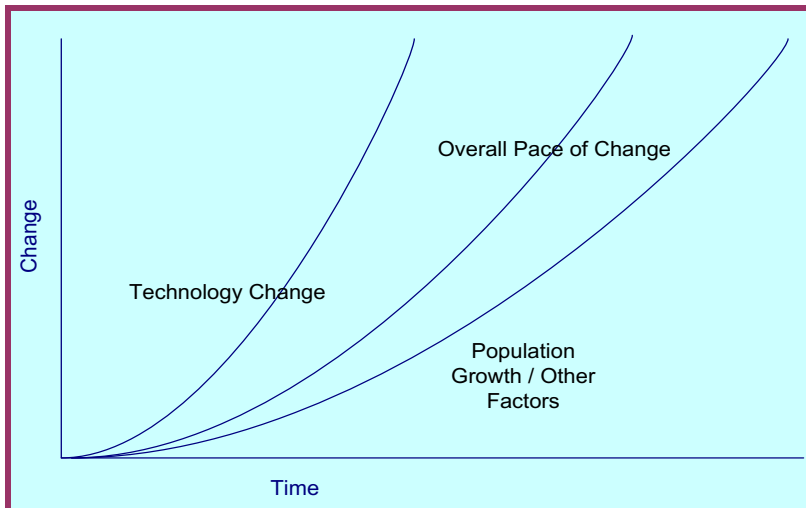


# *Change is Shaping our Future*

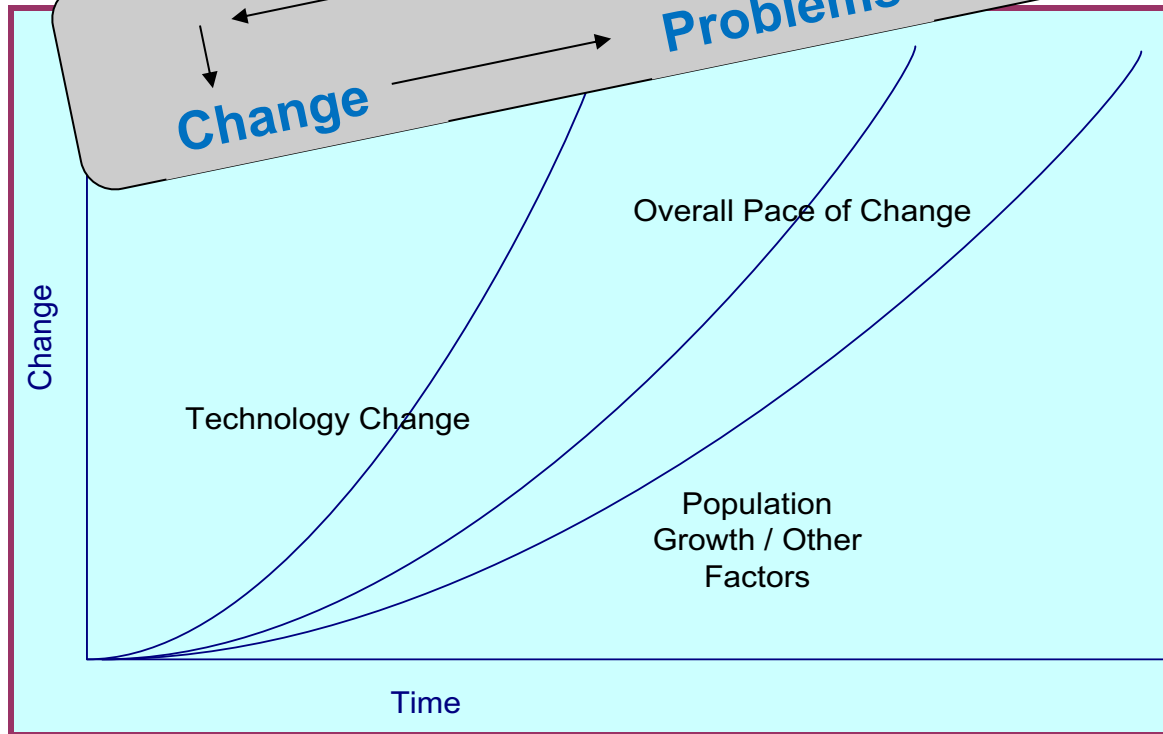


*Presented by Dr. David Gould*

# *Pace of Change*

Research

Exponential Growth



Contributing Factors

1. Population Growth
2. Process Improvement
3. Innovation
4. Product Combinatorics
5. Market Demand
6. Globalization
7. Cost Reductions

Societal knowledge doubles every 8 – 10 years: Ray Kurzweil

Processing speed doubles every 12 – 18 months: Moore's Law

It must be considered that there is nothing more difficult to carry out nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things.

Niccolo Machiavelli (1469-1519)

# Purpose

## **To review .....**

Economic, technology, societal, government, and environmental trends, events, and forecasts shaping our future

## **And**

To think about implications for leadership and possible research ideas

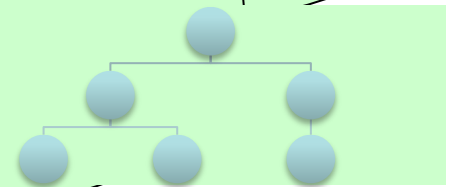
# Contents

- Environmental Context
- Trends, Events, Forecasts
- At the Edge
- Wrap up

# Environmental Context

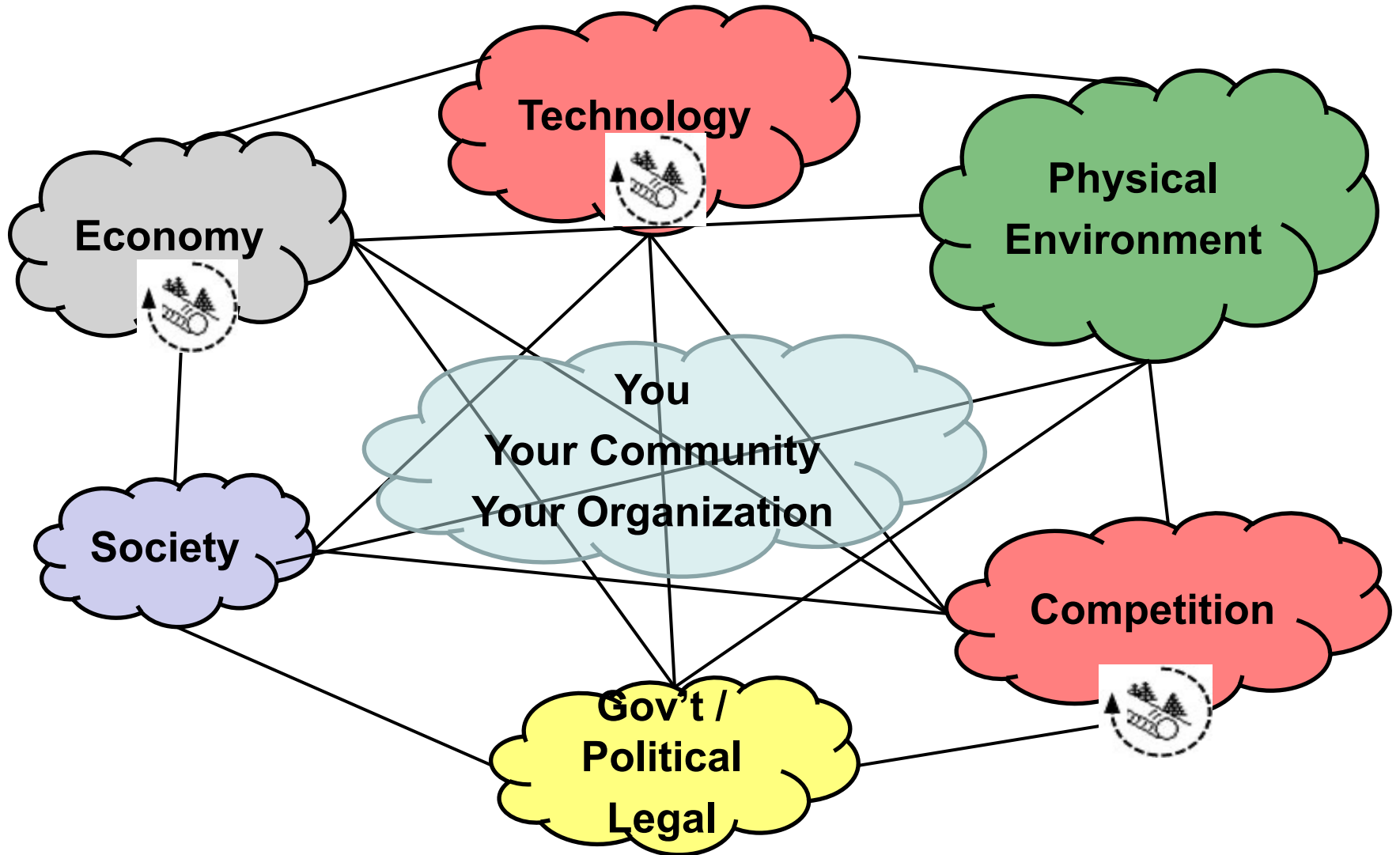
## A Universe of Complex Systems

A complex system is a group of “agents” existing far from equilibrium, interacting through positive and negative feedbacks, forming interdependent, dynamic, evolutionary networks, that are sensitive dependent, fractionally organized, and exhibit avalanche behavior (abrupt changes) that follow power-law distributions.



# Environment Context

A network of complex systems



# The times, they are a'changing!

- Pace of change is driven by two primary factors:
  - Change in one or more of the economy, technology, government, society, physical environment, and competition.
  - And changes resulting from interactions and combinations of two or more of the economy, technology, government, society, physical environment, and competition

Example: Rapid advances in smartphone technologies along with a drop in prices led to a rapid adoption by society.



# Past, Present, and Future Societal Patterns

- Change occurs as an outcome of interactions among these key elements:
  - Society
  - Economy
  - Technology
  - Government, Military, Legal
  - Physical environment
  - Competition

# Past, Present, and Future Societal Patterns

- Past, present, and future patterns and cycles include:
  - Economic cycles
  - Innovation cycles
  - Tragedy of the commons (resource usage and depletion)
  - Escalation (war, conflict, revolution)
  - Limits to growth (overshoot and collapse)
  - Positive feedback loops (boom and bust)
  - Negative feedback loops (goal seeking)
  - Birth / death
  - ..... And several more

# Systems Model

Material, Energy,  
Messages (Information +)

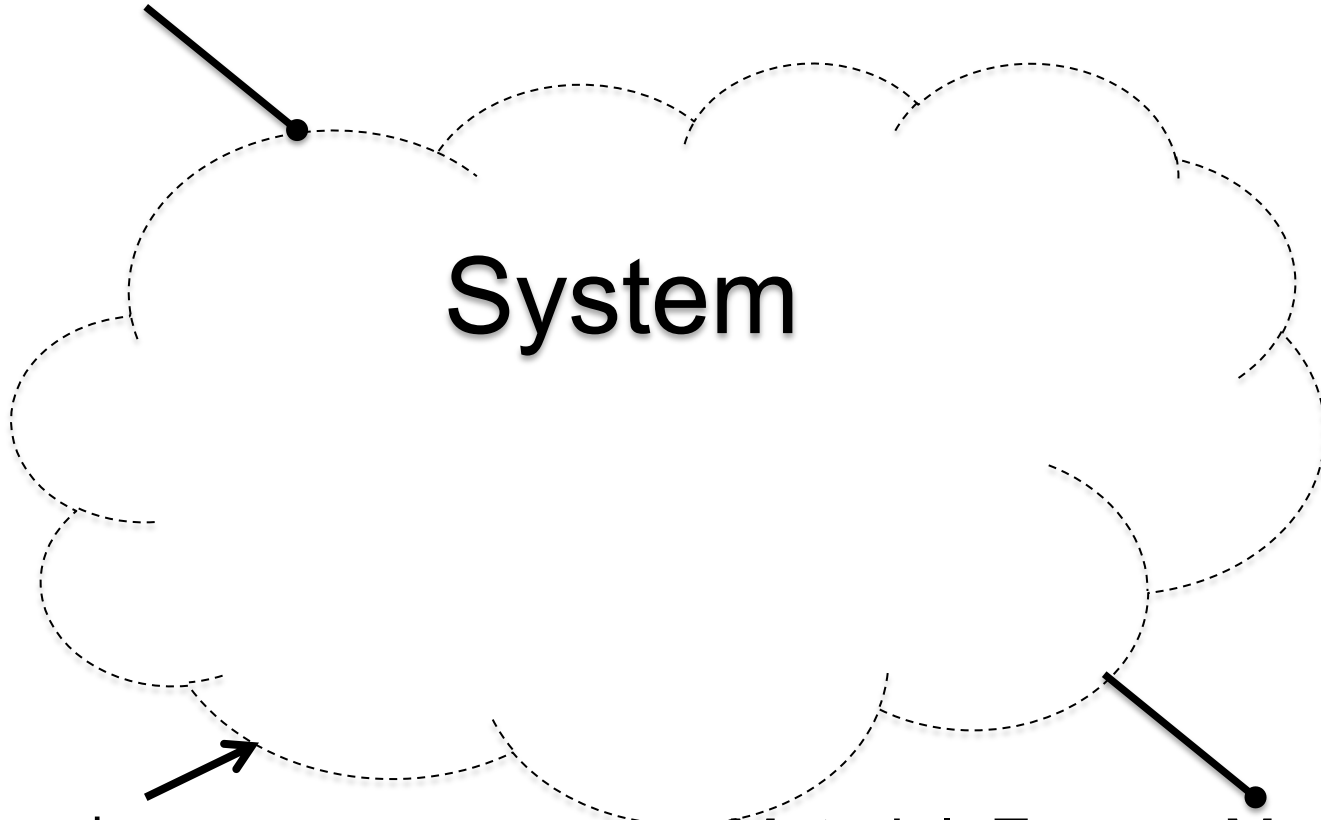
Environment

**Thresholds**  
(tipping  
points)

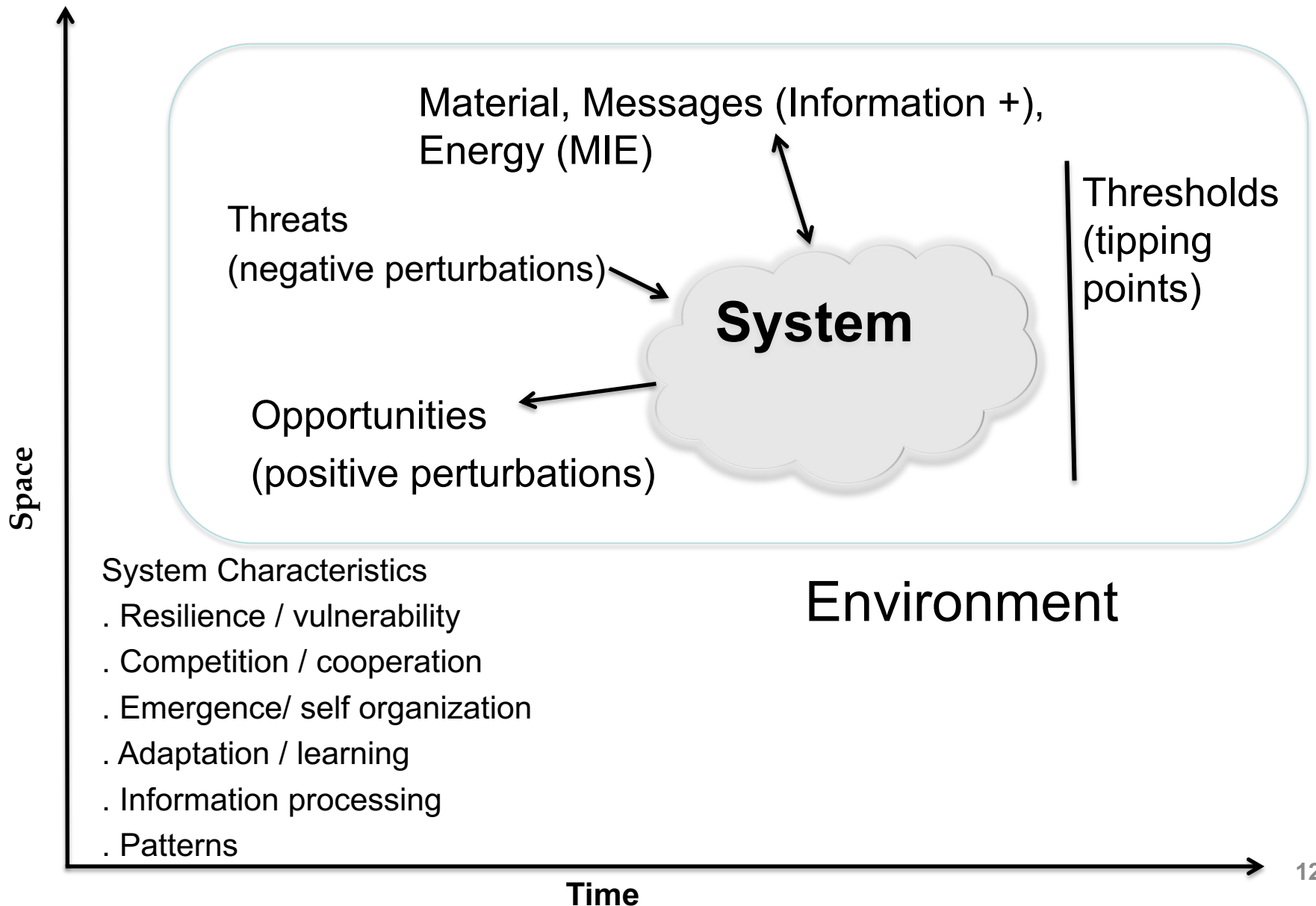
**System**

Boundary

Material, Energy, Messages  
(Information +)



# A Complex Systems Model



# Economy

## Employment

- Jobs (in round numbers)
  - 18% in F500
  - 15% in Public Service
  - 75% in small / mid-size business and NGOs
- Startups account for most job growth



Implications for leadership, ideas for research?

# Economy

## Inequality

- Increasing inequality (rich-poor) gap in U.S.
  - Charitable Giving
  - Civic Engagement
  - Education
  - Family Structure
  - Health / Lifespan
  - Income / Wealth
  - Opportunity
- U.S. Top 1% 25 years ago
  - 12% of income, 33% of wealth
- U.S. Top 1% today
  - 25% of income, 40% of wealth



Implications for leadership, ideas for research?

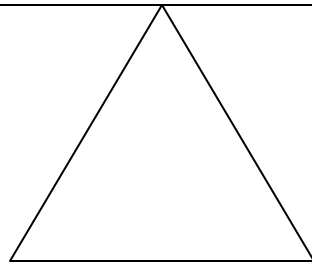
Source: Joseph Stiglitz, Enrico Moretti

# Economy

## Wealth Inequality

Top 85

Bottom 3,500,000,000



# Economy

## Inequality: Consumption

- The top 5% make up 38% of U.S. domestic consumption
- This is up from 28% in 1995.

Where is the middle?

Is there a middle?

Implications for leadership,  
ideas for research?



# Economy

## Debt

- U.S. student loan debt >> U.S. credit card debt as of 2011-2013-2023



~ 1.5 T USD

>>



~ 1 T USD

# Economy

## Cities



- In 2010,
  - Large U.S. cities generated ~85% of the nation's GDP
- By 2025,
  - the largest 259 U.S. cities are projected to generate > 10% of global GDP growth
  - City 600 GDP will increase over \$30 T or ~ 65% of global growth
  - Over \$10 T in additional **annual** investments will be needed in cities worldwide

Implications for leadership, ideas for research?

# Economy

## World Economies

- 2010

1. US
2. China
3. Japan
4. India
5. Germany
6. Russia
7. Brazil
8. UK
9. France
10. Italy



- 2050

1. India
2. China
3. US
4. Indonesia
5. Brazil
6. Nigeria
7. Russia
8. Mexico
9. Japan
10. Egypt

# Economy

## The iEconomy



The economic growth of nations is linked to one factor: adoption of information and communication technology

The more advanced the country, the greater the impact of digitization, which establishes a virtuous cycle: A country reinforces and accelerates its own progress as it moves along the line

**Might this be true for cities, communities, families, individuals?**

# Economy

## Healthcare

- 18% of U.S. economy is health care and the percentage is increasing
  - Most other developed countries spend about half or 9% on healthcare
  - Approximately \$3 T annually
- U.S. ranking
  - 31 / 34 of OECD countries on infant mortality
  - 27 / 34 in life expectancy
  - 33 / 34 on obesity (Mexico just passed us!)

Implications, research ideas?

# Economy

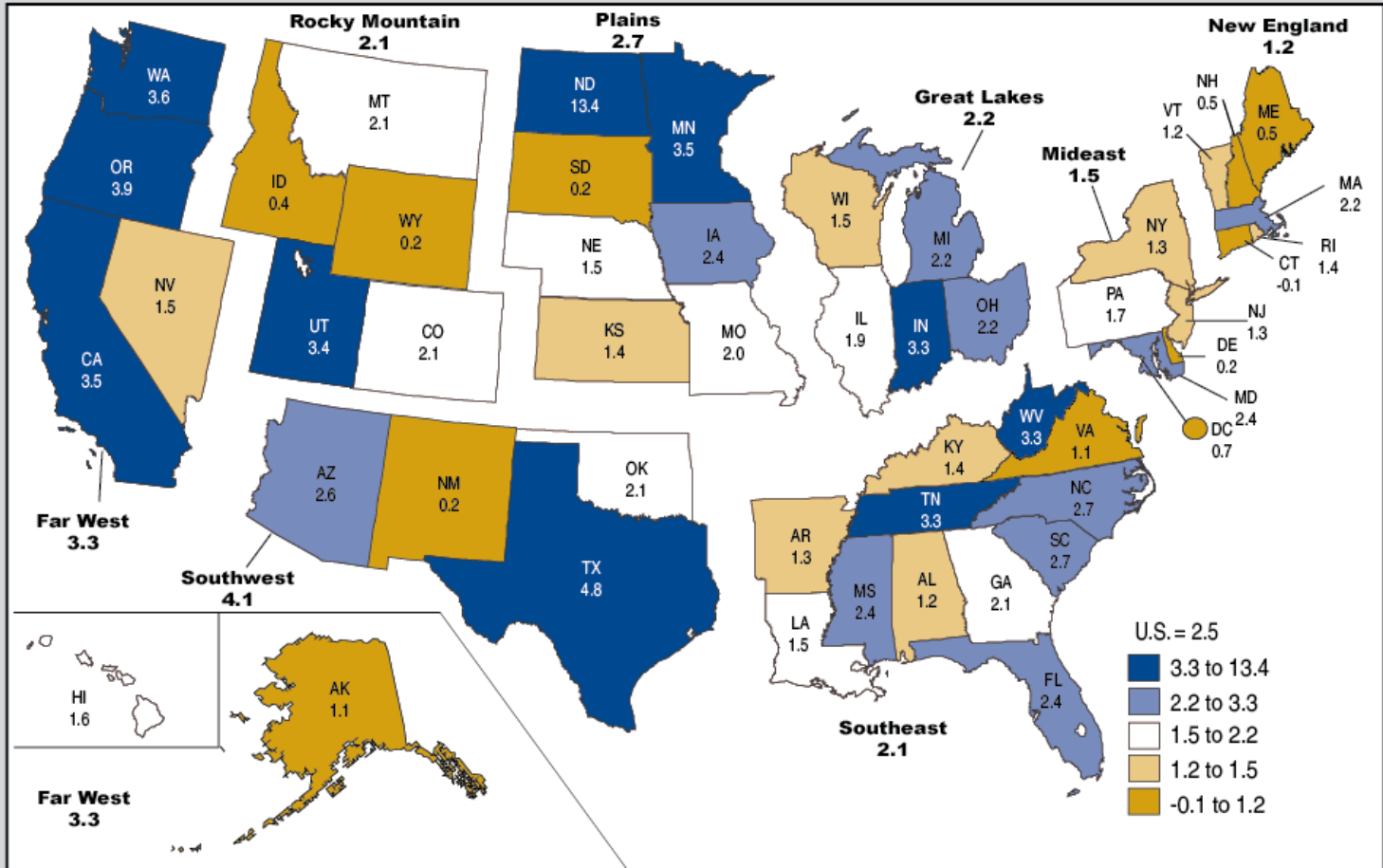
## U.S. GDP

- Year / GDP / Growth Rate / Debt to GDP
  - 1995: \$7.41 T / 2.51% / 66.68%
  - 2000: \$9.95 T / 4.13% / 57.26%
  - 2005: \$12.62 T / 3.07% / 62.59%
  - 2010: \$14.52 T / 3.03% / 91.22%
  - 2013: \$15+ T / 2.8% / 73% (Approximate)
  - 2015E: \$17.78 T / 3.31%

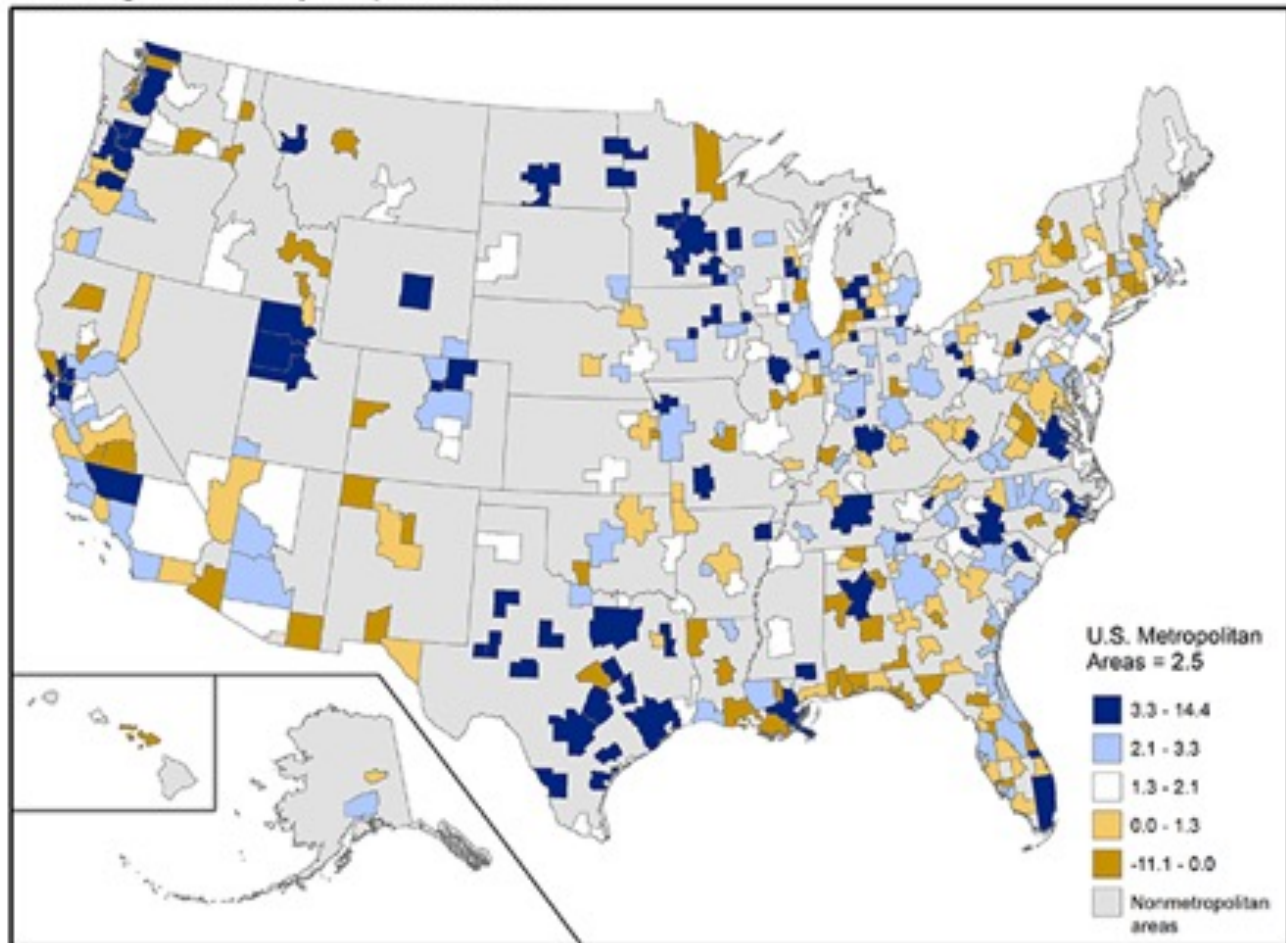
5% growth rate estimated to be required to improve society.

- Gallup

# Percent Change in Real GDP by State, 2012



Percent Change in Real GDP by Metropolitan Area, 2012



U.S. Bureau of Economic Analysis



# Technology

The processing speed of a computer doubles every 12 to 18 months. Along with this comes disk storage and bandwidth.

Continued miniaturization of electronic components

Speech, touch, gesture, motion, and thought... interfaces

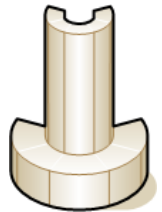


# Technology

## Processing Speeds

Exponential Curve

- iPad 2
  - 170 megaflops ( $10^6$ )
- Cat Brain
  - 61 Million megaflops ( $10^{12}$ )
- Human Brain
  - 2.2 Billion megaflops / petaflops ( $10^{15}$ )
- Super Computer
  - 34 Billion megaflops / petaflops ( $10^{15}$ )
  - One megaflop = one million floating point operations per second



On the horizon, superfast computers with processing speeds measured in exaflops ( $10^{18}$ ), and some day in yottaflops ( $10^{24}$ ) 2030E 😊

# Processor Performance

- Intel 4004
  - 2300 transistors
- Intel 80386
  - 275,000 transistors
- Apple M1 Ultra
  - 114 billion transistors
- Apple M2 Ultra
  - 134 billion transistors
  - 15 ++ trillion operations per second (15 million billion operations per second)
- NVIDIA RTX 4090 GPU
  - 76 billion transistors
- Apple M3 Max
  - 92 billion transistors

# Human Brain Processing Speed

- The human brain is not optimized for sequential processing as a computer's CPU is.
- Some estimates are that the human brain can process at about 1,000 instructions per second.
- The human brain is optimized for image processing.

# Technology

Business processes will be transformed by increasing levels of:

- Efficiency
- Self-service
- Automation / mechanization
- Outsourcing / off shoring
  - Note 1: Once a process / job can be well-defined or scripted, it can become self-service, automated, outsourced, offshored or some combination of the above. That is, the job may well disappear
  - Note 2: The next source of low cost labor will be **robotics**
  - Note 3: The next source of low cost talent will be **software**



# Technology--Healthcare



- Digital Biology
- mHealth Monitoring
  - Sensors and other device add-on's and software apps for Smartphones and other mobile products
  - Apple Watch and iPhone, and other devices, can do all or some of the following: monitor distance walked, run or bicycled; compute number of calories burned; elevation gained / lost; test blood oxygen, monitor heart rate, and more...
- Robotic Assisted Surgeries
- Telemedicine
- Tissue Engineering

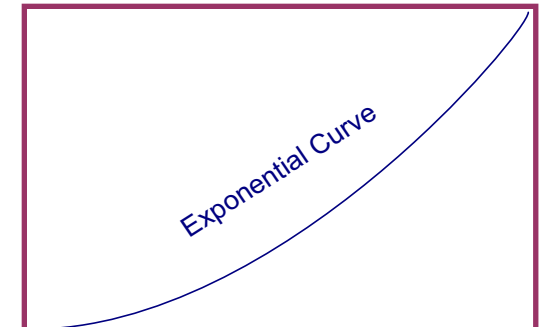
# Technology

- 10-20 years ago
  - Camera
  - CD Player
  - Cell Phone
  - Calculator
  - Clock Radio
  - Encyclopedia
  - Flashlight
  - Library
  - Newspaper
  - Notepad
  - Photo Album
  - Radio
  - Stereo
  - Watch

- Today
  - Smartphone



- Today / Tomorrow?
  - ✓ Education Manager
  - ✓ Health Care Manager
  - ✓ Home Manager
  - ✓ Travel Agent
  - ✓ Wallet
  - ✓ ....

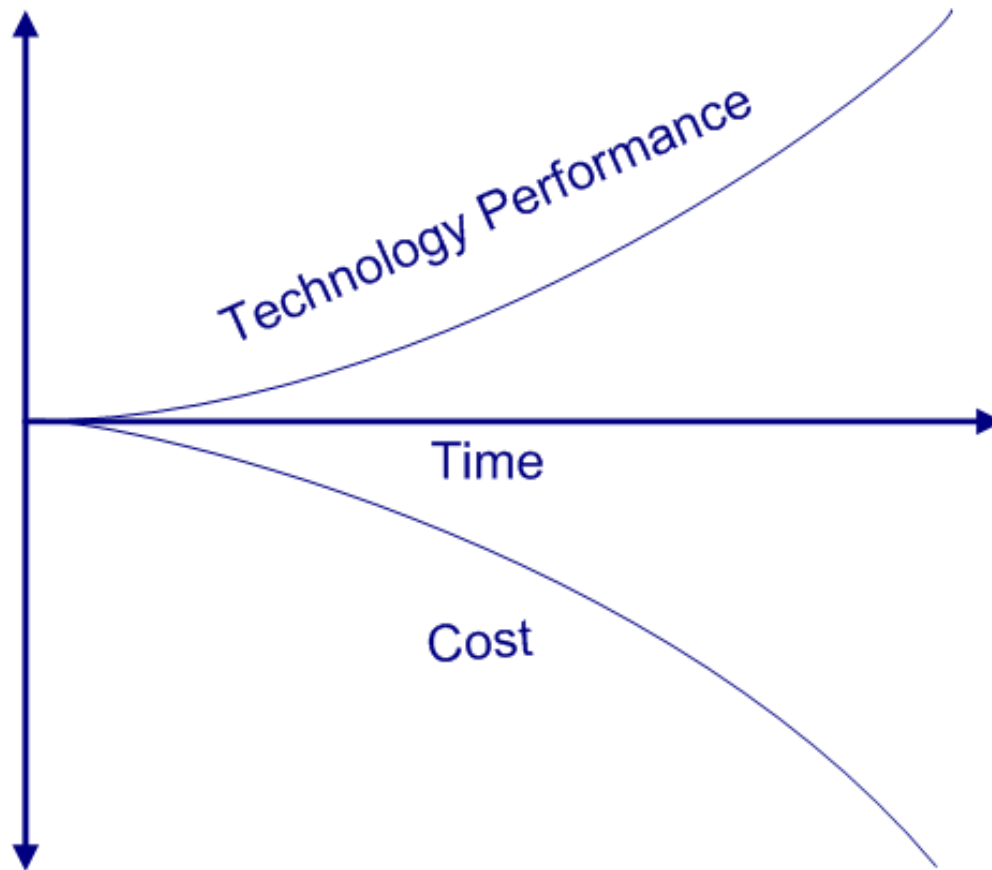


A few thousand dollars to a few hundred plus a few dollars monthly and it fits into a pocket

Supply chain issues, job loss, ... or ??

# Technology

## Wright's Law



*Learn by doing.*

A generalized Moore's Law. The performance of a technology increases while the cost decreases.

Think aerospace, biotechnology, energy, information technology, medical technology, ...



# Technology

## Transformational Technologies

1. Mobile internet
2. Automation of knowledge work (AI)
3. The Internet of things (IoT)
4. Cloud technology
5. Advanced robotics
6. Autonomous and near-autonomous vehicles
7. Next-generation genomics
8. Energy storage
9. 3D printing
10. Advanced materials
11. Renewable energy
12. Advanced oil and gas exploration and recovery

And of course many more interesting technologies. Implications for managers?

Will leaders need to be more “tech savvy?”

# Society

World population projected to increase from 7 billion today to 9.2 billion by 2050.



55,000,000 per year  
A new California every year

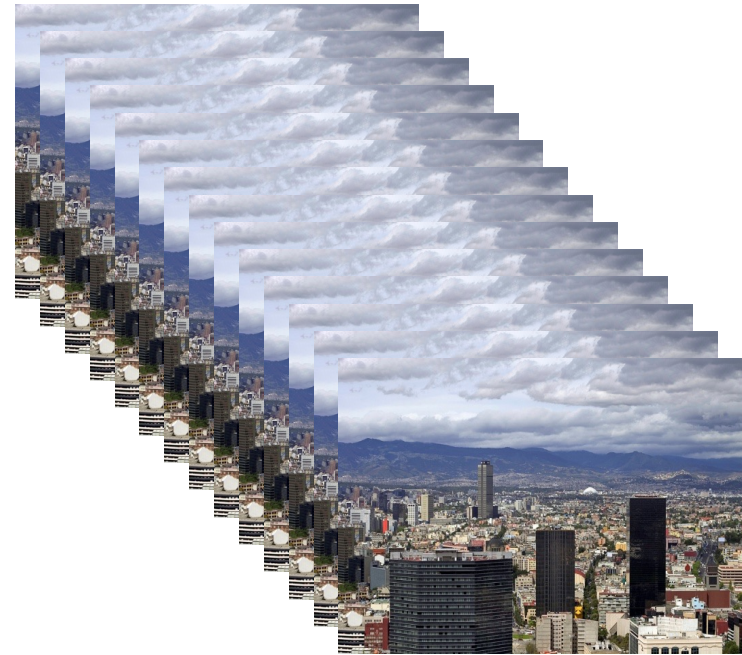
U.S. population projected to increase from 308 million today to 440 million by 2050.



3,300,000 per year  
A new Chicago every year!

# Society

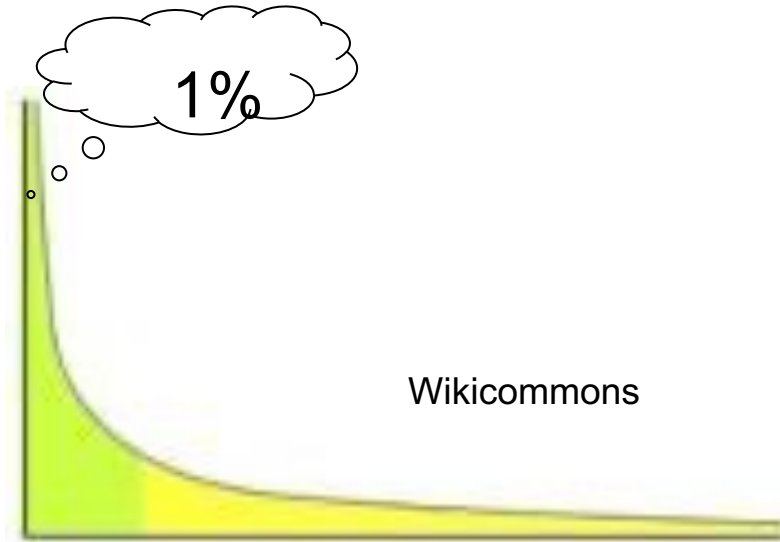
- Migration / sorting
  - World population increase living in cities from 50% today to 70% by 2050
    - This will require the construction of four thousand Seattles over the next 40 years.
    - One million per week moving to cities
  - Continued sorting out into like-minded cultural communities
- Polarization
  - Continued polarization of world views, values, mental models, education, belief systems



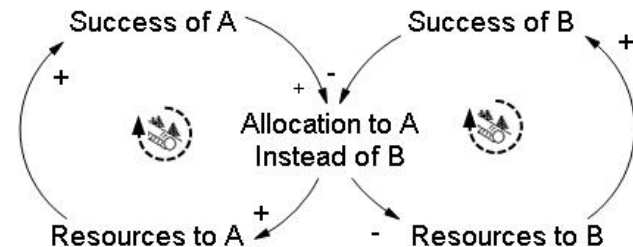
Implications for leadership,  
ideas for research?

# Society

- Pareto's Law (80/20)
  - Few have more, most have less
- Examples
  - Income attainment of people, states, counties, cities, companies
  - Wealth attainment of people, states, counties, cities, companies
  - Education attainment
  - Hospital visits
  - Plus ?????



Success to the Successful Archetype



Implications for leadership,  
ideas for research?

# Society

## The Big Sort



- America may be more diverse than ever coast to coast, but the places where we live are becoming increasingly crowded with people who live, think, and vote like we do.
  - Source: Bill Bishop, *The Big Sort*
  - <http://www.thebigsort.com/home.php>
- Voluntary segregation!

*We live in the same country,  
but inhabit different worlds*

# Society

## United States



- **United States is becoming bigger, older, and more ethnically and racially diverse**
  - Over 65, projected to increase from 13% in 2010 to 20% by 2050
  - White population projected to decline from 81% in 2000 to 74% by 2050
  - African American and Asian population projected to increase from 19% in 2000 to 26% by 2050
  - Racial and ethnic minorities make up over 50% of children born as of 2011
  - Six states have minority majority populations: Hawaii, California, New Mexico, Nevada, Texas, and Maryland. An additional 11 states have less than 60% non-Hispanic white population: Alaska, Arizona, Louisiana, Mississippi, Florida, Georgia, Illinois, New York, New Jersey, Delaware, and Virginia.
  - **We are a nation of mutts!**
    - **David Brooks**

U.S. Census Bureau-2011, 2012

# Society

## United States



### Lifespan

1900: 47

1950: 68

2000: 77

2050: ??

### Population

1850: 25 million

2011: 302 million

2050: 440 million?

2100: 1 billion?



# Society

## United States

- Baby Boomers and Retirement
  - 2030—Baby Boomers retired
  - Between 2011 and 2030, approximately 10,000 boomers per day will reach age 65

Implications for leadership,  
ideas for research?



# Society

## United States



- Blue or red / urban or rural or ???
- 3143 counties
  - 1135 or about 1/3 losing population (D > B or ?)
- Maps



- 12 Community types
  - Boom towns
  - Campus and careers
  - Emptying nests
  - Evangelical epicenters
  - Immigration nation
  - Industrial metropolis
  - Military bastions
  - Monied burbs
  - Mormon outposts
  - Service worker centers
  - Tractor country

Chinni, D., & Gimpel, J. (2010). *Our patchwork nation: The surprising truth about "real" America*. New York, NY: Penguin

# Society

What might be some tipping points for society?

Has any society tipped before?

Are there any ideas for research or implications for leaders?

**Education is about freedom!**

Education in its truest sense is not about “a saleable skill set.”

It's about freedom from inherited prejudice and argument by authority.

Joshua Epstein

# Society

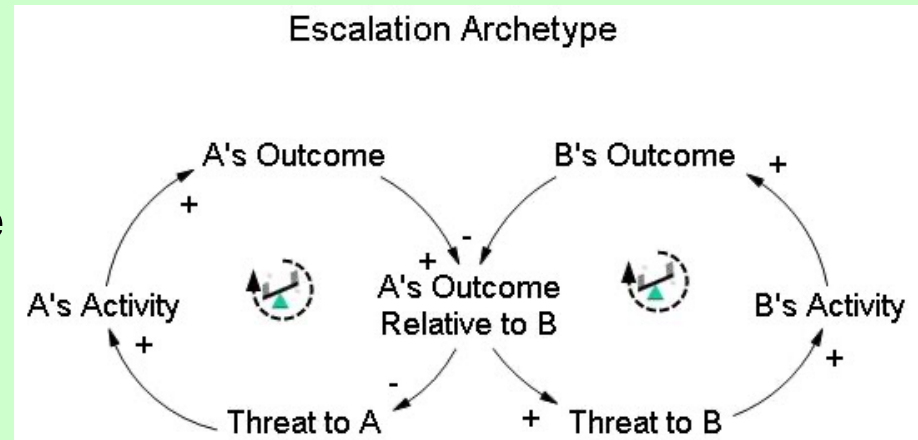
## War

- Commoditization of weapons of war
- Cyber warfare
- Cyber kidnapping
  - Identity theft
- Virtual terror groups
  - Domestic / transnational / nonstate
- Personal drones
  - Complete with cameras, bombs, under remote control and in the future, autonomous control

# Government / Political / Legal



- Political gridlock (divergent world views or philosophical civil war?)
  - Climate change
  - Economic / Financial (austerity, debt, growth, jobs, ....)
  - Reproductive Issues (abortion, birth control, services ...)
  - Education
  - Healthcare
  - Immigration
  - Marriage
  - Science
  - Separation of church and state
  - Weapons
  - And many more issues ...



Implications?

# Government / Political / Legal



- Increasing complexity of problems
  - War, crime, terrorism, security, energy, population health care, education, jobs, poverty, retirement, water and food supplies, homelessness, ...
  - Yet, these are typical problems, many requiring international cooperation and collaboration
  - What can the private sector provide? The public sector? NGOs? Universities? You? Your family? Your community?
- Actions / investments / problem solving are postponed
  - Can we wait? Should we wait? What then?
- May have to move to some sort of global governance to address fundamental problems
  - Yet, can countries be governed to the benefit of their citizens?

Implications?

# Physical Environment

## Declining Resources

Half of the world's tropical and temperate forests and wetlands are gone.



Speth, J. G. (2008). *The bridge at the edge of the world*.  
New Haven, CT: Yale University Press.

# Physical Environment

## Declining Resources

- Water is being used faster than it is being replenished in many places
- Topsoil is lost faster than it is being renewed.
- 33% of land surface, not covered in ice sheets, is used for agriculture and livestock



Implications for leadership, ideas for research?



# Physical Environment

## Declining Resources



Human consumption is now 23% larger than nature's capacity to regenerate or to absorb our "ecological footprint."

Image from:

<http://alexscolloquiumjournal.blogspot.com/2009/10/ecological-footprint.html>

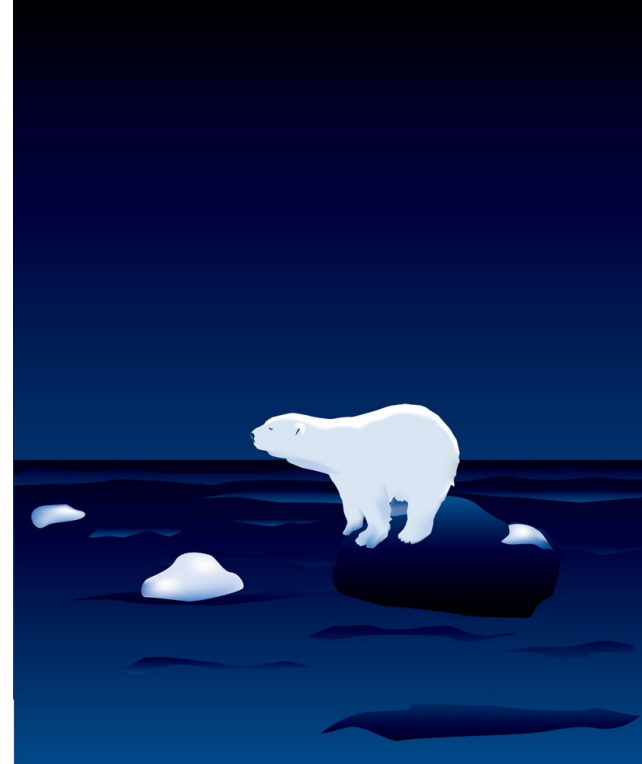
Speth, J. G. (2008). *The bridge at the edge of the world*.  
New Haven, CT: Yale University Press.

# Physical Environment

## Climate Change

- Rising sea levels.
  - 1-2 meters forecast over next 50 + years
- Ocean acidification
- Declining numbers of species.
- Loss of fresh water and agricultural lands.
- Loss of coastal cities
- Migrations of people.
- Increase in tropical disease
- Factors (Insolation, Albedo, GHG)
- Volcanoes emit between 130 and 380 million tons of CO<sub>2</sub> per year, while humans emit about 30 billion tons of CO<sub>2</sub> each year--100-300 times more than volcanoes--by burning fossil fuels--NASA

## Implications?



Union of Concerned Scientists / IPCC

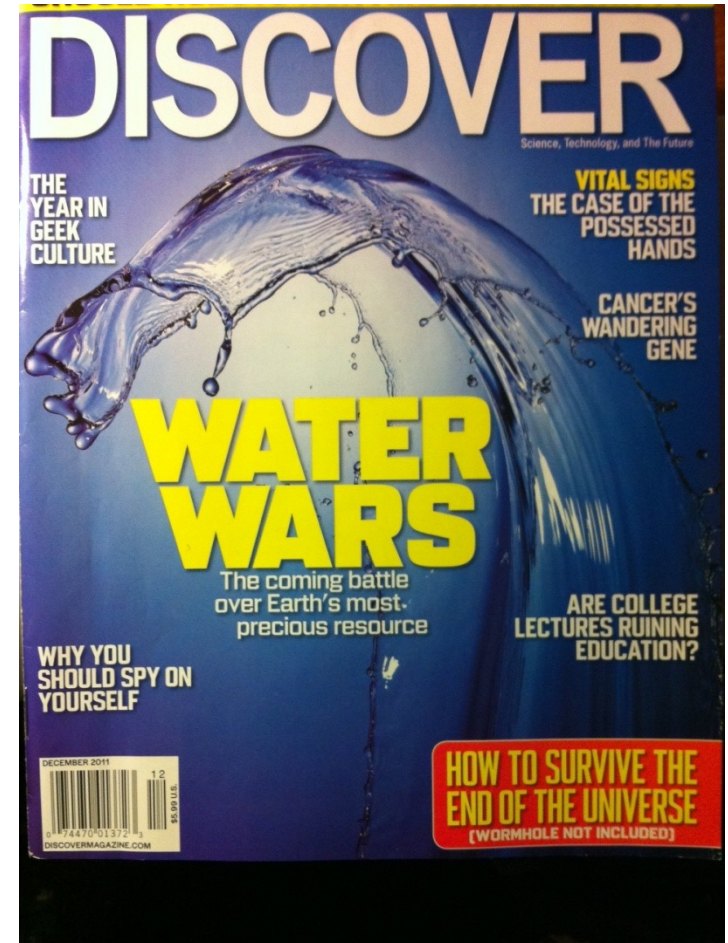
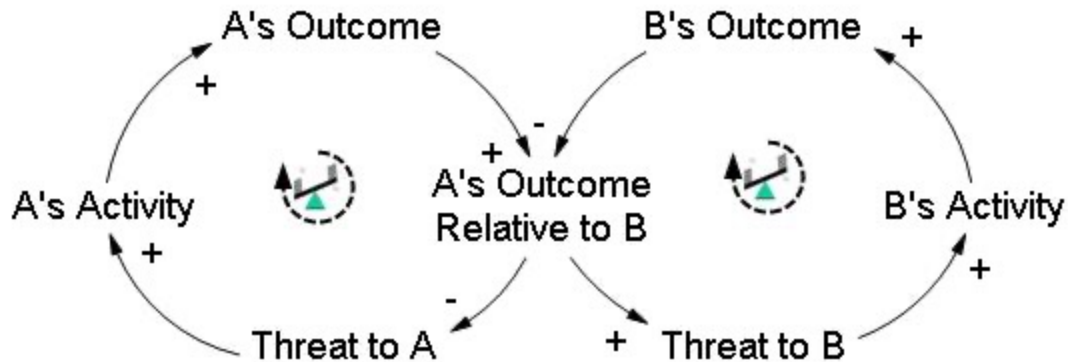
Ward, P. D. (2010). *The flooded earth*. Philadelphia, PA: Basic Books.

# Physical Environment

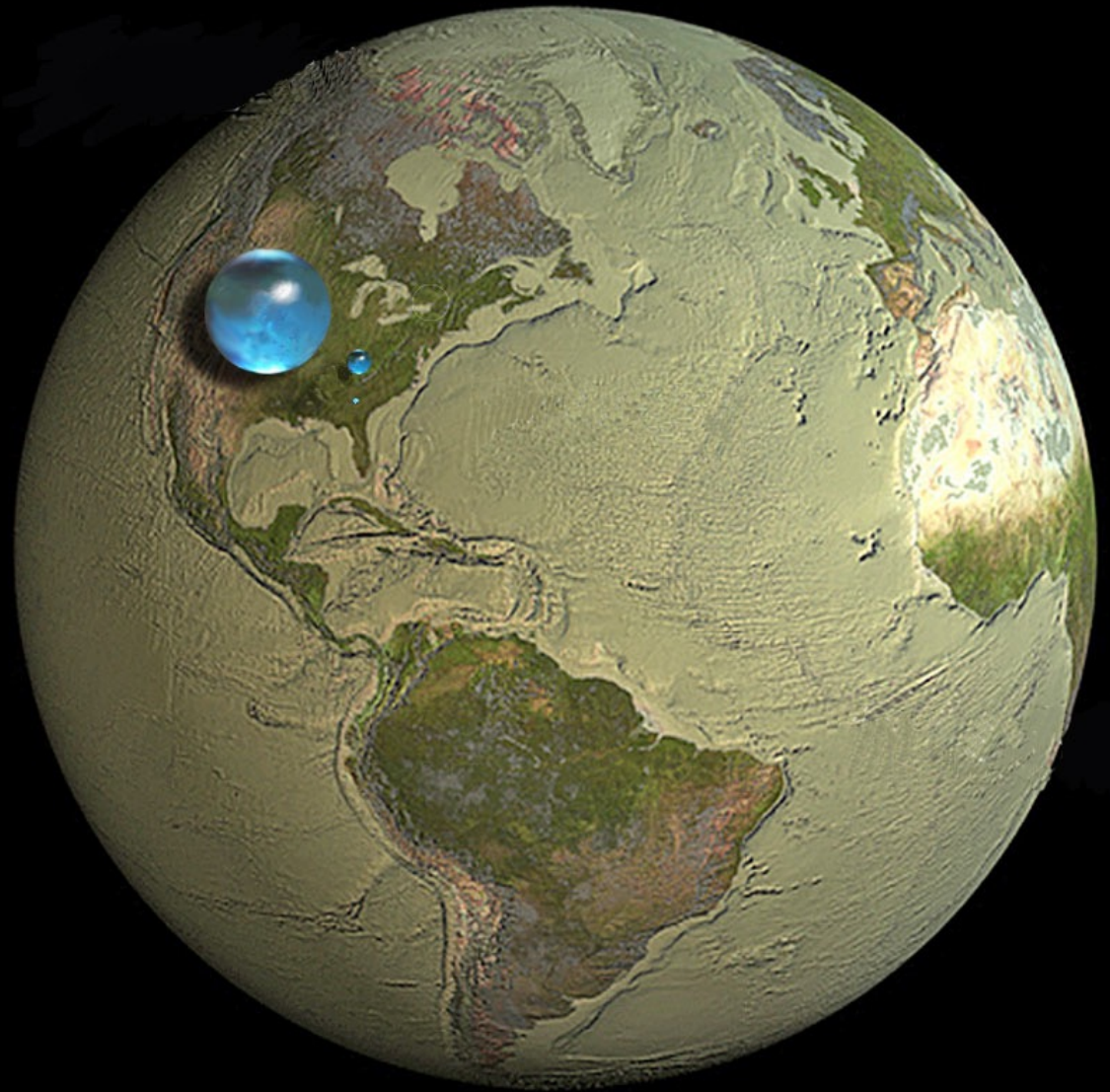
## Resource Wars

Climate / resource wars in our future?  
See Colorado river and dependent states for example.

Escalation Archetype



Implications for leadership, ideas for research?



USGS



# Physical Environment

## Planetary Boundaries

- 1. Climate change**
- 2. Nitrogen / phosphorous cycle**
- 3. Ocean acidification**
- 4. Land use**
- 5. Biodiversity**
- 6. Biogeochemical flows**
7. Ozone depletion
8. Freshwater use
9. Atmospheric aerosols

Threshold  
passed



# Physical Environment

## Ecosystem Services

### Provisioning Services

- Food
- Water
- Fuel / Energy
- Wood



### Supporting Services

- Nutrient Dispersal
- Seed Dispersal

### Cultural Services

- Bicycling
- Camping
- Hiking
- Sailing
- Skiing

### Regulating Services

- Air /Water Purification
- Carbon Sequestration
- Waste Decomposition

**Increasing / Decreasing?**

# Physical Environment

## Tragedy of the Commons

Tragedy of the Commons Archetype

Developed in MapSys

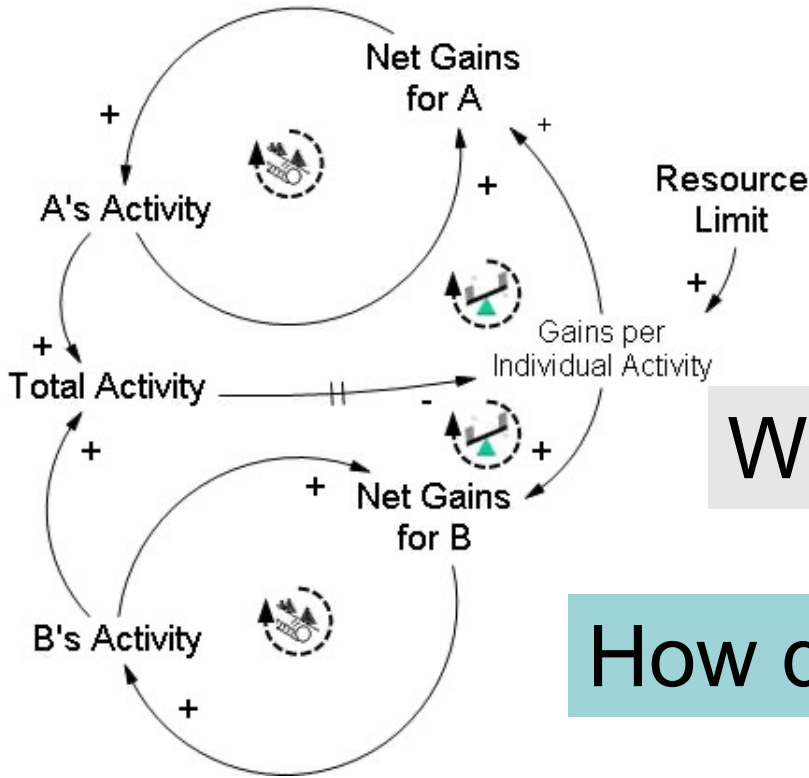
Source: Peter Senge's Fifth Discipline

What is a commons?

What is the tragedy?

What are some examples?

How do we get out of it?



# Top Five Global Risks 2023

- Short Term
  - Cost of living crisis
  - Natural disasters and extreme weather events
  - Geoeconomic confrontation
  - Failure to mitigate climate change
  - Erosion of social cohesion and societal polarization
- Long Term
  - Failure to mitigate climate change
  - Failure of climate-change adaptation
  - Natural disasters and extreme weather events
  - Biodiversity loss and ecosystem collapse
  - Large-scale involuntary migration



# Serious Change is Coming

Exponential Curve

Technology to clone ourselves

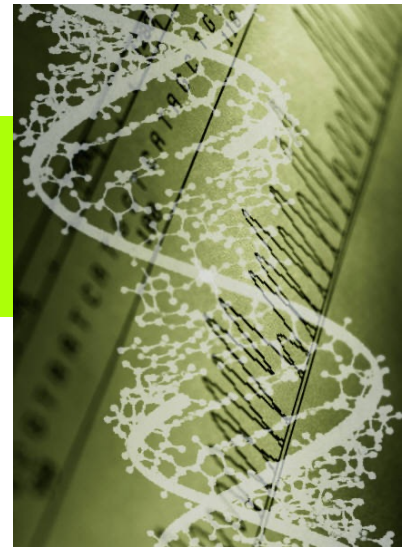
Rewrite genetic codes to create thousands of new life forms

Reverse engineering of the human brain

Genetically change ourselves and future generations into one or more new species

AI, VR, AR, and Robotics ...

And things are just warming up....



# The times, they are a'changing!

There can be no question that today's *turbulent times* are not a transition to a new era, a new environment for organizations and their managers.

To the contrary, these *turbulent times* are the new era, they are the long-term future.

How are we going to feed, clothe, shelter, transport, and educate another 2,000,000,000 people?

Implications for leadership, ideas for research?

*What then must we do?*

*- Tolstoy*

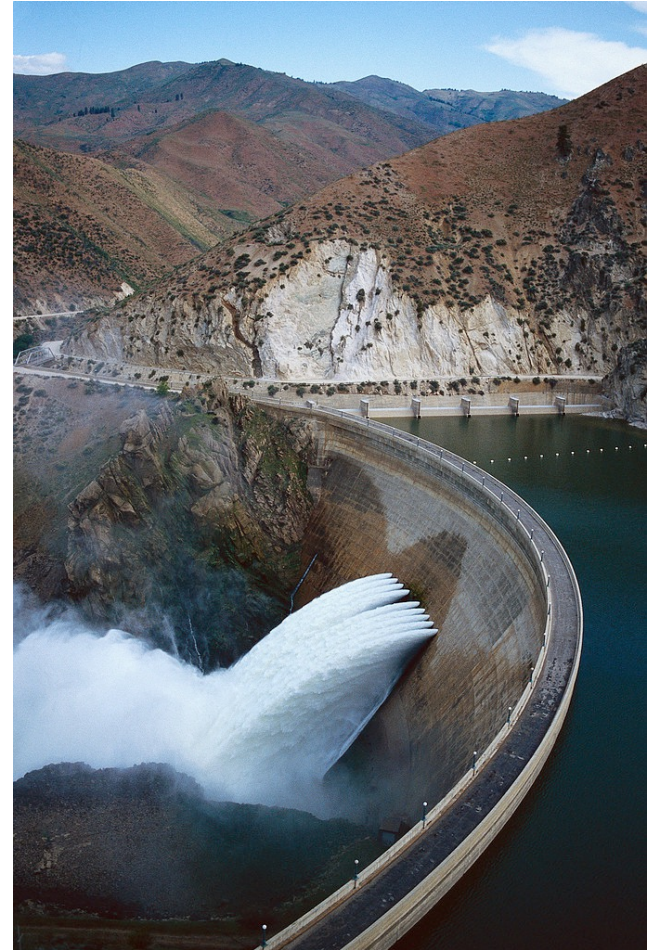
**Thank you!**



# U.S. Infrastructure Needs - Dams

Of the 79,000 dams,  
more than 3,500 are  
rated unsafe.

Needed investment -  
\$840 million annually.



*American Society of Civil Engineers Report Card for America's Infrastructure*  
(2005)

# U.S. Infrastructure Needs - Transit



Investment to keep up is estimated at about \$15 billion.

**American Society of Civil Engineers *Report Card for America's***



# Technology



Fossil fuels will continue to supply world's energy needs for the next 20 to 30 years.

Alternative energy sources years away.



3D Farming and 3D Printing in early stages of development.

100+ 3D Farms in Singapore, 1,000 more expected next year. 3D Farm technology being readied for export

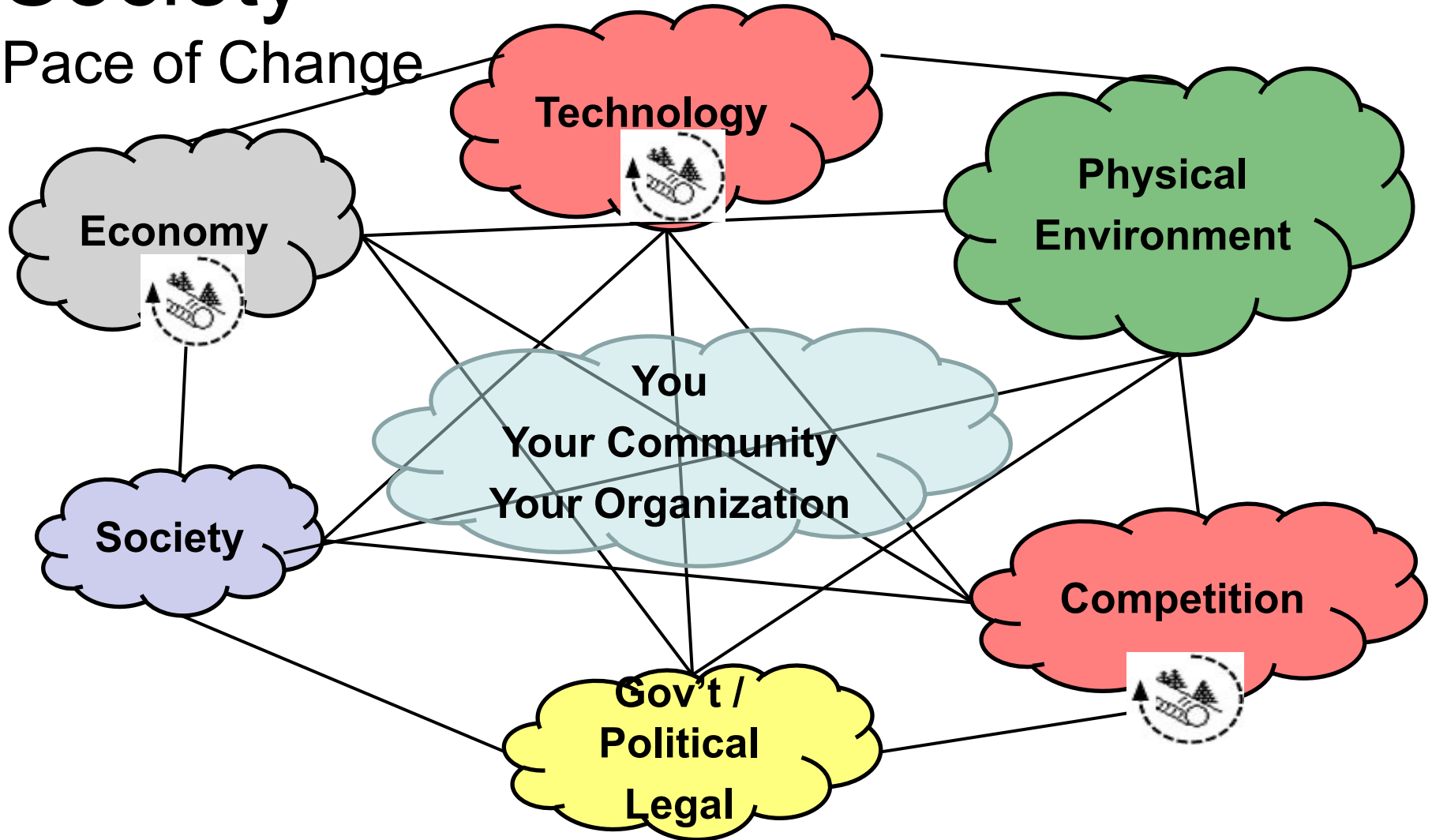


P4 Medicine - Personal, preventive, predictive, and participatory.



# Society

Pace of Change



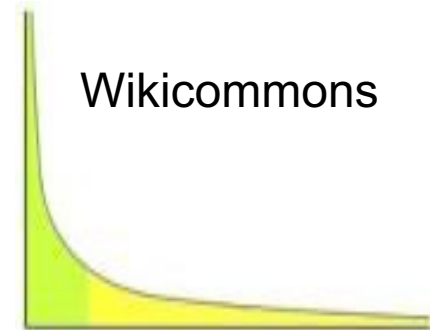
# Global Flows

- \$26 T goods, services, \$\$\$ in 2012; expected \$85 T by 2025
- 18 X increase in cross-border internet traffic between 2005 and 2012
- 500% increase in international Skype call minutes since 2008
- Growth in knowledge-intensive goods trade 1.3 X as fast as labor-intensive goods

# Economy

## Jobs

- Millions of lost U.S. jobs, 8-9% unemployment, housing crisis, state, and city restructuring with some bankruptcies
- 46+ million people in poverty + another 50+ million in near poverty in U.S.
- 21 M new jobs needed by 2020 to return to full employment. 187,000 new jobs monthly



Have we reached the end of the jobs-for-pay model?

- Map 15 global challenges to 6 elements of strategic planning
- Map global challenges to SDGs

# Energy