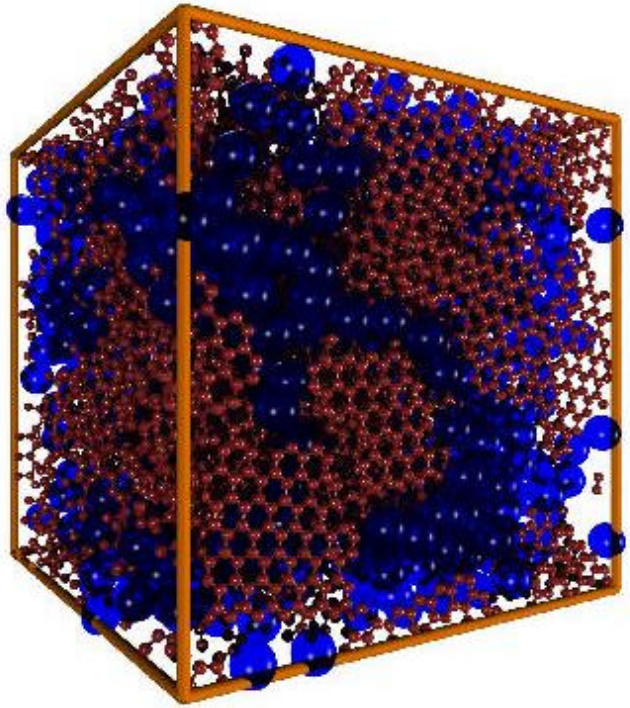


Welcome to the Next Industrial Revolution

National Science Foundation
September 15, 2003

David Rejeski
Director, Foresight and Governance Project
Woodrow Wilson International Center for Scholars

Today's Headlines

EPA Eases Clean Air Rules on Power Plants
Washington Post, 8.27.2003

TVA Is Free to Ignore EPA Orders
Washington Post, 6.26.2003

Senate Rejects Bill on Fuel Economy
San Francisco Chronicle, 7.30.2003

Utilities Aim to Postpone Mercury Emissions Targets Until 2018
Washington Post, 6.29.2003

7 States Vow to Sue U.S. on Pollution Policy
Washington Post, 2.1.2003

EPA Drops Chemical Security Effort
Washington Post, 10.3.2002

Lead Hazards Brushed Aside
Boston Globe, 2.1.2003

EPA Seeks Leeway in Rules About Dirty Water
Washington Post, 8.8.2002

Efforts to Ease Air Rules Decried
Washington Post, 10.19.2002

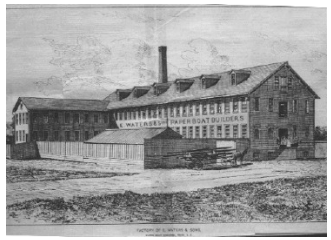
But in a Parallel Universe

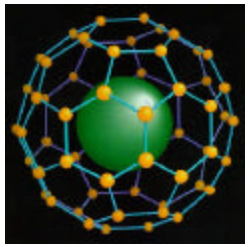
Mass customization
Distributed manufacturing
Build-to-order
Real-time enterprise
Personalization of production
Evolutionary design
Autonomic systems
Little BANG (Bits-Atoms-Neurons-Genes)

The Next Industrial Revolution

Imagine Waking Up in 2020

Surprise! The Next Revolution is Over





First Industrial Revolution

1970

Second Industrial Revolution

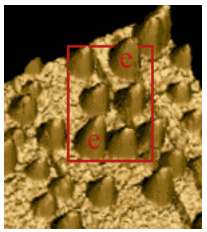
Environmental Policy

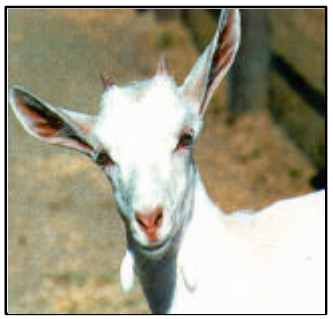
1970 1990

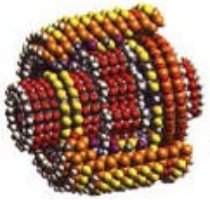
By-Products of Production → **Products** of Production → **Production** (of almost everything)

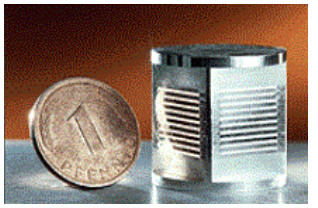
A Revolution in:

How things are made

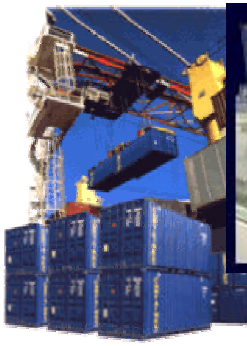






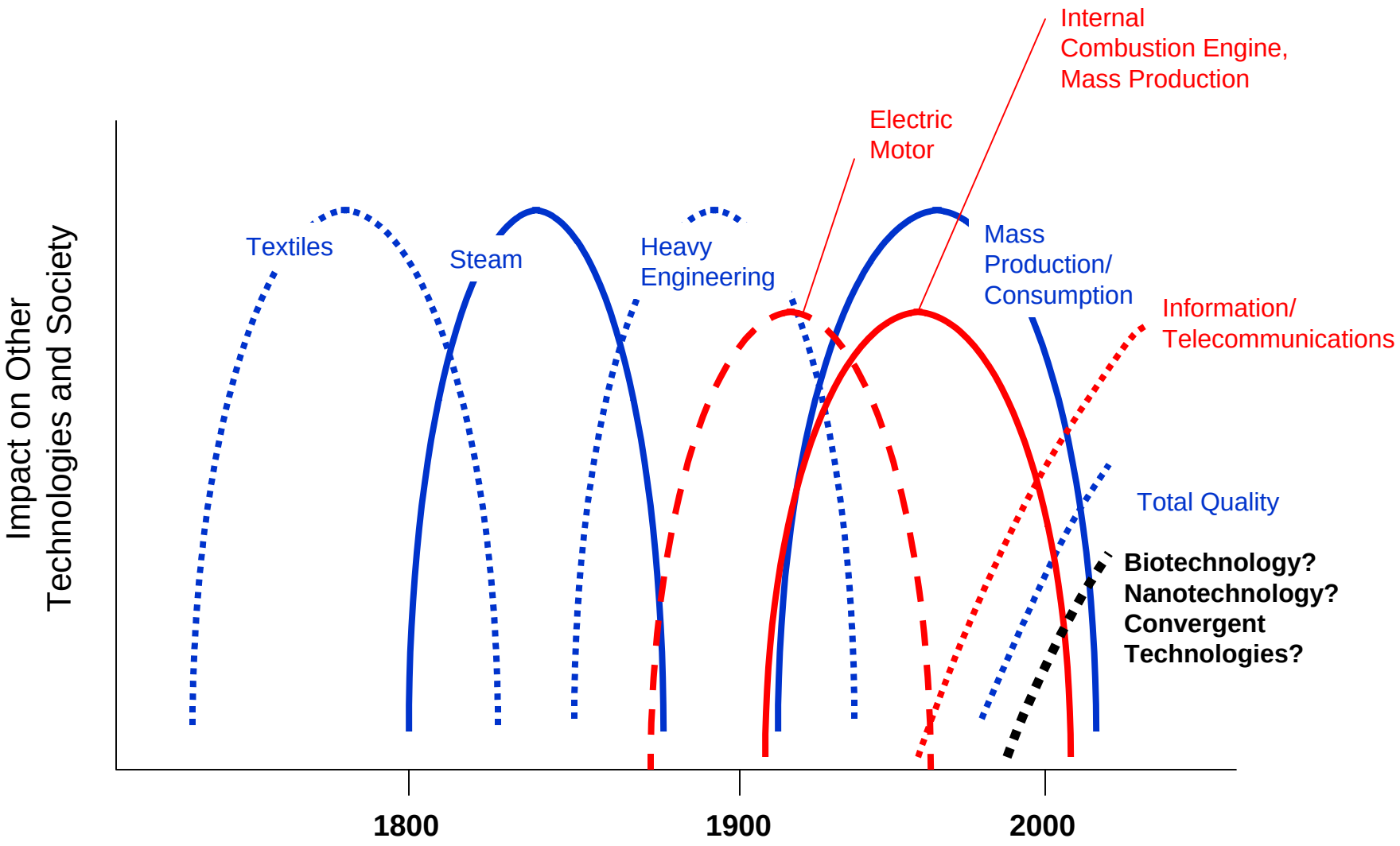


Where things are made

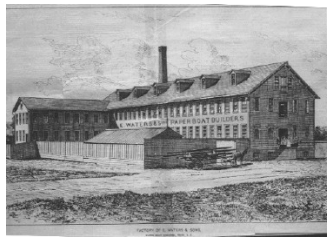


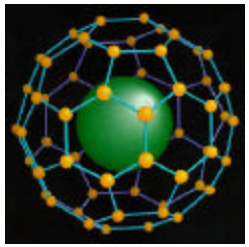
And whether they are made

So, What is the Next Big Thing?



Different Worlds/Different Challenges





First Industrial Revolution

Second Industrial Revolution

Adapt

Atoms
Sharp boundaries
Incremental change
Science of discovery

Shape

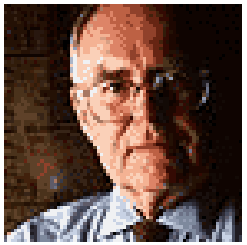
Bits/Atoms/Neurons/Genes (convergence)
Fluid, mobile, interconnected
Exponential change
Science of disruption

TINA - There is no alternative

“Revolutions are cruel precisely because they move too fast for those whom they strike.”

Jacob Bronowski

Tempo Challenge



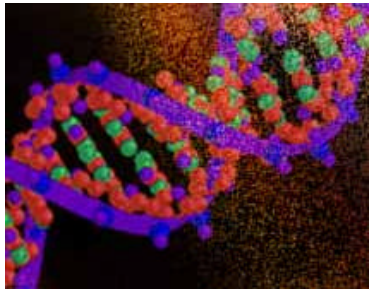
Moore's Law

The logic density of silicon integrated circuits doubles every 18 months

Displays = Moore's Law
Storage = 1.5X's Moore's Law
Bandwidth = 2X's Moore's Law
GPU's = 2-3X's Moore's Law

Metcalfe's Law

Connect any number "n"of machines - whether computers, phones or even cars - and you get "n" squared potential value.



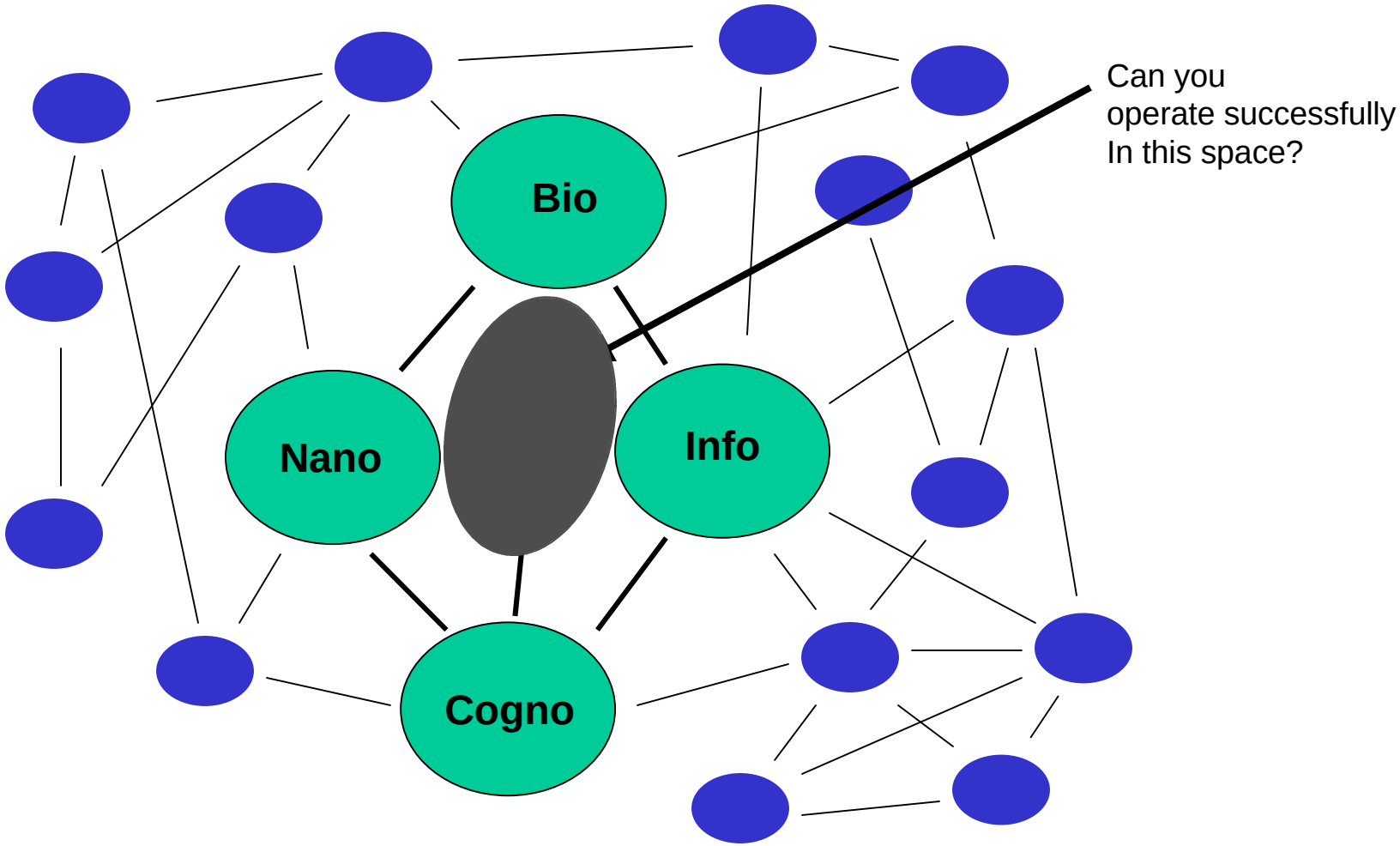
Monsanto's Law

The amount of useful genetic information doubles every 18-24 months.

Dawkin's Law

The cost of sequencing DNA base pairs halves every 27 months.

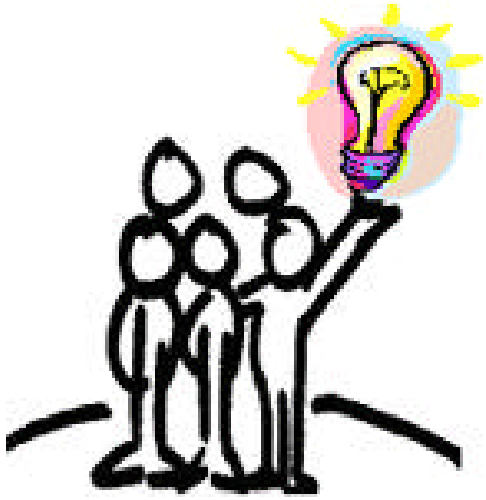
Convergence Challenge



Now

Shape the next industrial revolution to co-optimize for environmental benefits

But how?

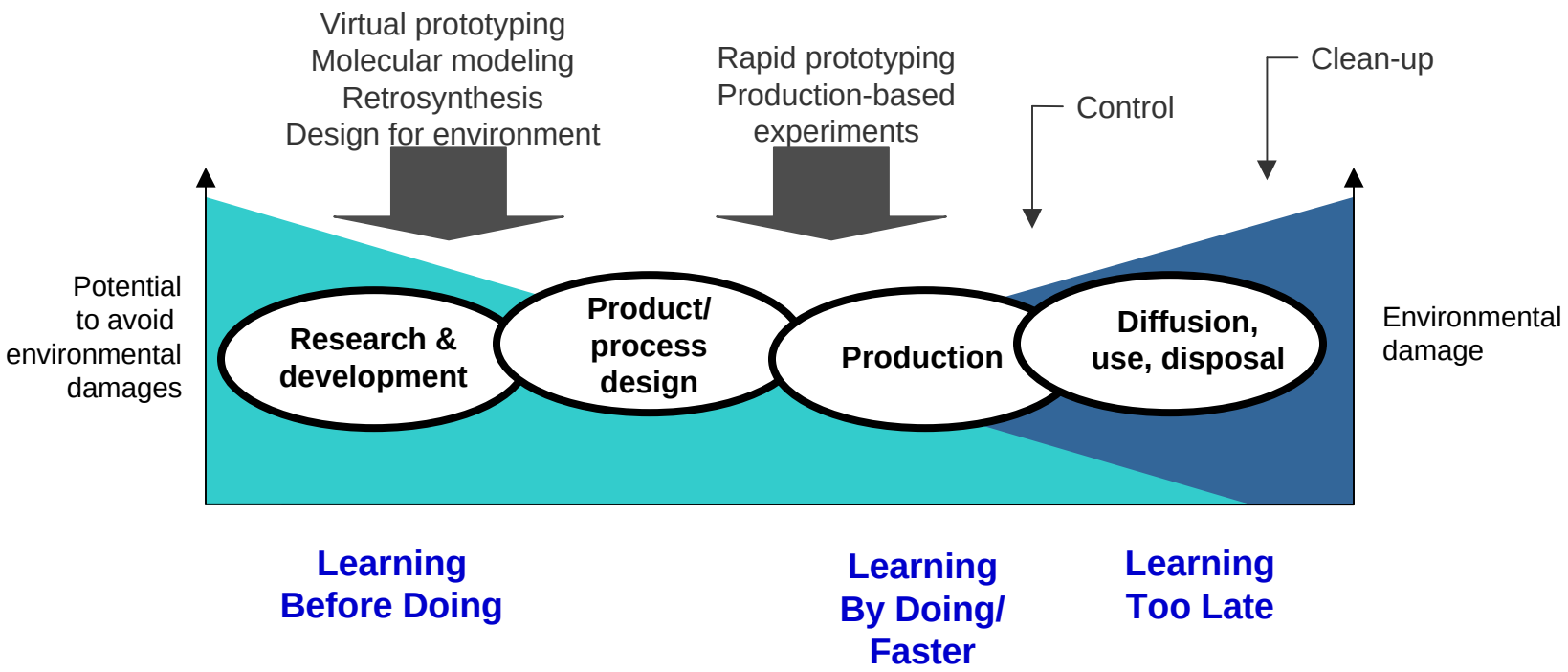


Change the Learning Paradigm

Environmental Learning Model

1870 - 2010	Learning too Late
1970 - ???	Learning through Mandate
1990 - ???	Learning by Doing Learning by Doing *Faster*
1995 - ???	Learning before Doing

Learning Strategies & the Production Life Cycle



INCREASING: →

- Capital investment
- System inertia
- Risk aversion
- Number of careers at stake
- Number and extent of special interests

Two Scenarios

Rip van Winkle Scenario

Slow Learning/Adaptation

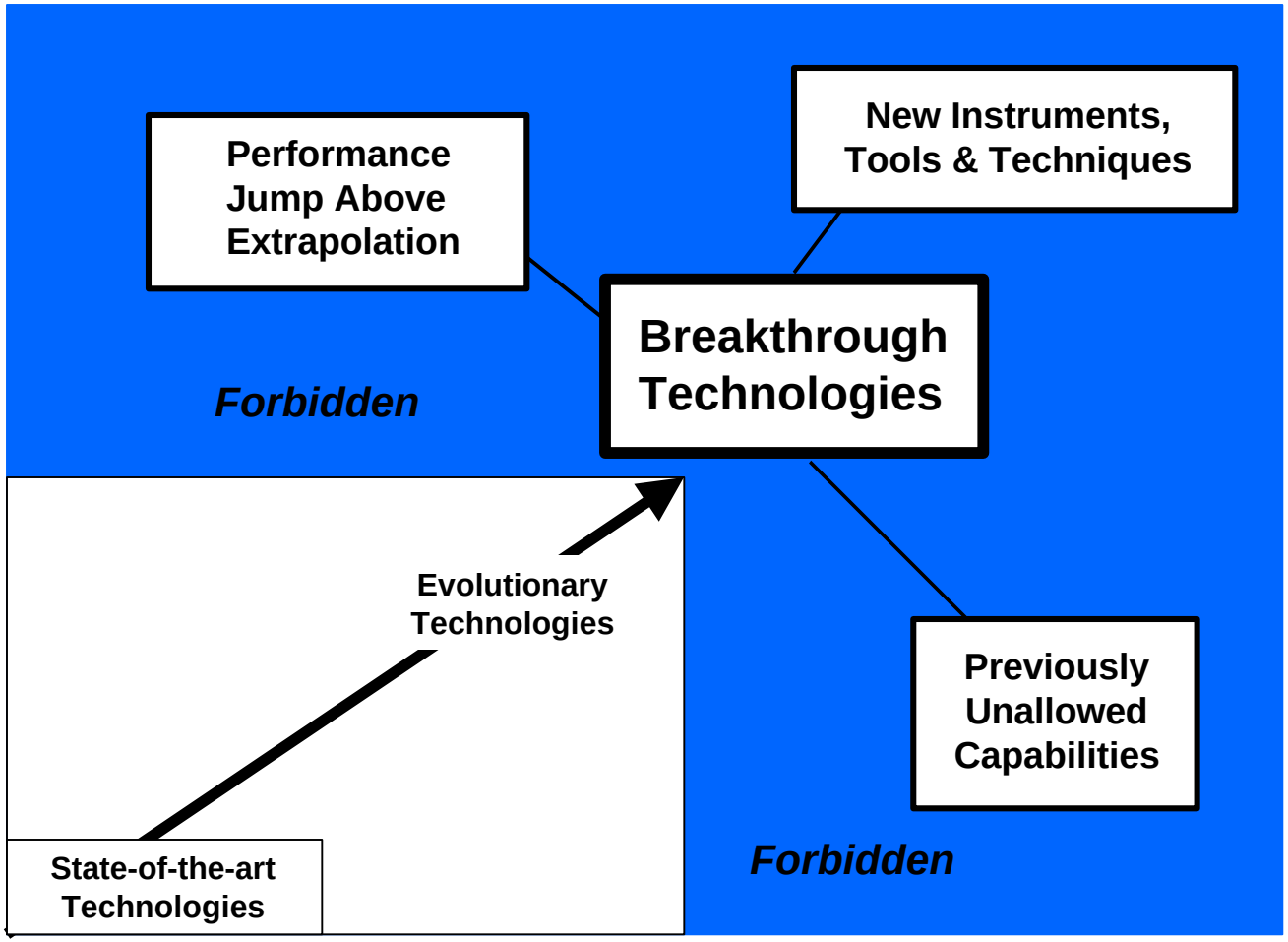
Environmental impacts are an unintended consequence
of technology development and deployment
and
Regulation must be applied, after the fact, to reduce impacts

Vulcan Scenario

Fast Learning/Shaping

Environment is co-optimized as a part of technology development and deployment, or is the primary goal, and,
Mechanisms to deal with unintended consequences are implemented aggressively and early

A Third Scenario: The Leap



Adapted from: Anderson, J. (1996): "Leaps of the Imagination: Interstellar Flight and the Horizon Mission Methodology," *Journal British Interplanetary Society*, Vol. 49.

Address Key Failure Modes

1. **Failure of Imagination**

   We fail to anticipate a problem, think around problems and limitations, or develop innovative solutions.

2. **Failure of Perception**

   Once the problem arrives, we fail to perceive it.

3. **Failure of Nerve**

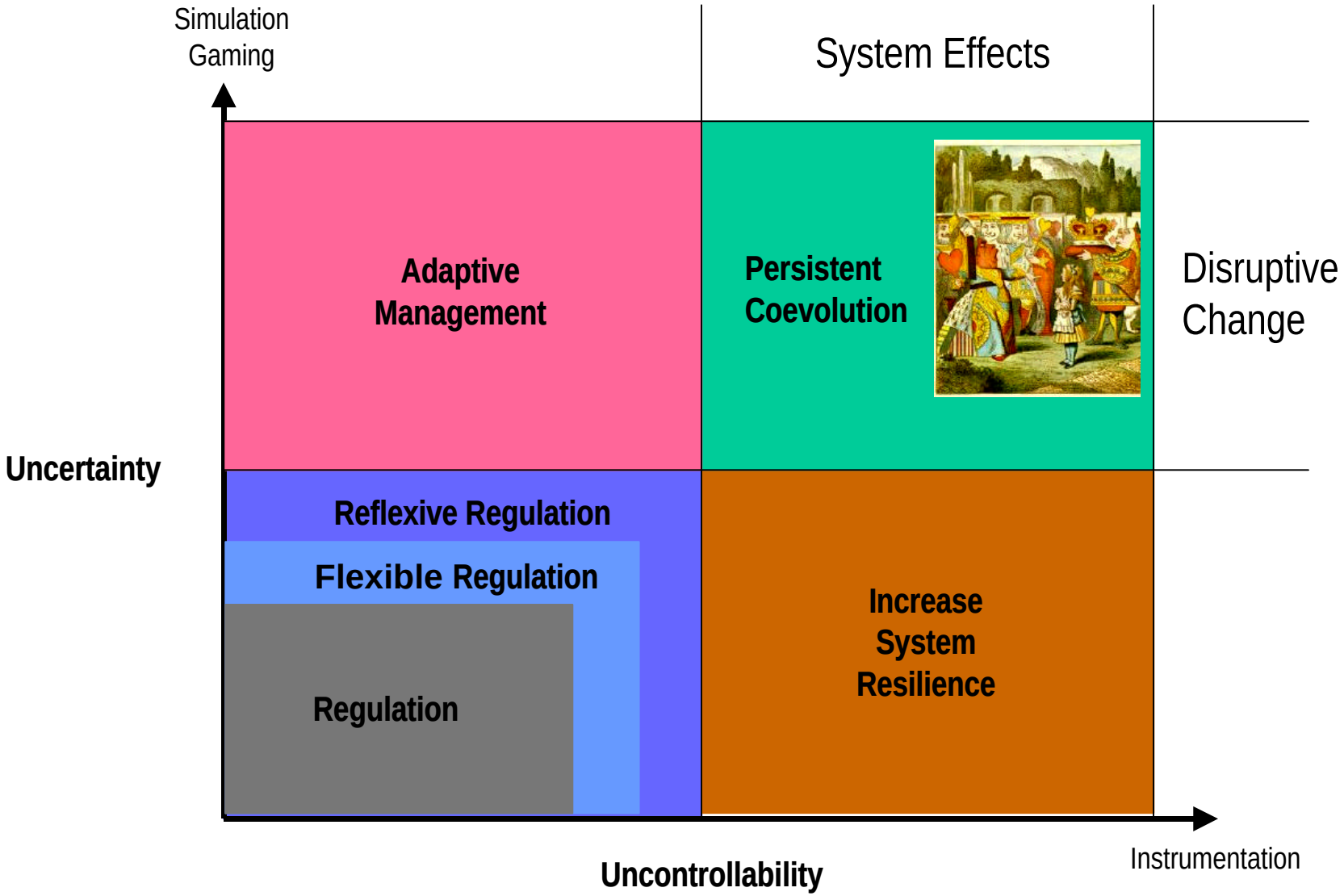
   After we perceive the problem, we may fail to address it.

4. **Management Failure**

   We may address it, but use the wrong techniques, and fail to solve it.

Adapted from: Jared Diamond, “Why Some Societies Make Disastrous Decisions,” April 28, 2003, Edge (www.edge.org)

Radically Expand the Toolbox



“Those who avoid new remedies can expect new evils, for time is the greatest innovator.”

Francis Bacon

Further Information

For more information:

http://www.wilsoncenter.org/foresight/

Also: www.foresightandgovernance.org

or: rejeskidw@wwic.si.edu

or: http://rejeski.blogspot.com