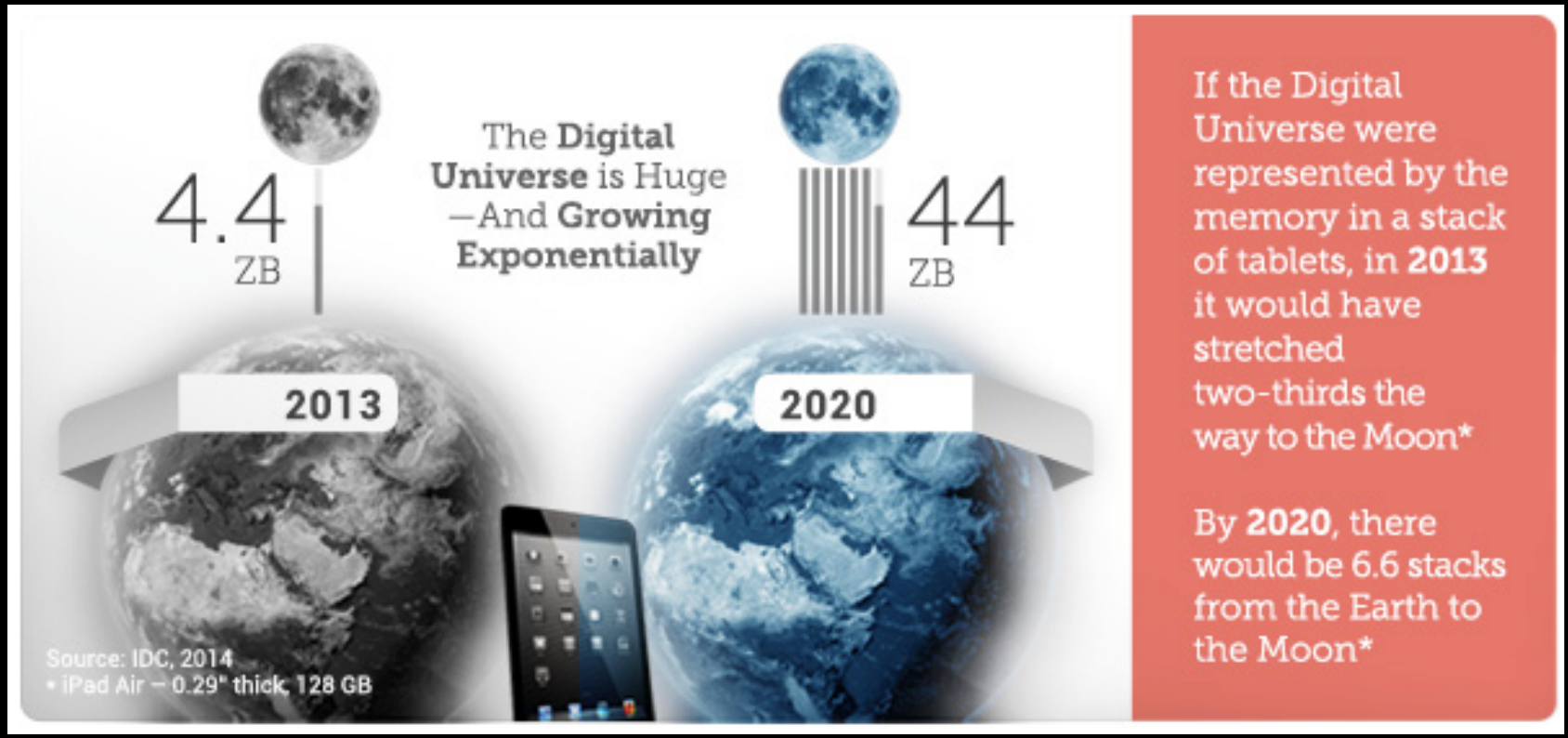
# Making Value for America:

## Embracing the Future of Manufacturing, Digital Technology, and Work

**Theresa Kotanchek**
**Chief Executive Office**
**Evolved Analytics LLC**
**www.evolved-analytics.com**
**theresa@evolved-analytics.com**

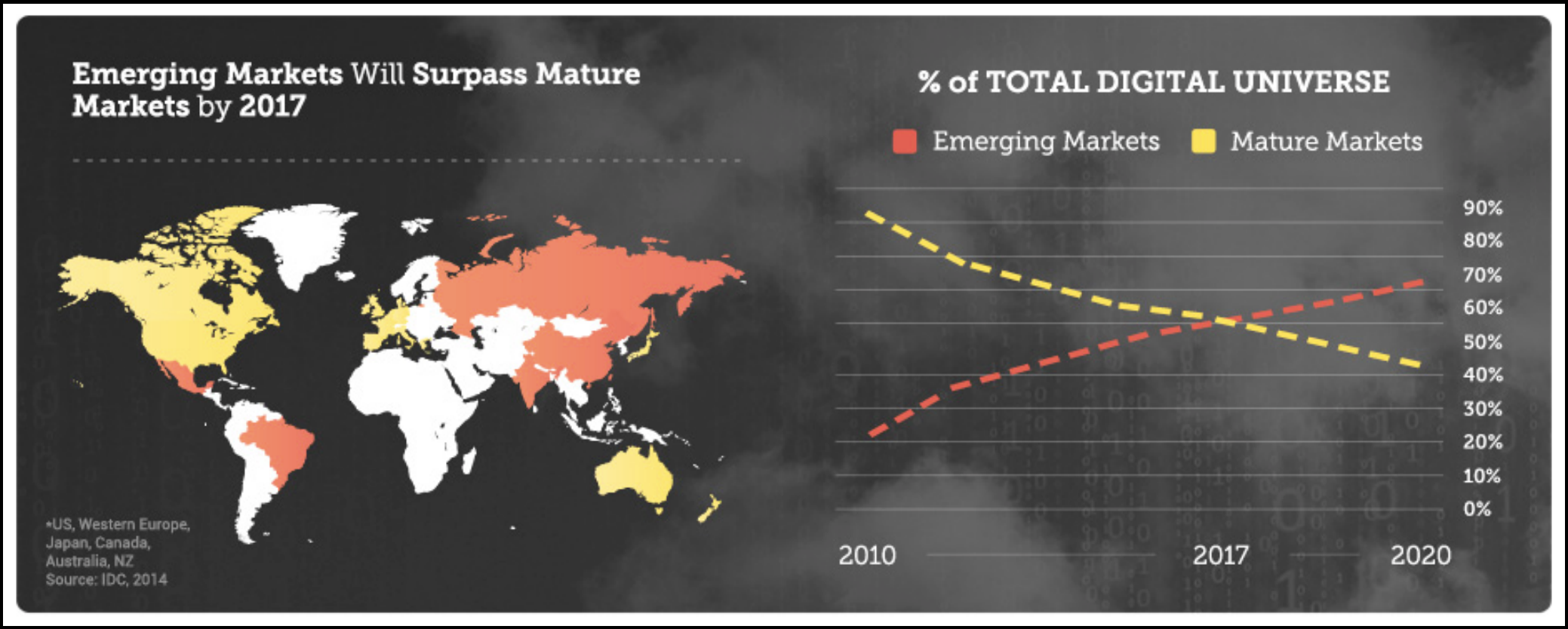
**Government-University-Industry Roundtable**
**Washington, DC**
**October 26, 2016**

# Digital Universe is Growing Exponentially



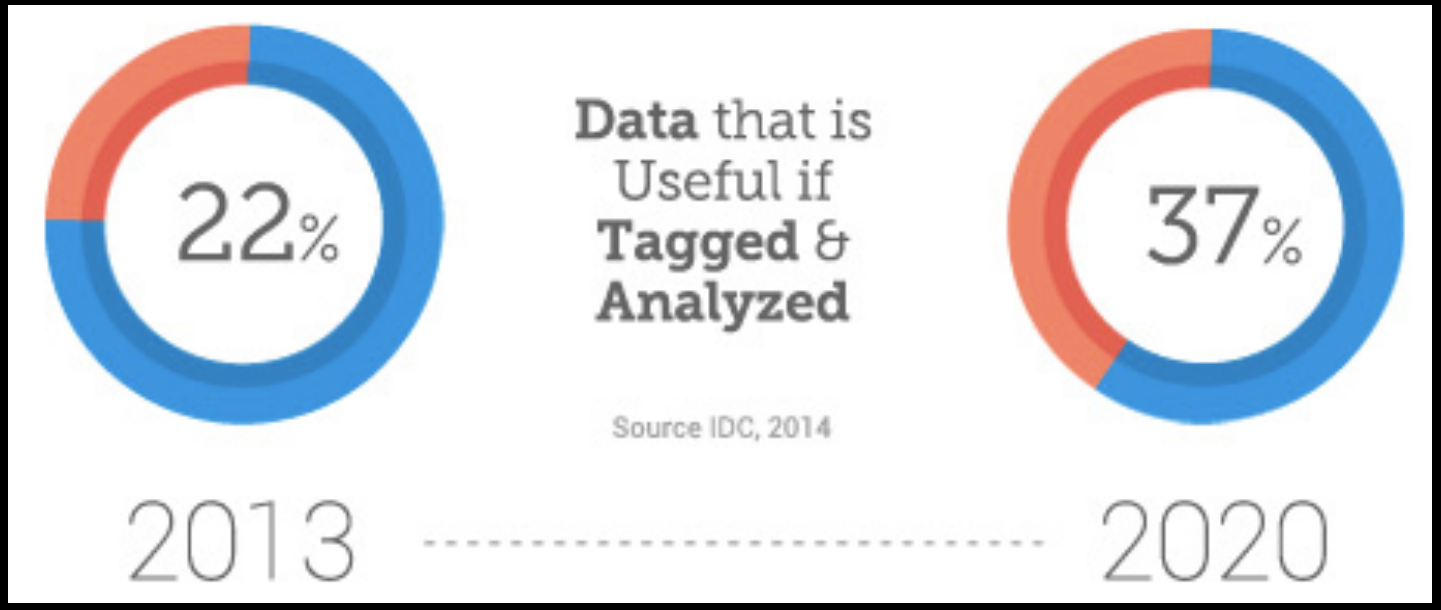

ZB = 1 Zettabyte = $10^{21}$ Bytes = 1 Trillion GB= 1 Billion Terabytes

# Emerging Markets Surpass Mature Markets in 2017




Source: IDC, 2014

# Not All Data Is Useful




< 25% of Data Tagged

Source: IDC, 2014

# Only 5% of Data is Target Rich

## Easy to access.

Can you obtain the data, or is it hopelessly locked away on end-user PCs, shuttling about on closed-end data processing systems, or trapped in proprietary embedded systems?

## Transformative.

Could this kind of data, properly analyzed and acted upon, actually change a company or society in a meaningful way?

## Real-time.

Is the data available in real-time, or does much of it come too late to drive real-time decisions and actions?

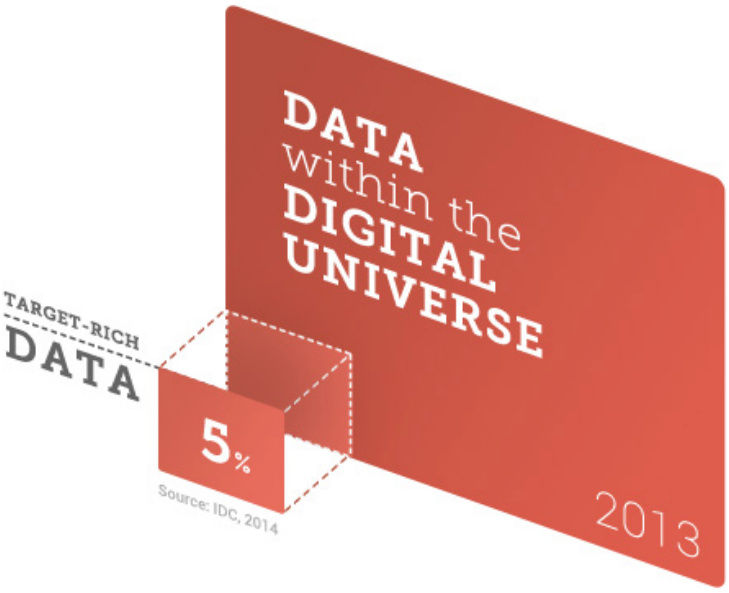
## Intersection synergy.

Could this kind of data have more than one of the above attributes?

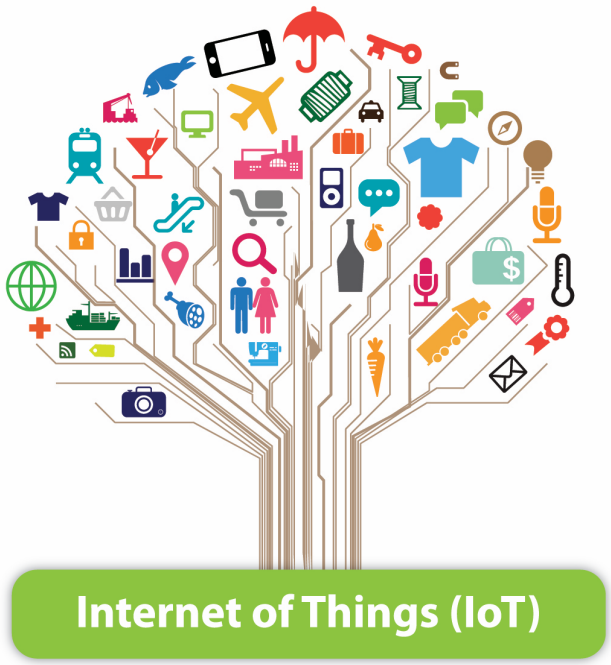
## Footprint.

Could top-notch analysis of this data affect a lot of people, major parts of the organization, or lots of customers?

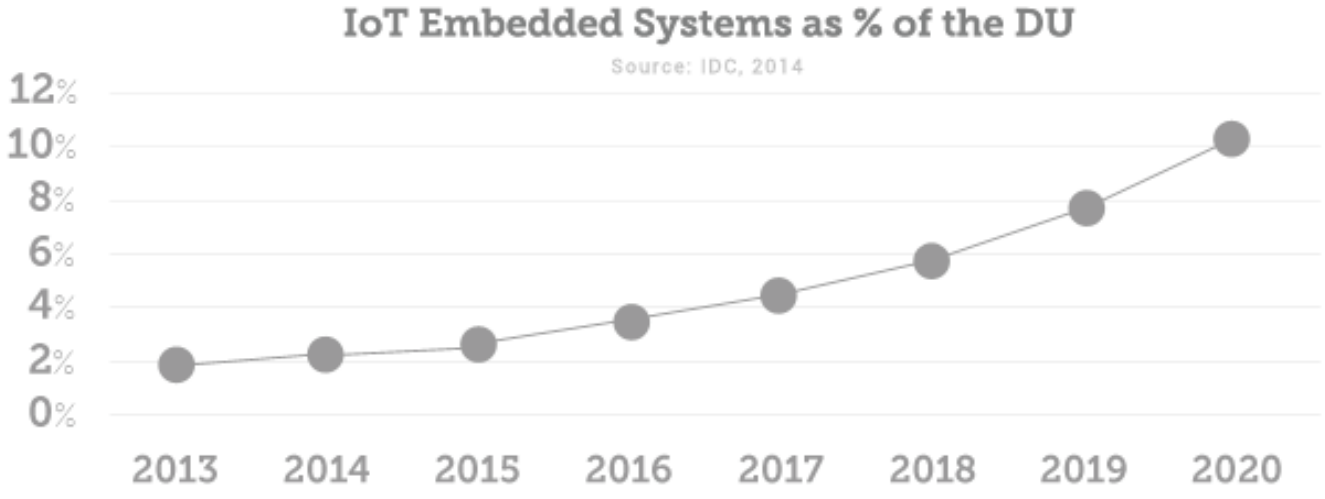
- 95% of Asset Under Utilized
- Missed Business Opportunities




Source: IDC, 2014




# Internet of Things Digital Universe




The impact of the IoT is already visible in the digital universe. Data just from embedded systems – the sensors and systems that monitor the physical universe – already accounts for 2% of the digital universe. By 2020 that will rise to 10%.

Source: IDC, 2014

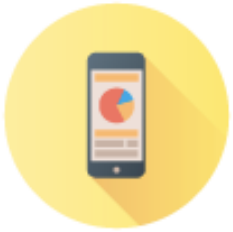
# IoT Creating New Opportunities for Business in 5 Ways

## New business models

The IoT will help companies create new value streams for customers, speed time to market, and respond more rapidly to customer needs.

## Real-time information on mission-critical systems

Enterprises can capture more data about processes and products more quickly and radically improve market agility.



## Diversification of revenue streams

The IoT can help companies monetize additional services on top of traditional lines of business.

## Global visibility

The IoT will make it easier for enterprises to see inside the business, including tracking from one end of the supply chain to the other, which can lower the cost of doing business in far-flung locales.

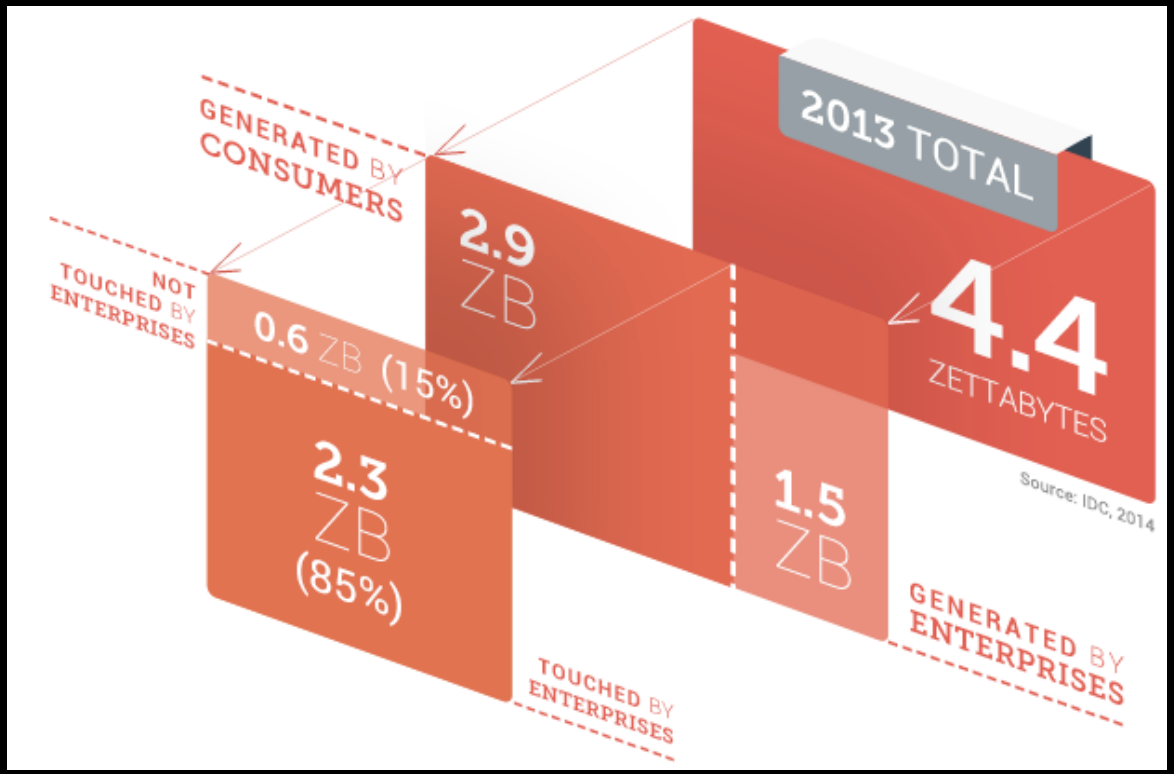
## Efficient, intelligent operations

Access to information from autonomous endpoints will allow organizations to make on-the-fly decisions on pricing, logistics, and sales and support deployment.

Source: IDC, 2014

# Information Security & Privacy

- 70% content is created by individuals—taking pictures, watching digital TV, being captured on surveillance cameras in airports, but…
- Enterprises have contact with, and therefore liability & responsibility for 85%, e.g., account information, email addresses, location stamps, etc.
- 40% require data protection; however, < 20% have protection

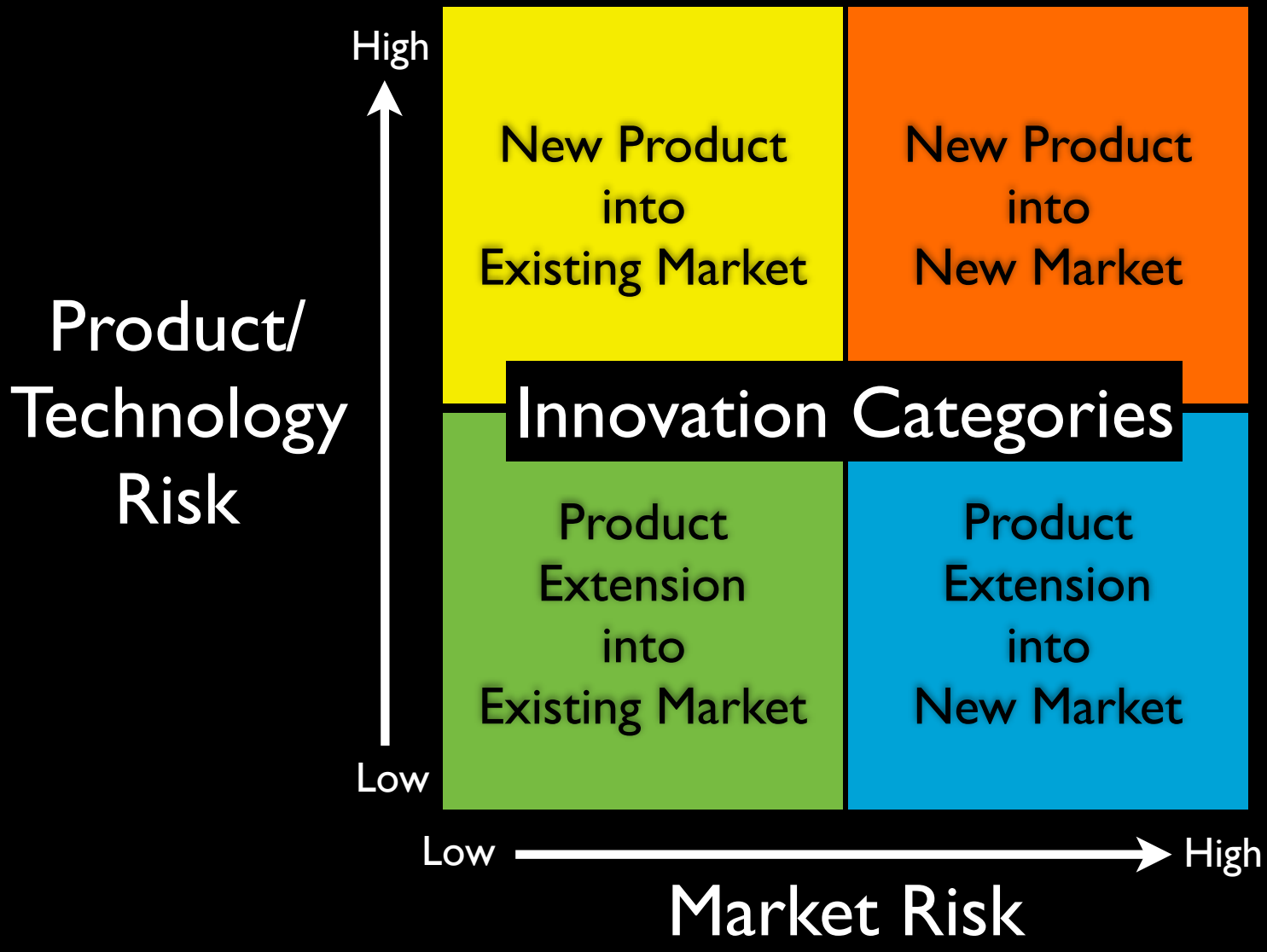


# Realities
# Time Value of Money

- Security Risks
- Technology Risks
- Market Risks
- Product Risks
- Regulatory Risks
- Financial Risks
- Business Model Risks

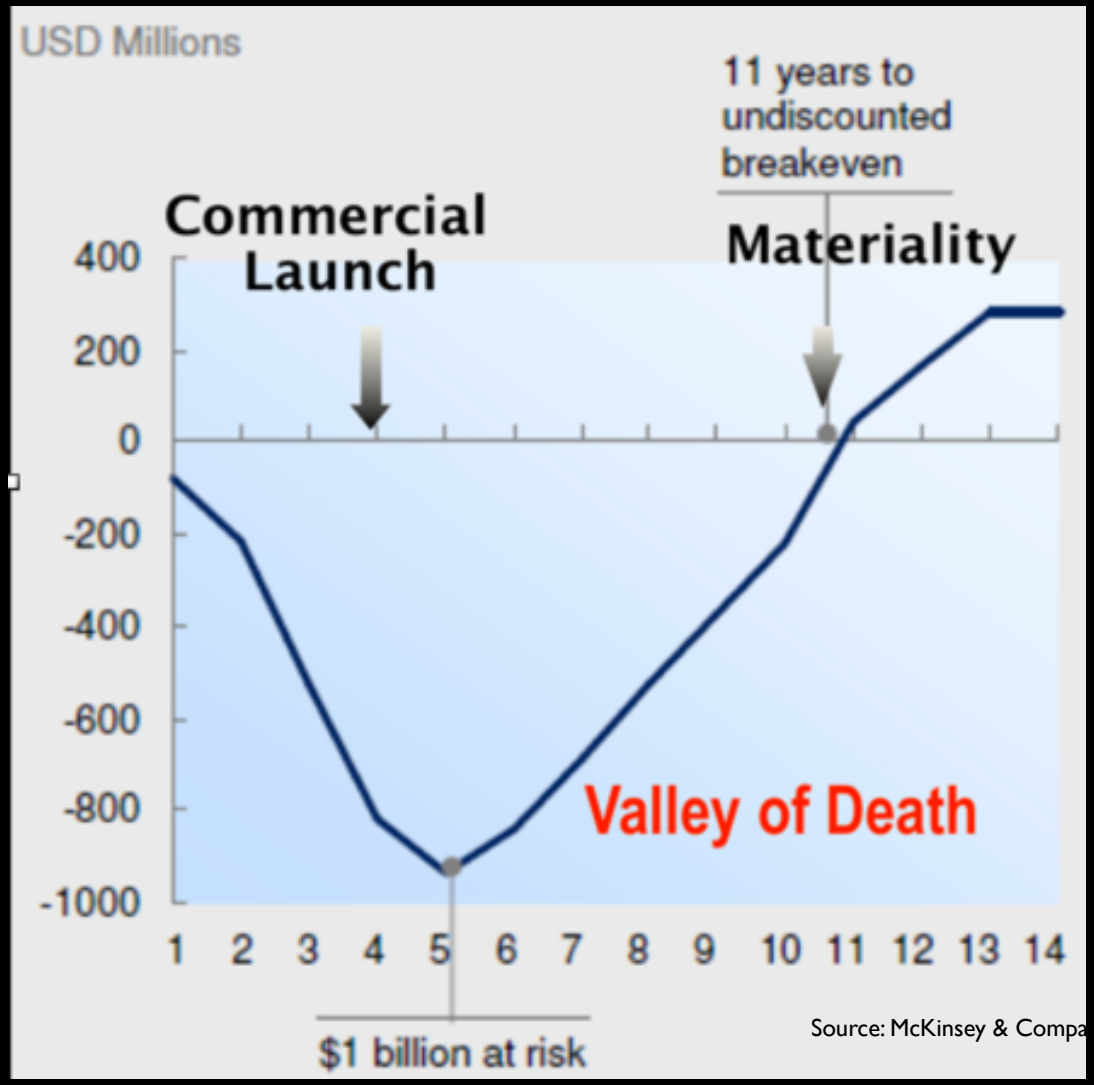
Holistic
Data Analytics...

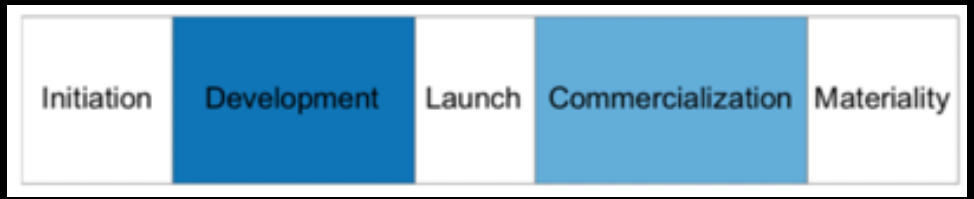
Accelerate Growth
Mitigate Risks
Maximize Profits


High
Low
Product/
Technology
Risk
New Product
into
Existing Market
New Product
into
New Market
Innovation Categories
Product
Extension
into
Existing Market
Product
Extension
into
New Market
Low
High
Market Risk

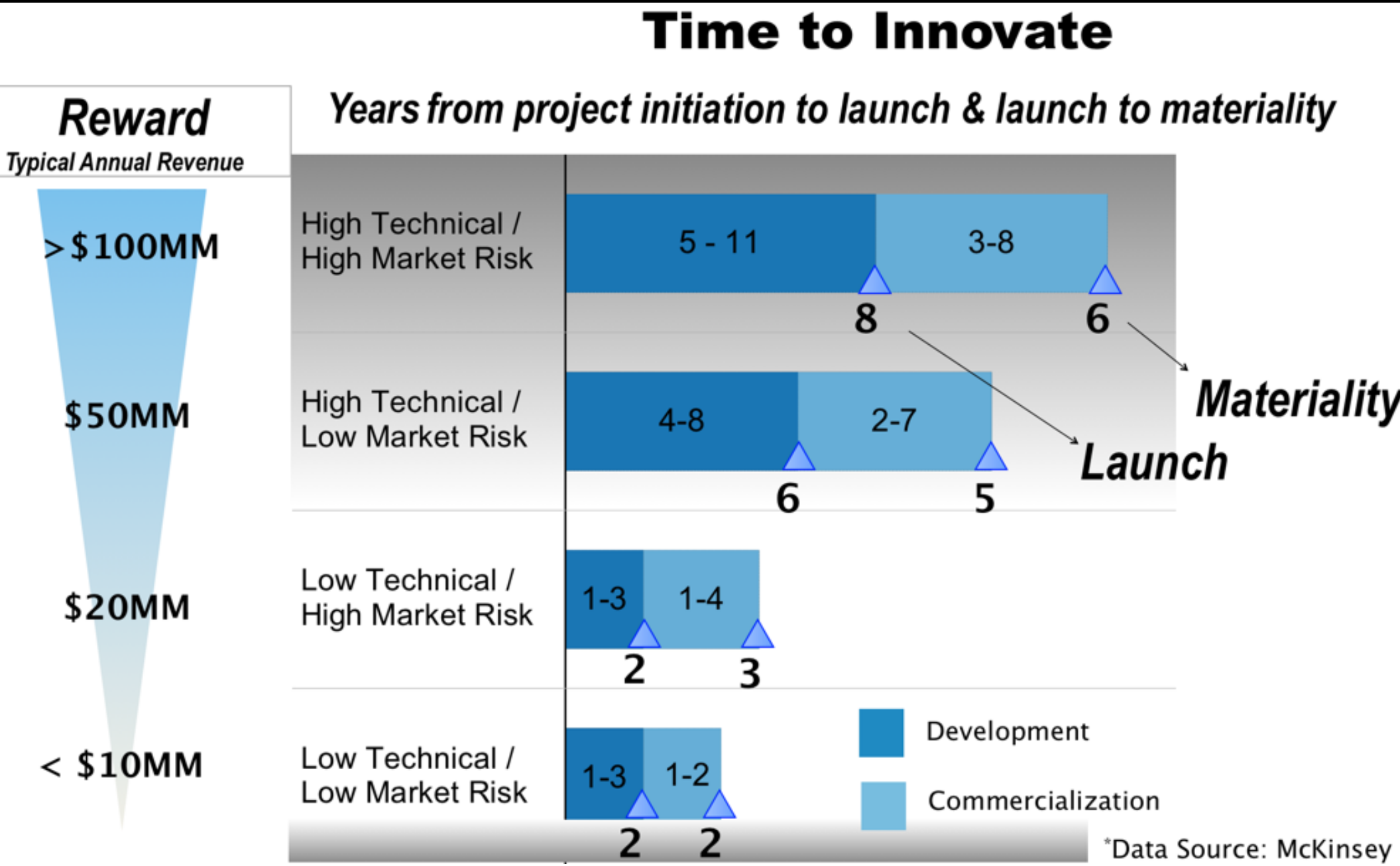
# Commercialization of New Innovations

Cumulative Free Cash Flow

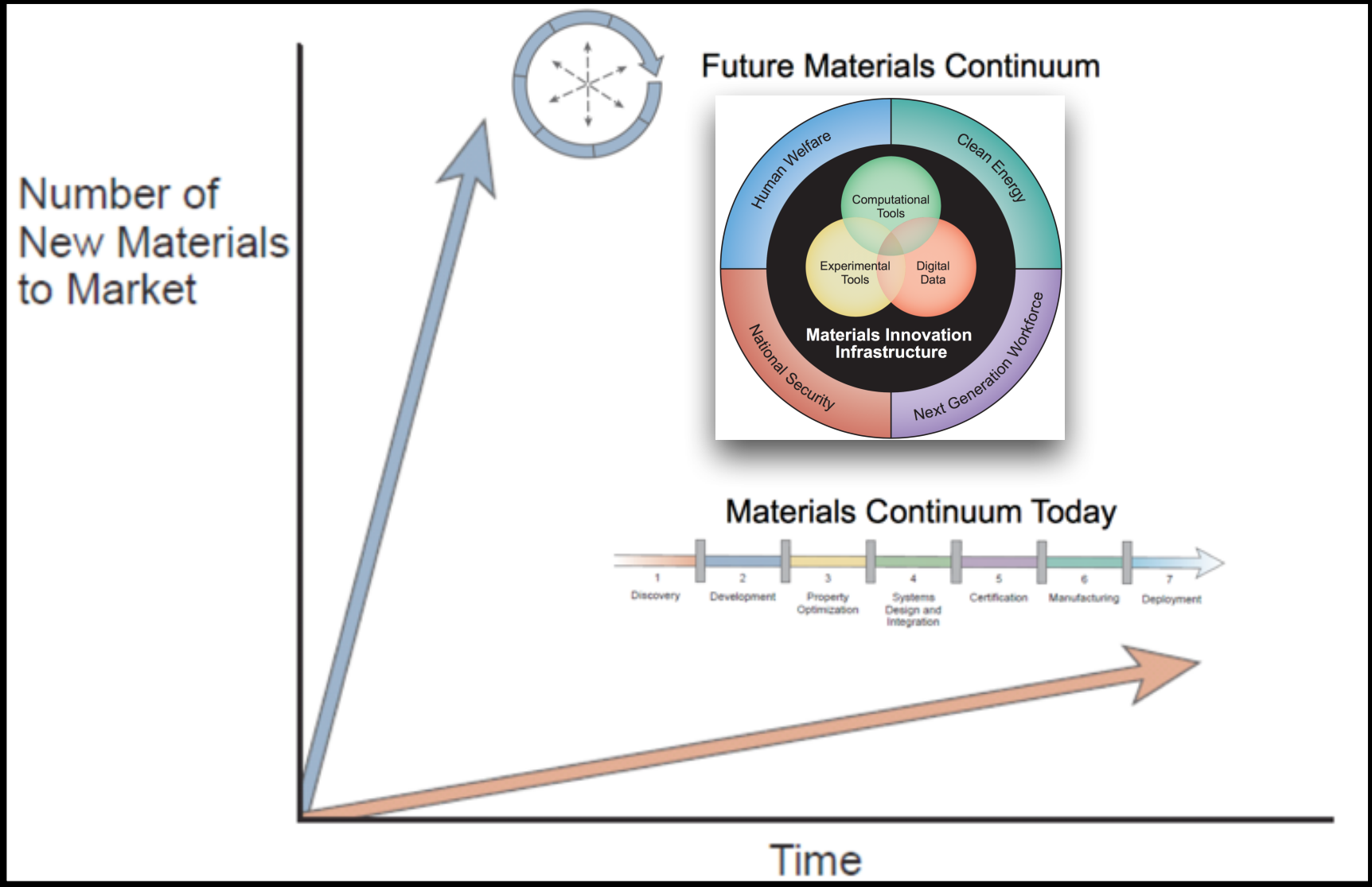


# Time Line to Innovation- Results



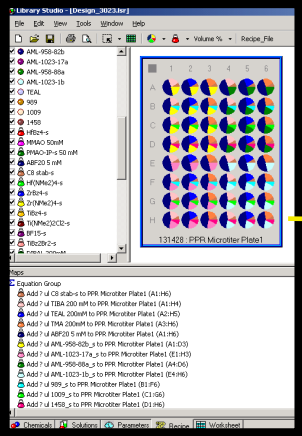
# Materials Genome Initiative




## 2x Faster….1/2 Cost

http://www.whitehouse.gov/mgi

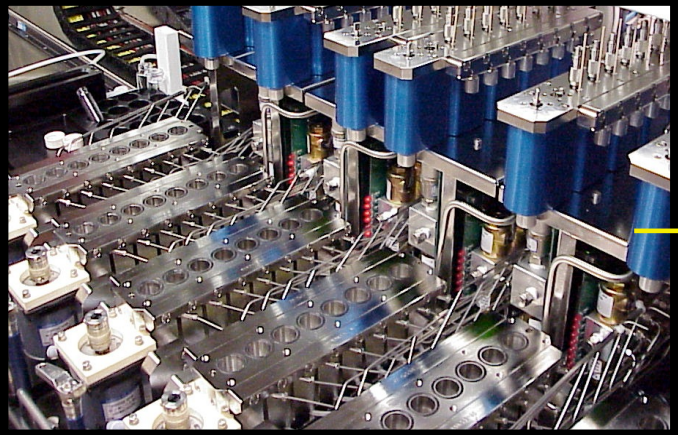
# High Throughput Discovery



Library Design

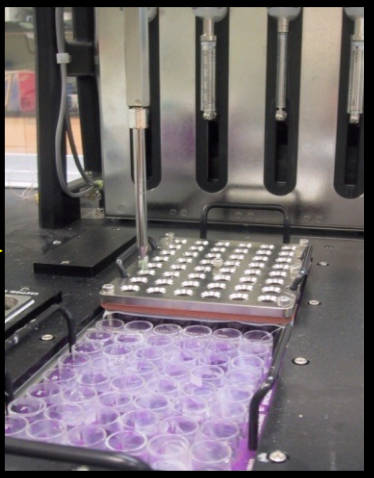
Add reagents

Make polymers

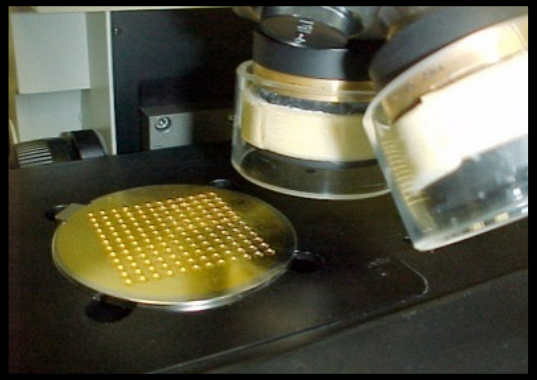


Dry Samples

Weigh Samples



High Temp Robot
Transfers Samples



Rapid Sample & Data Analysis

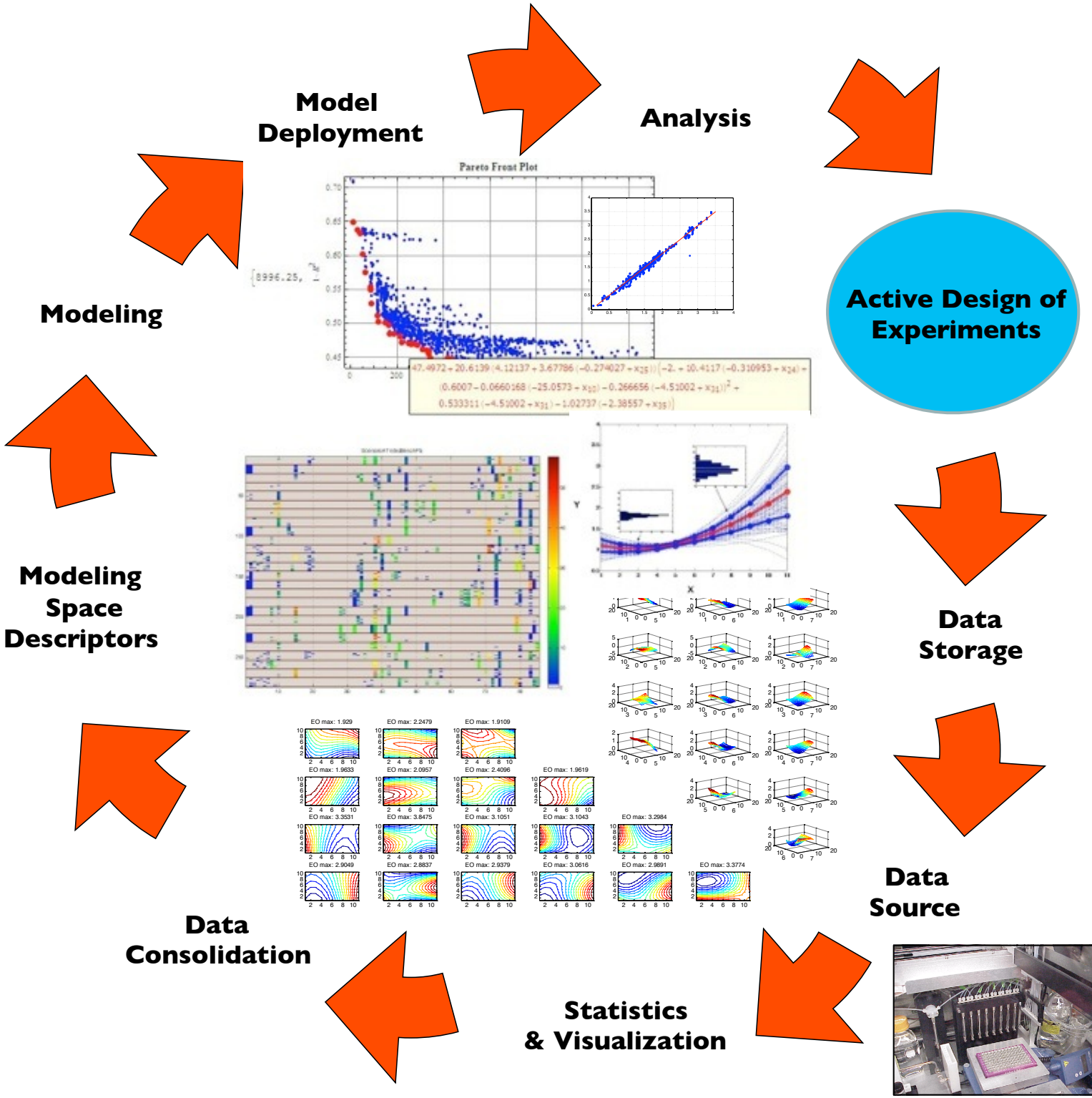
Rapid
Iteration

**Rapid Optimization**

Catalysts
Co-catalysts
Polymers
Process conditions

Source: Dow Chemical, NIST Workshop, 2012

# Informatics Critical for Active Design of Experiments and Machine Learning



# Active Design of Experiments

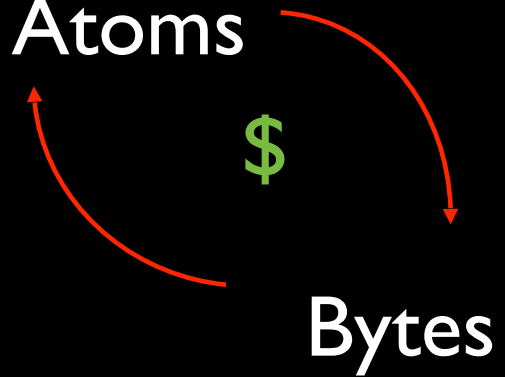
- Compute millions of options
- Computationally select most probable
- Experimentally screen most probable
- Utilize outcome to accelerate learning, discovery & decision making

## IMPACT

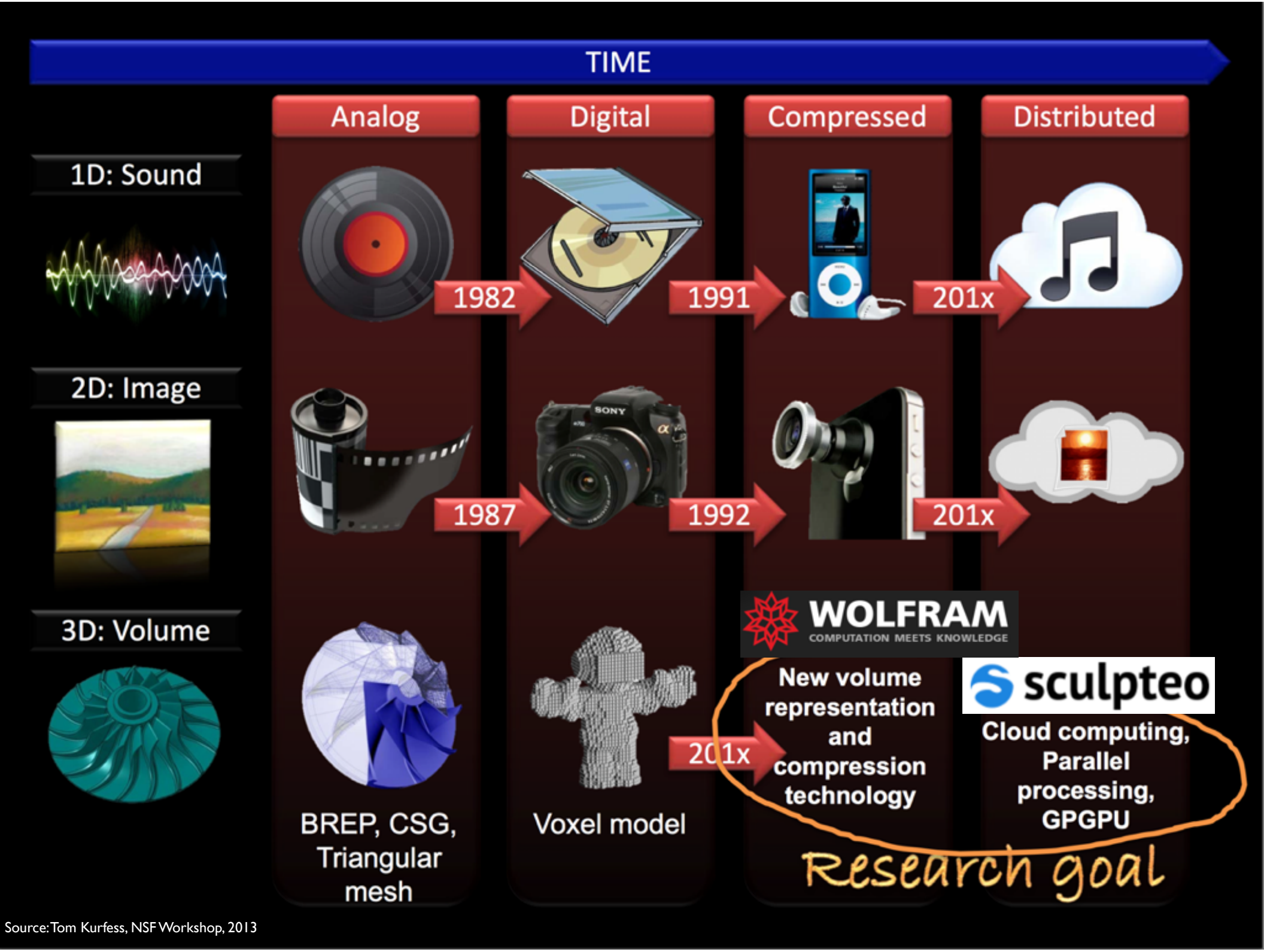

- Increase speed to market
- Deeper scientific understanding
- Discover new products
- Design better products
- Develop new processes
- Optimize engineering
- Improve effectiveness & efficiency

# Changing Market Place

- Research Discovery
- Product Design
- Application Development
- Manufacturing
- Distribution & Delivery
- Sales & Service
- Training & Education
- Publishing & Libraries




**"The future belongs to the companies and people that turn data into products"**
**Mike Loukides (2010)**




Source: Tom Kurfess, NSF Workshop, 2013

# The FOUR V's of Big Data

From traffic patterns and music downloads to web history and medical records, data is recorded, stored, and analyzed to enable the technology and services that the world relies on every day. But what exactly is big data, and how can these massive amounts of data be used?

As a leader in the sector, IBM data scientists break big data into four dimensions: **Volume, Velocity, Variety and Veracity**

Depending on the industry and organization, big data encompasses information from multiple internal and external sources such as transactions, social media, enterprise content, sensors and mobile devices. Companies can leverage data to adapt their products and services to better meet customer needs, optimize operations and infrastructure, and find new sources of revenue.

By 2015
**4.4 MILLION IT JOBS**
will be created globally to support big data, with 1.9 million in the United States

## Volume
SCALE OF DATA

**40 ZETTABYTES**
[ 43 TRILLION GIGABYTES ]
of data will be created by 2020, an increase of 300 times from 2005


It's estimated that
**2.5 QUINTILLION BYTES**
[ 2.3 TRILLION GIGABYTES ]
of data are created each day

**6 BILLION PEOPLE**
have cell phones

WORLD POPULATION: 7 BILLION

Most companies in the U.S. have at least
**100 TERABYTES**
[ 100,000 GIGABYTES ]
of data stored

## Variety
DIFFERENT FORMS OF DATA

As of 2011, the global size of data in healthcare was estimated to be
**150 EXABYTES**
[ 161 BILLION GIGABYTES ]

**30 BILLION PIECES OF CONTENT**
are shared on Facebook every month

By 2014, it's anticipated there will be
**420 MILLION WEARABLE, WIRELESS HEALTH MONITORS**

**4 BILLION+ HOURS OF VIDEO**
are watched on YouTube each month


**400 MILLION TWEETS**
are sent per day by about 200 million monthly active users

## Velocity
ANALYSIS OF STREAMING DATA

The New York Stock Exchange captures
**1 TB OF TRADE INFORMATION**
during each trading session

Modern cars have close to
**100 SENSORS**
that monitor items such as fuel level and tire pressure

By 2016, it is projected there will be
**18.9 BILLION NETWORK CONNECTIONS**
– almost 2.5 connections per person on earth

## Veracity
UNCERTAINTY OF DATA

**1 IN 3 BUSINESS LEADERS**
don't trust the information they use to make decisions

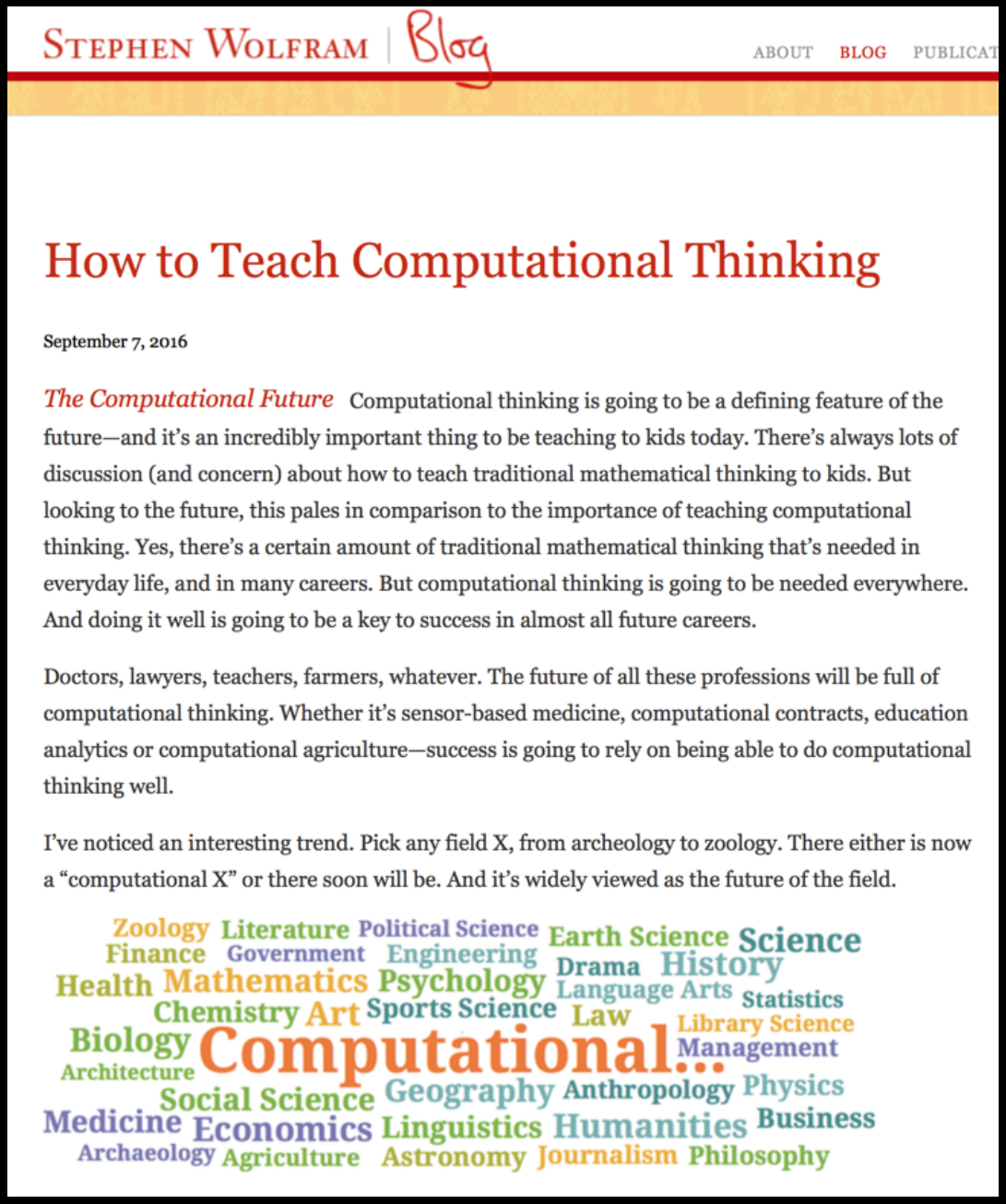

in one survey were unsure of how much of their data was inaccurate

Poor data quality costs the US economy around
**$3.1 TRILLION A YEAR**

**Sources:** McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTEC, QAS

IBM

# Computational Thinking



STEPHEN WOLFRAM | Blog

ABOUT BLOG PUBLICAT

## How to Teach Computational Thinking

September 7, 2016

*The Computational Future* Computational thinking is going to be a defining feature of the future—and it's an incredibly important thing to be teaching to kids today. There's always lots of discussion (and concern) about how to teach traditional mathematical thinking to kids. But looking to the future, this pales in comparison to the importance of teaching computational thinking. Yes, there's a certain amount of traditional mathematical thinking that's needed in everyday life, and in many careers. But computational thinking is going to be needed everywhere. And doing it well is going to be a key to success in almost all future careers.

Doctors, lawyers, teachers, farmers, whatever. The future of all these professions will be full of computational thinking. Whether it's sensor-based medicine, computational contracts, education analytics or computational agriculture—success is going to rely on being able to do computational thinking well.

I've noticed an interesting trend. Pick any field X, from archeology to zoology. There either is now a "computational X" or there soon will be. And it's widely viewed as the future of the field.

Zoology Literature Political Science Earth Science Science
Finance Government Engineering Drama History
Health Mathematics Psychology Language Arts Statistics
Chemistry Art Sports Science Law Library Science
Biology Computational... Management
Architecture
Social Science Geography Anthropology Physics
Medicine Economics Linguistics Humanities Business
Archaeology Agriculture Astronomy Journalism Philosophy

***"It's about formulating things with enough clarity, and in a systematic enough way that one can tell a computer how to do them."***
***Stephen Wolfram***

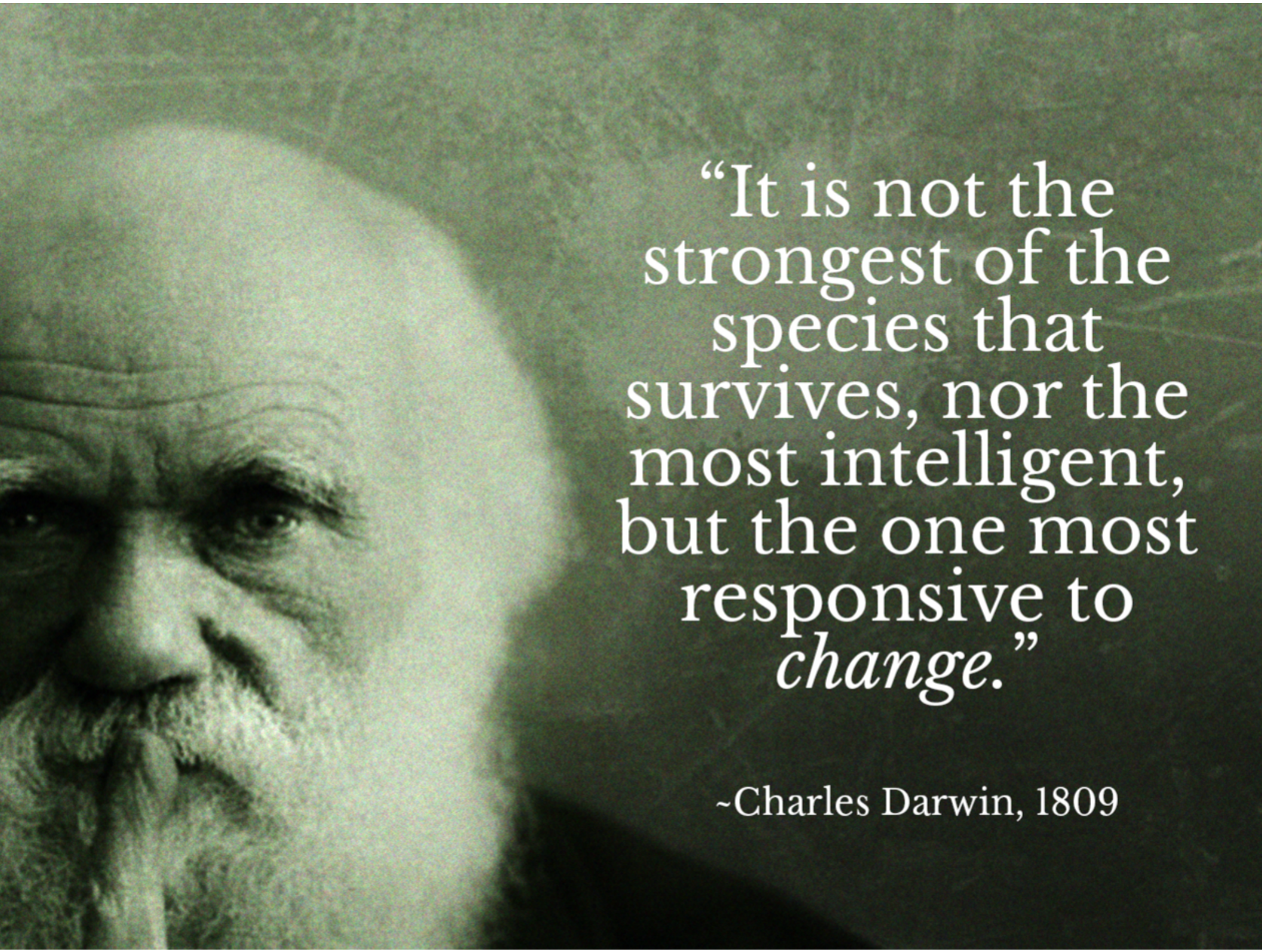
**<u>Cross-Disciplinary Collaborations in Computing (C3) Initiative</u>**

Provides framework for partnerships among colleges & universities to respond to the national & local need for greater access to computing competencies and computational & analytical thinking, especially for students not intending to major in computer science.

Harvey Mudd, Claremont McKenna College, Cornell Tech, Stanford University

# Conclusions…

- Revolution in our capability to **generate** data as well as to **analyze** and **create VALUE** from it
- Enterprises need to establish training programs to prepare workers and build & manage the **capability for the long term**
- **Middle schools, high schools, universities & local communities** should provide opportunities for students to participate in team-based engineering design experiences & learn to use emerging digital & distributed tools
- **Businesses, local school districts, labor & community colleges and universities** should form partnerships to help students graduate from high school, earn an associate's or bachelor's degree, and take part in continuing education in the workplace
- **Businesses, industry associations and higher education institutions** should work together to establish national skills certifications that are recognized and count towards a degree program, and improve access for students and workers to gain these certifications.


“It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to *change*.”
~Charles Darwin, 1809