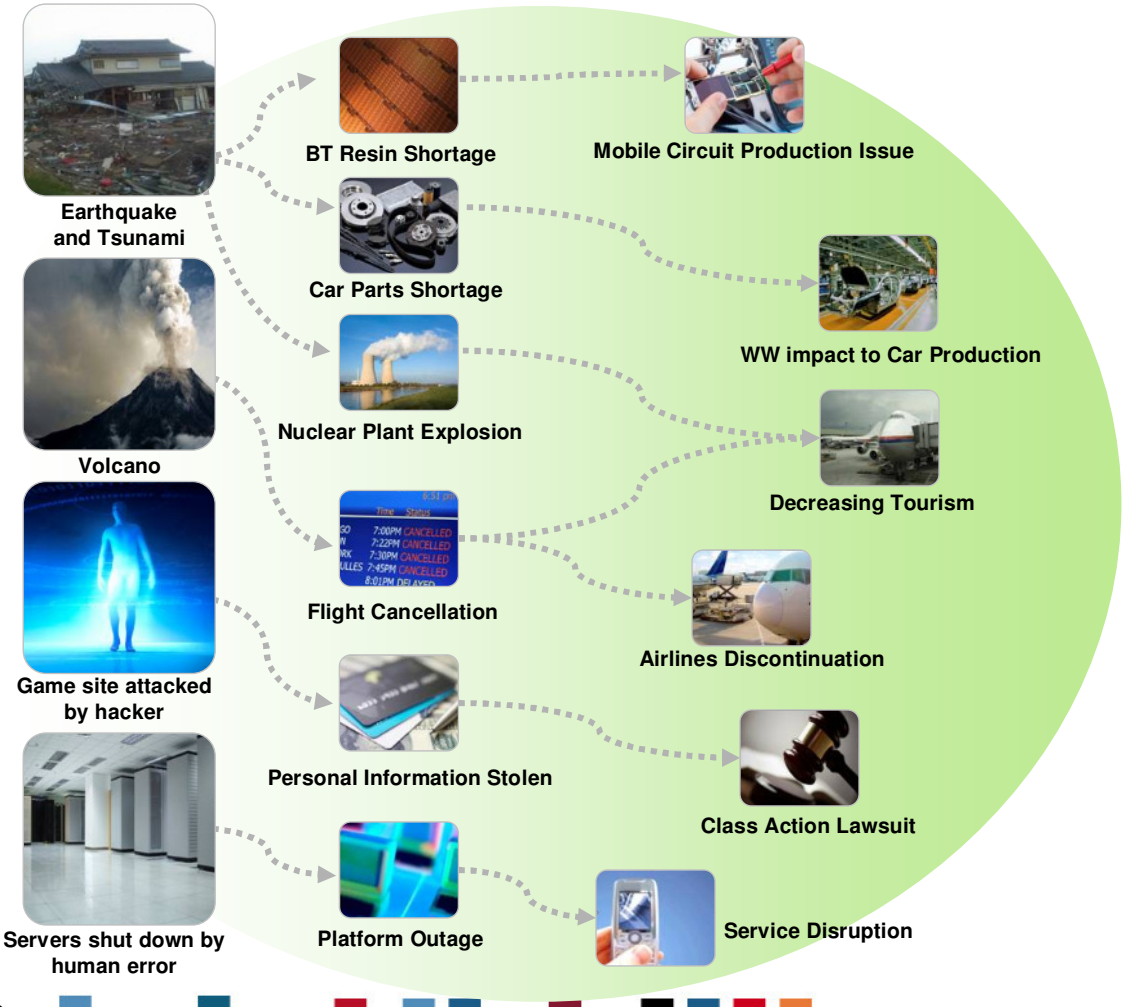
Resilient Business and Services

The increasingly connected world magnifies the impact on every aspect of life

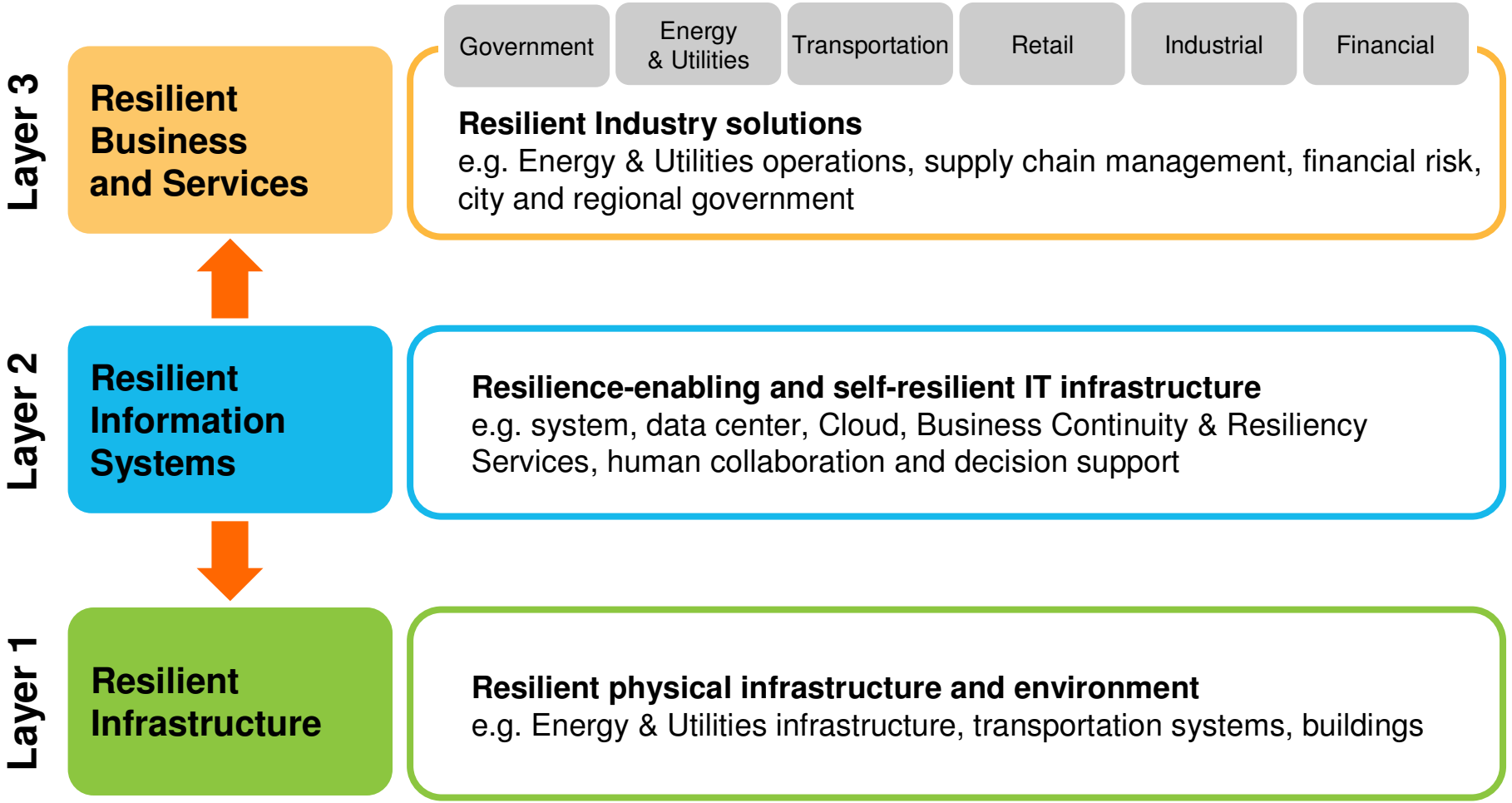
To maintain business operations, we can not assume any part of the system is always reliable, available or trustworthy



After the 2011 Japan Earthquake and Tsunami:

- **90% of WW BT resin supply stopped**
- **World wide car production was down 30% for Toyota during April and May**
- **Visitors to Japan dropped 60% in April**
- **The Iceland volcanic eruption cost airlines $1.7 billion with more than 10 million people affected**
- **Personal information leakage cost $170M, led to class action law suits, and damaged corporate reputation**
- **Amazon S3 outage affected platform and services, including Twitter, Dropbox, foursquare**

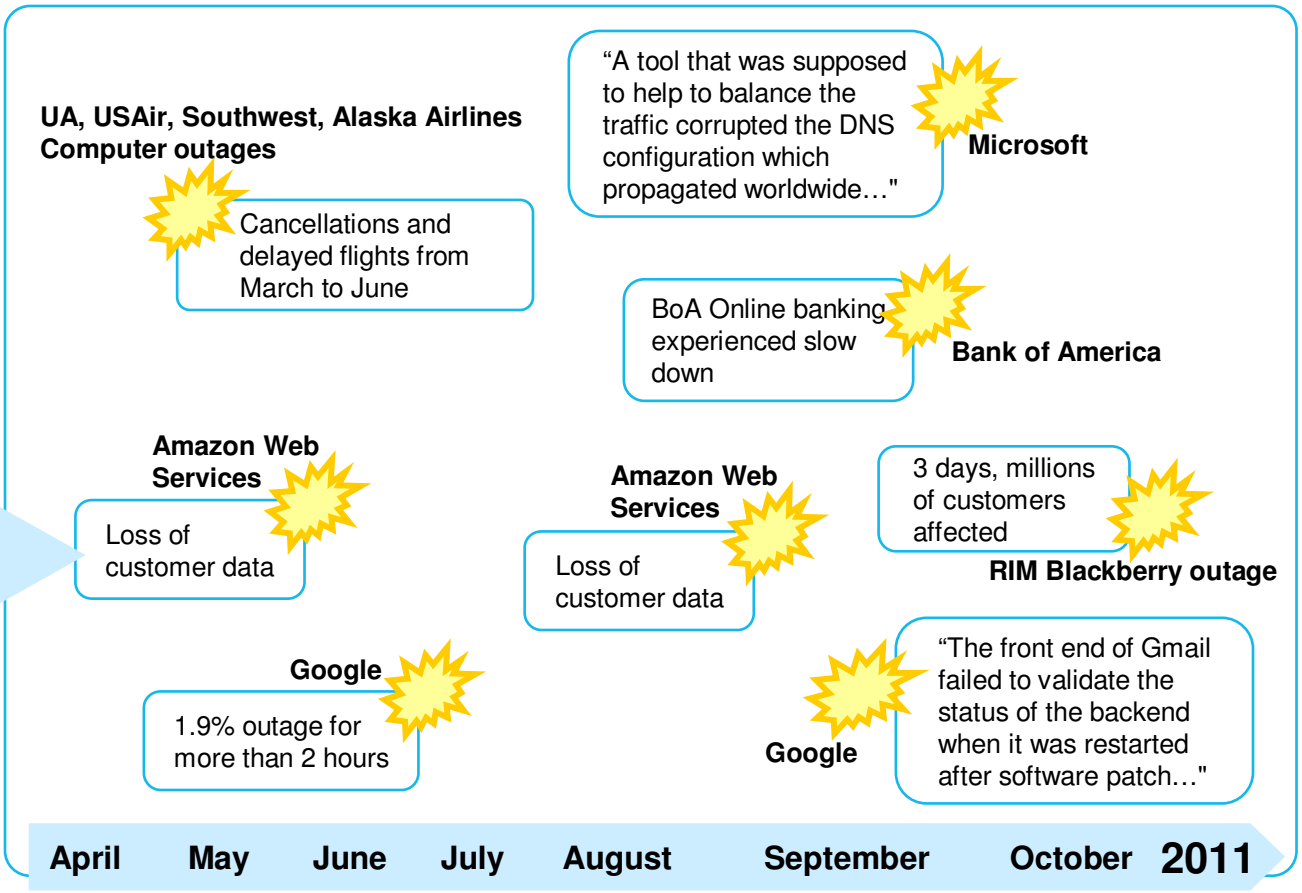
A resilient IT layer enables top-level resilient business and services, and supports the underlying physical infrastructure



Cascading failures

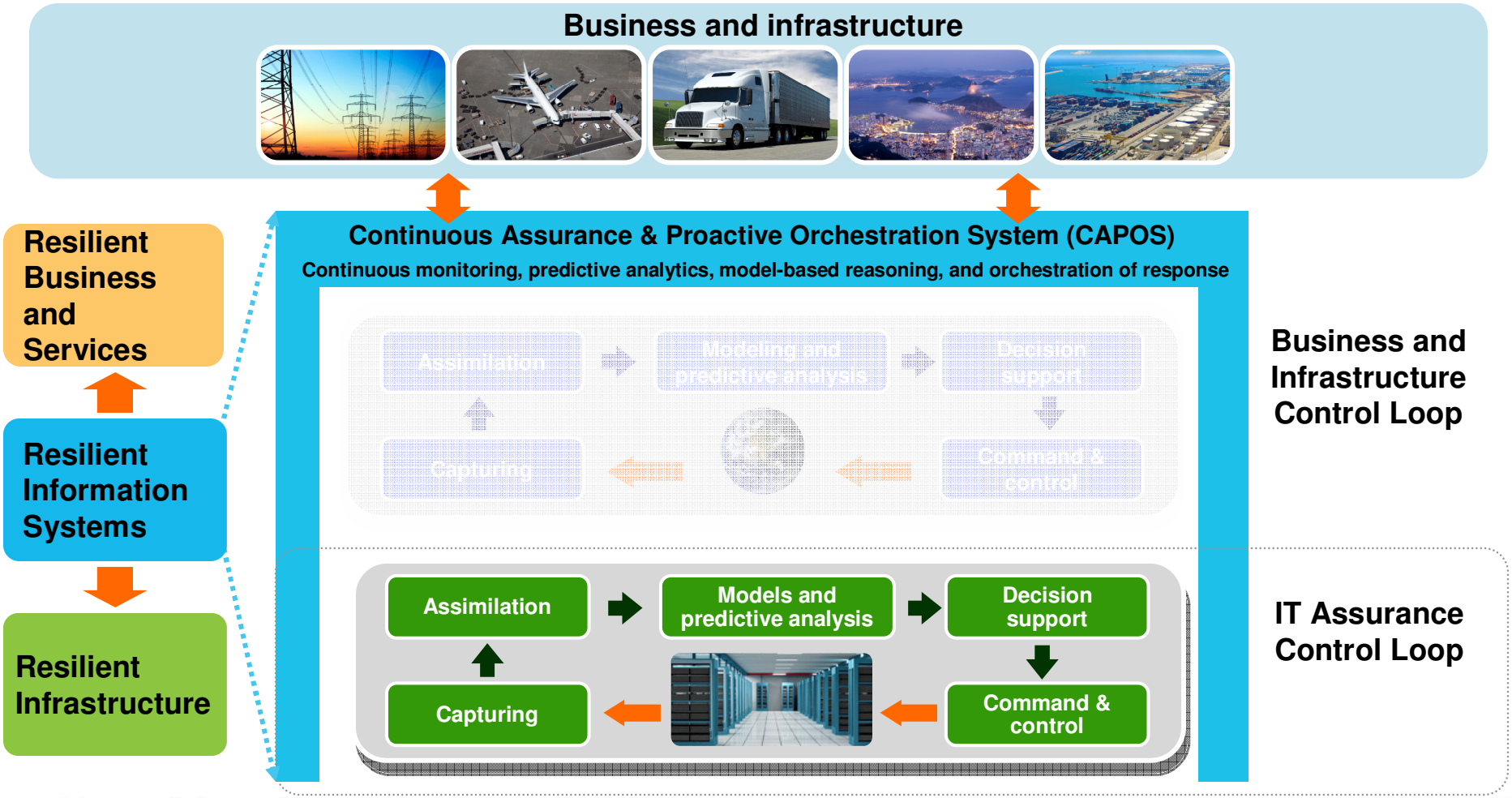
The cost of business disruptions due to data center outages reached $5300/min or $505K/incident in 2011; human error is a major cause of outages

- During April 21, 2011 part of Amazon Web Services was down for 18 consecutive hours, causing many websites to shut down
- Sequence of events:
  - Network configuration error
  - Connectivity lost to mirror site for Elastic Block Store
  - Restoring connectivity caused "mirroring storm," exhausting available storage
  - 13% of the availability zone "stuck"



Making the IT platform more resilient

There are three major problems: outages, cascading failures, and cyber-attacks



Scenario: City command center

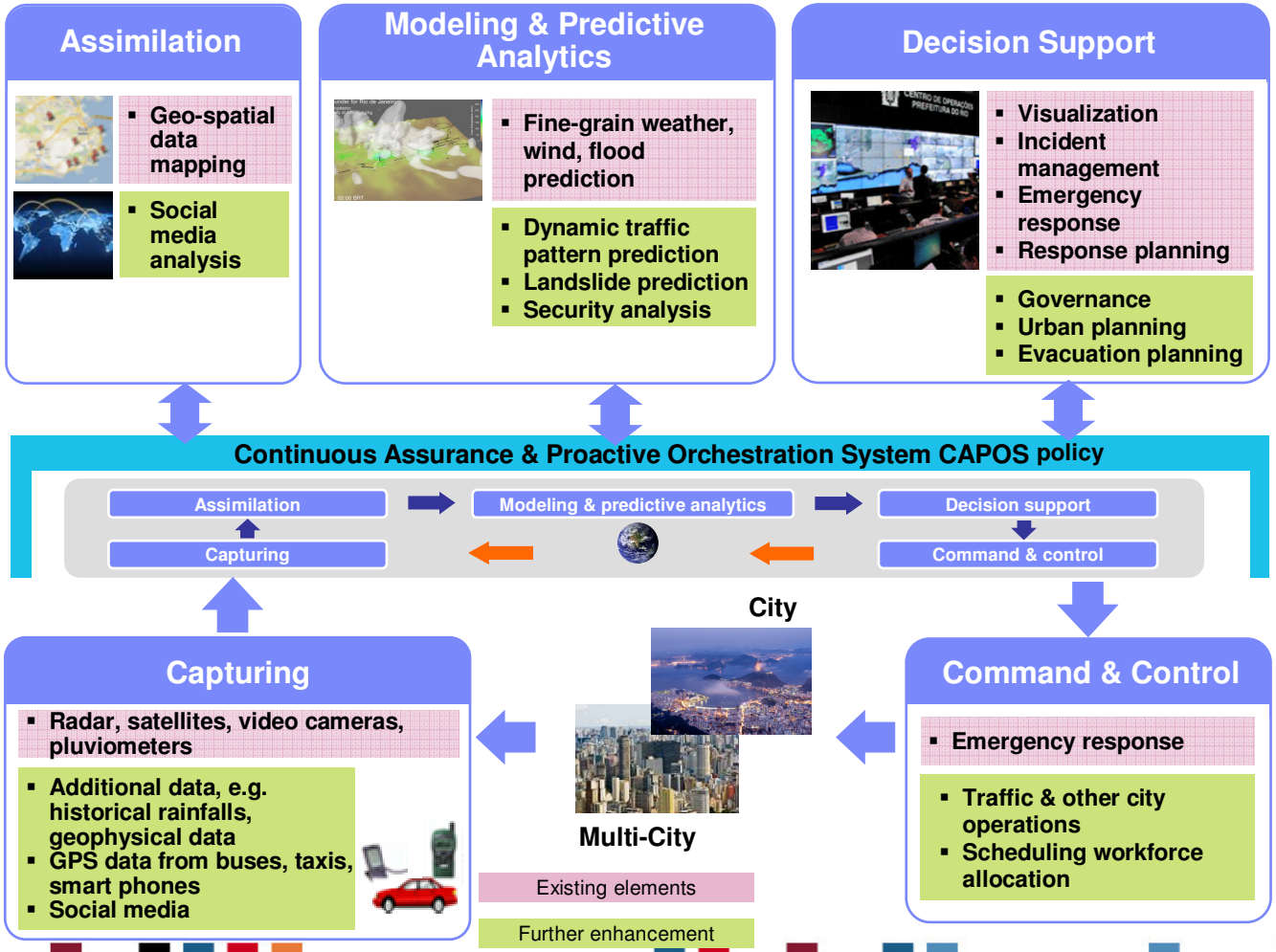
Monitoring weather and episodic events is used to improve the efficiency of daily city operations; Coupled with analytics technologies, it can respond proactively to events with higher complexity

Pain Points:

- City government needs better tools and governance systems to respond to major catastrophic events and daily incidents
- Complex situational management
- Traffic delays have caused loss in productivity affecting almost 1% of GDP

Benefits:

- Day-to-day monitoring of situations and events
- Improved, proactive planning and response to disasters (e.g. safe evacuation of people)



Resilient Business and Services

Business, physical and IT infrastructure are increasingly vulnerable

- Greater interconnectivity and system concentration exacerbates systemic and cascading failures
- Impact of disasters, human errors and security failures is increasing

A proactive approach is emerging

- Assume any part of any system can become unreliable, unavailable or untrustworthy
- Use model-based reasoning and predictive analytics to prevent, detect and contain failures or breaches

Opportunity for enhanced resilient business and services

- IT systems can continue to increase their applicability and value, while improving in resilience
- These systems will help to build an even more resilient Smarter Planet

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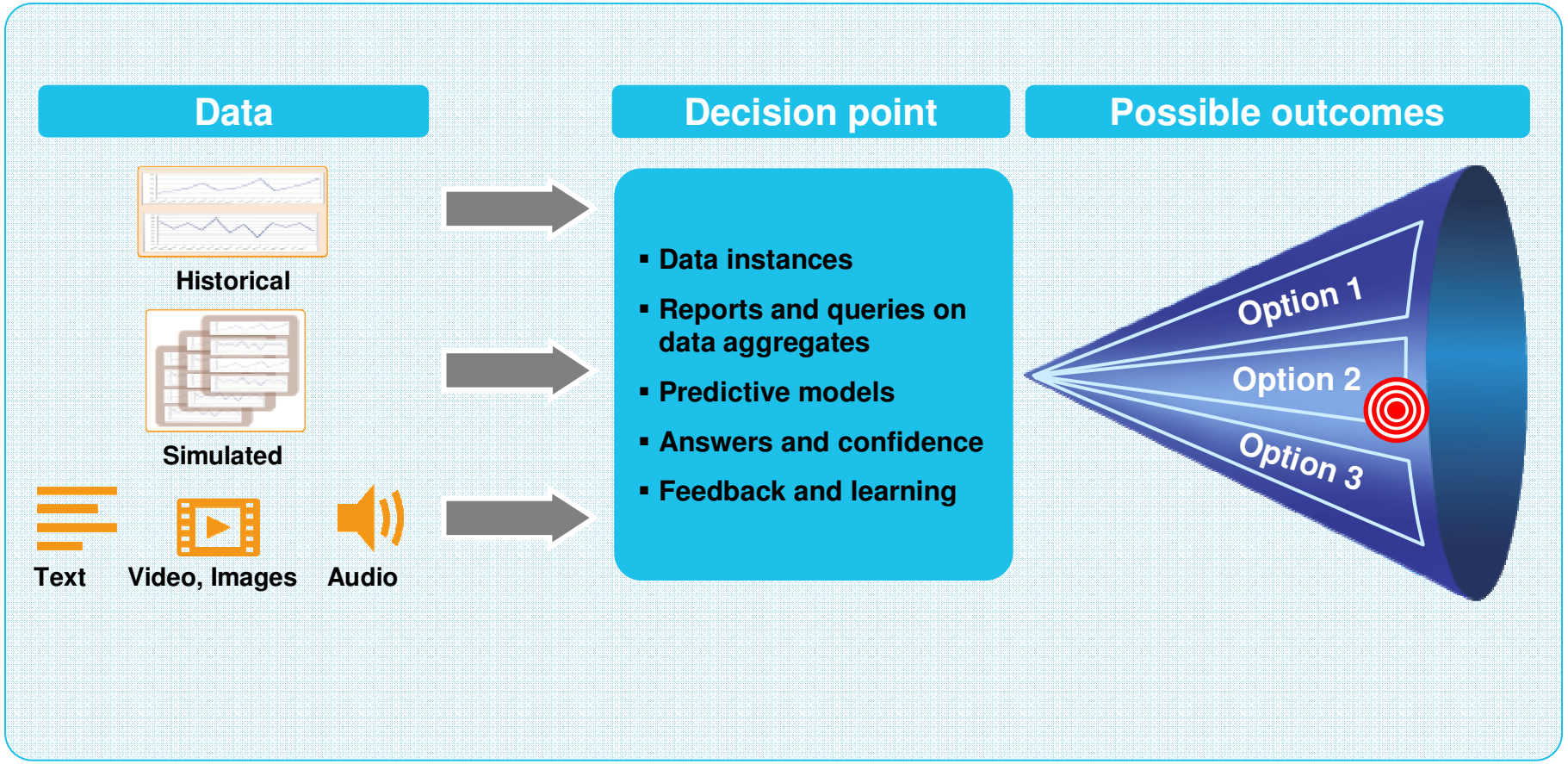
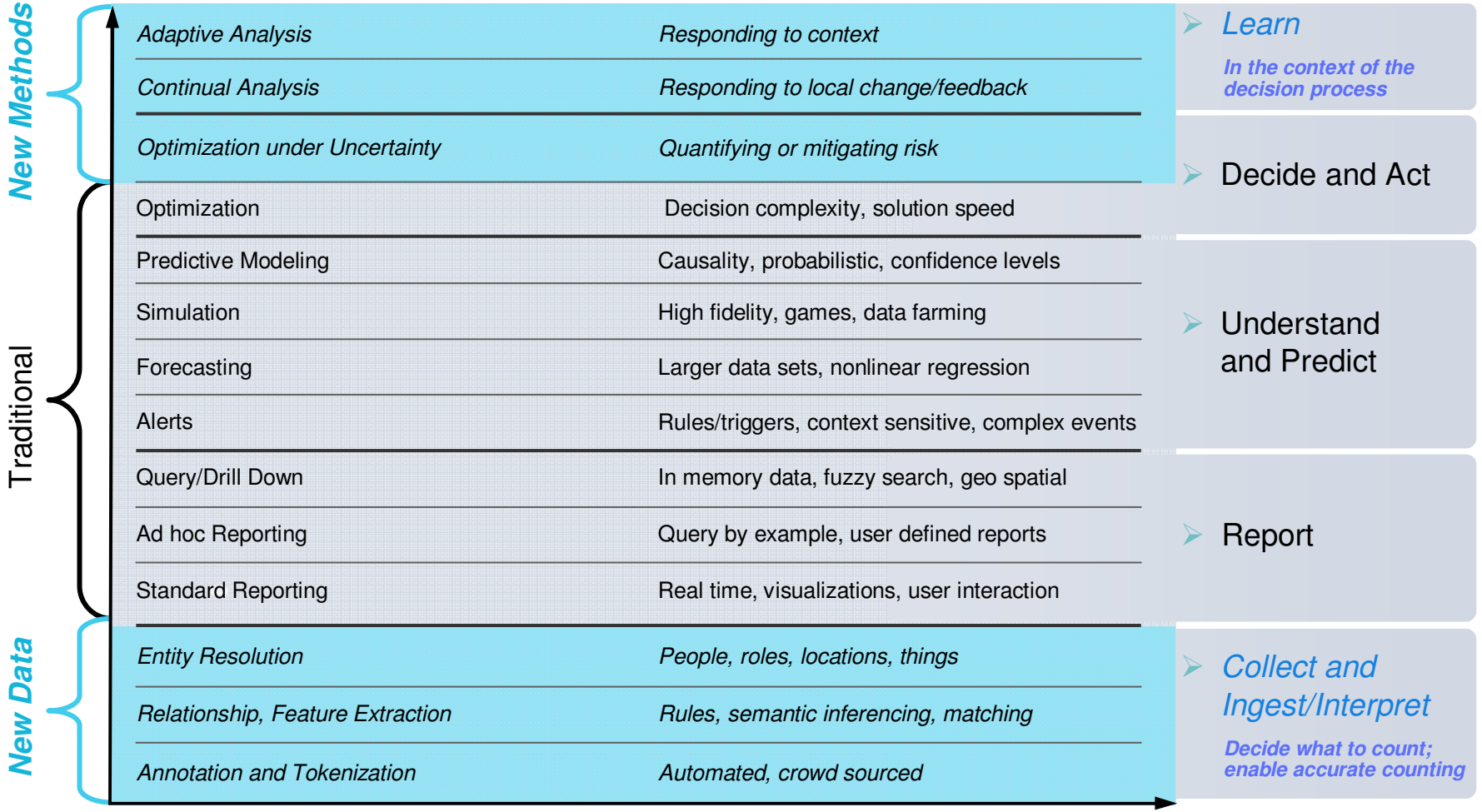
Future of Analytics

Analytics is broadly defined as the use of data and computation to make smart decisions



Analytics toolkits will be expanded to support ingestion and interpretation of unstructured data, and enable adaptation and learning



Extended from: Competing on Analytics, Davenport and Harris, 2007

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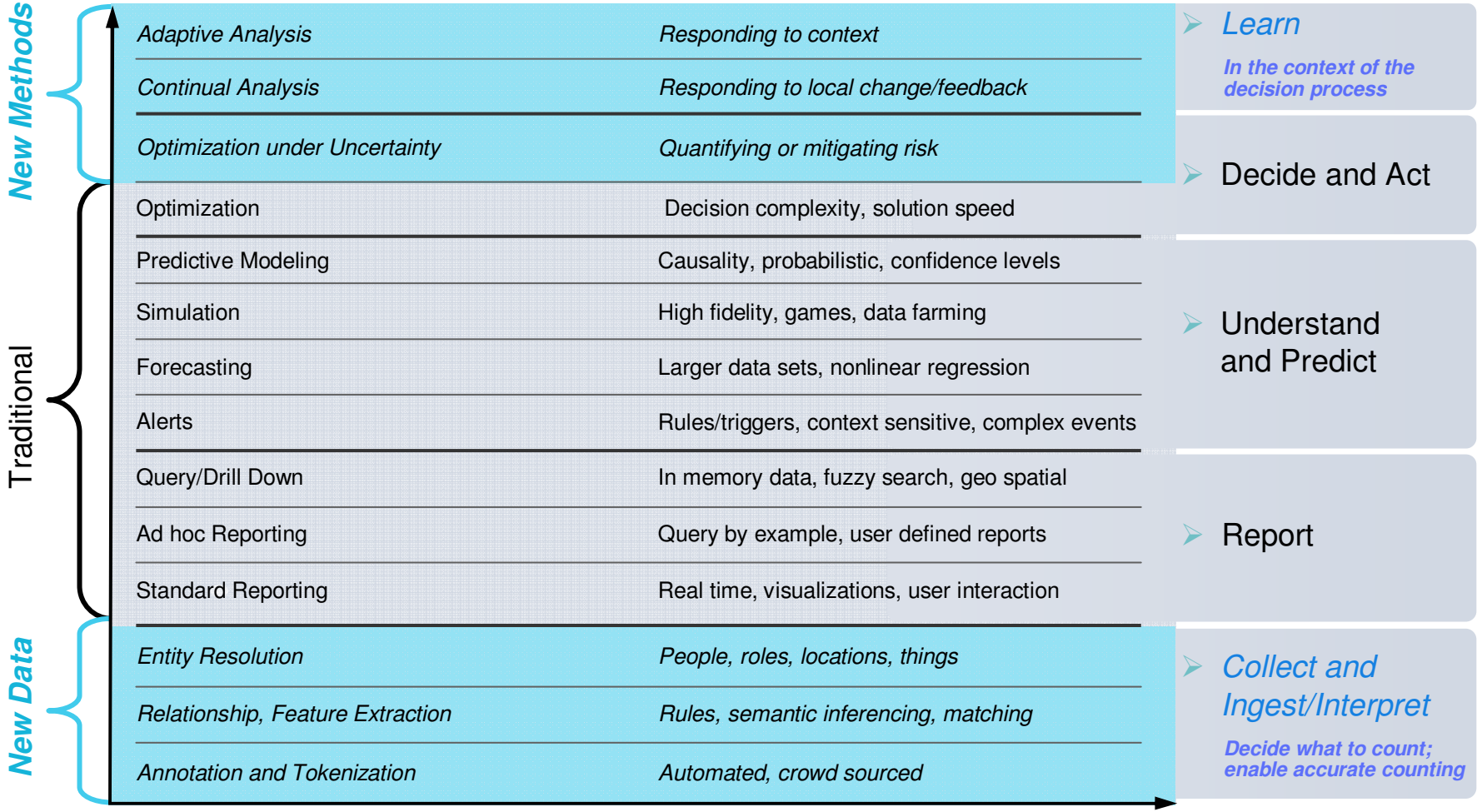

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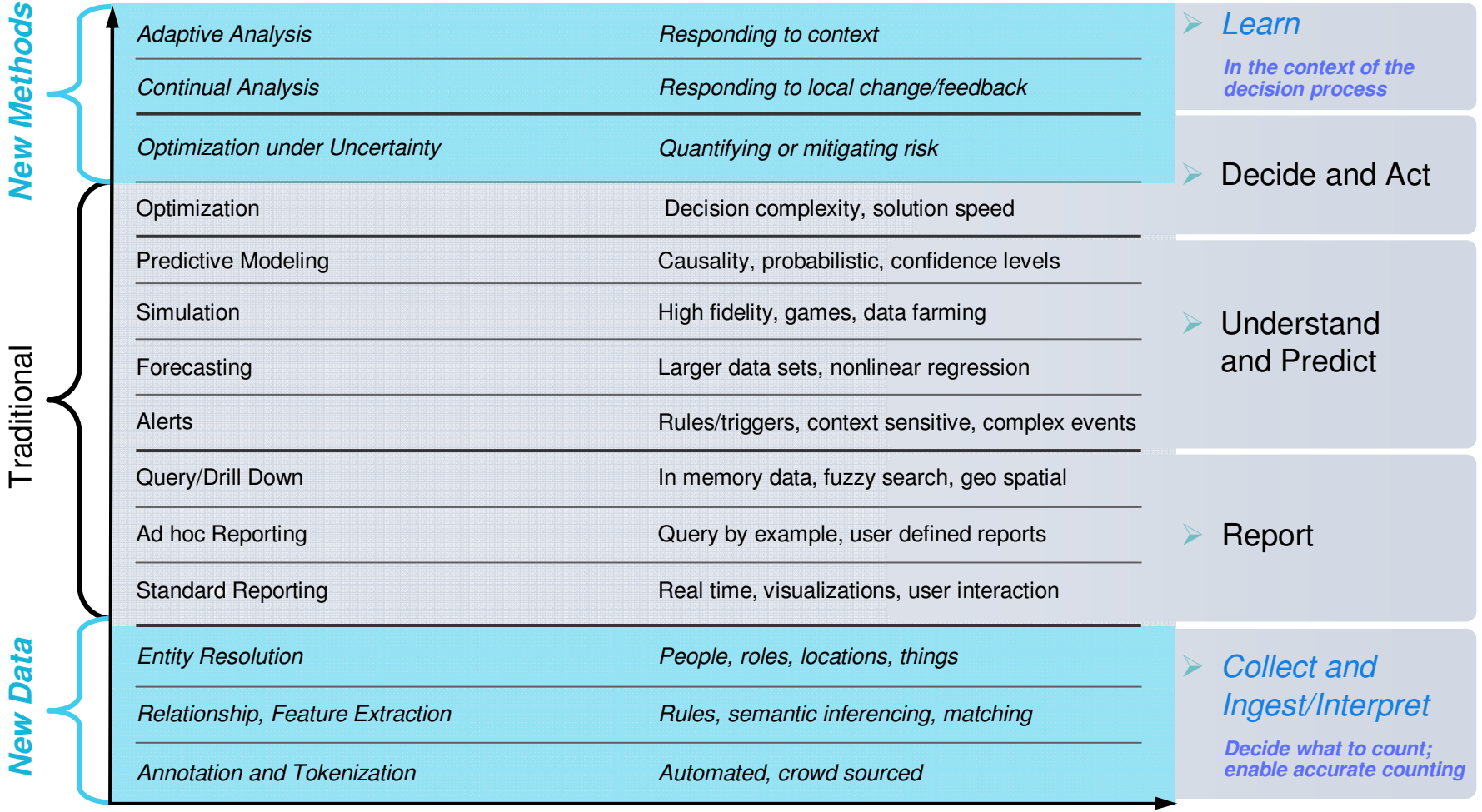
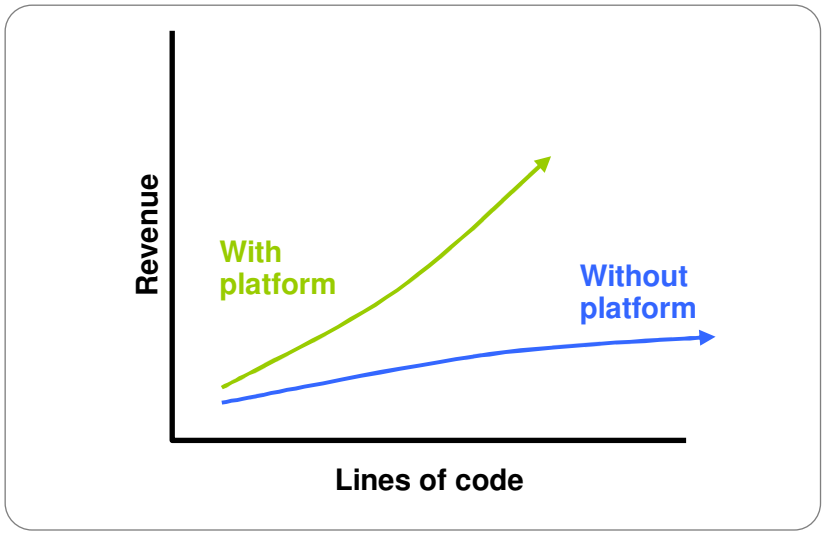


Extended from: Competing on Analytics, Davenport and Harris, 2007

An Analytics solution platform will increase enterprise value by supporting both the CxO solution and the CIO infrastructure



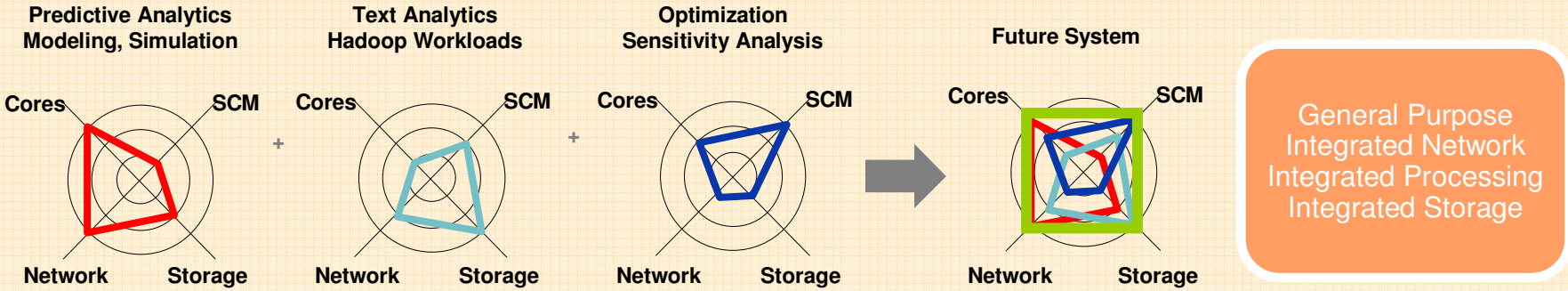
- Easier consumption of Analytics solutions
  - Have consistent look and feel
  - Changes are easier to implement effectively
  - Trustworthy solutions are produced
- More efficient, less complex development
  - Reduces growth of development costs
  - Speeds delivery of new functionality
  - Expands analytics solution developer population
- Reduces client cost of operation
  - Seamless integration eases deployment of solutions
  - Establishes preferred development path for new solution
  - Consistent and coherent infrastructure eases managing solutions

The CIO can reduce cost and add value to the use of analytics by supporting collaboration and data/analysis sharing

Optimizing across the stack will enable the deployment of analytics at scale

Systems supporting future analytics will be more data centric, composable and scalable

- Systems will support increasingly complex data sets and workflows.
- Different elements within these complex workflows will require different capabilities within systems.



- **Balanced, reliable, power efficient systems,** with integrated software that **scales seamlessly**
- Integrated **analytics, modeling and simulation capabilities** to address generation, management and analysis of **Big Data for Business Advantage**

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The Future Watson

IBM Research