

# **Governance in an Age of Complexity**

## **Pacing Governance with Complexity Workshop**

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# **CESEM**

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# Technological Change as Cultural Change

<b>Kondratiev Wave</b>	<b>Core/ Periphery (dates of wave)</b>	<b>Core industrial organization</b>	<b>Time construct</b>	<b>Capital and finance</b>	<b>Critical infrastructure</b>	<b>Consumption</b>	<b>Religious response</b>
<b>Industrial Revolution (textiles, water)</b>	<b>UK/Europe and colonies (1780-1840)</b>	<b>Factory</b>	<b>“time-thrift”, “day at work” model</b>	<b>(UK) capital from land-owners and aristocracy</b>	<b>Water, canals</b>	<b>Hereditary elite, some trickle down</b>	<b>Romantic and Cartesian shift of Sacred (e.g., to nature)</b>
<b>Rail, steam, and coal</b>	<b>UK and US/Europe (1850-1895)</b>	<b>Joint stock company (railroads)</b>	<b>Coordinated regional times by firm (rail)</b>	<b>Development of modern finance (RR)</b>	<b>Local and national rail (coupled to telegraph)</b>	<b>Capitalists, some trickle down</b>	<b>Technological sublime in US (from Eden to New Jerusalem)</b>
<b>Steel, heavy engineering, electricity</b>	<b>US, Germany/ Europe (1895-1930)</b>	<b>National firm, professional management (Taylorism)</b>	<b>Global time structure; mfg time models</b>	<b>Modern corporate finance</b>	<b>Rail, ocean shipping, roads</b>	<b>Capitalists, evolution of labor as class</b>	<b>Calvinism and rise of capitalism</b>
<b>Automobile, petroleum, mass culture</b>	<b>US/Europe and Asia (1930-1970)</b>	<b>Mass production system</b>	<b>Time as integrator of mfg/life</b>	<b>Mass credit, consumption financing (GMAC)</b>	<b>Roads, increasingly air</b>	<b>Egalitarian consumption, mass consumers in core</b>	<b>Calvinism into consumerism</b>
<b>Information, communication technology</b>	<b>Global corp and elite/US (1970-2000)</b>	<b>Network-centric firm</b>	<b>Asynchron-ous and 24/7, globalization of production</b>	<b>Finance as ICT; complex risk management</b>	<b>Networks</b>	<b>Rise of meritocratic elite, some trickle down</b>	<b>Growing fundamental-ist backlash</b>
<b>Nano, bio, robotics, ICT, cogsci</b>	<b>Global elite/global proletariat (2000- )</b>	<b>Virtual, rapid adapt, network</b>	<b>Asynchron-ous, time as order of events</b>	<b>Global demat-erialized financial networks</b>	<b>Conversion of physical into global information networks</b>	<b>Meritocratic elite (shift from financial to quality of life consumption)</b>	<b>Fundamentalism as reaction against rapid change, disen-franchisement of non-elite</b>

# Railroad Technology Implications

- Required uniform, precise system of time, thus co-evolving with “industrial time” and associated culture
- Created need for, and co-evolved with, national scale communications systems
- Co-evolved with modern managerial capitalism (modern accounting, planning, and administration systems)
- Co-evolved with modern capital and financial markets (railroad construction was the single most important stimulus to industrial growth in Western Europe by 1840s)
- Transformed landscapes at all scales: Chicago existed, and structured the Midwest economically and environmentally, because of railroads
- Changed structure of US economy: from local/regional business concentrations to trusts (scale economies of national markets)
- Enabled and validated US power structures – e.g., Manifest Destiny
- Changed center of gravity of US culture from Jeffersonian agrarianism, an Edenic teleology, to technology-driven New Jerusalem

# Technology Level/Policy Response Matrix

<b>Policy Response</b> <b>Response</b>  <b>Technology Level</b>	<b>Goals</b>	<b>Policy Response</b>
<b>Level I</b>	Defined; technology and goals tightly coupled	Yes or no to technology and the explicit goal
<b>Level II</b>	Defined but loosely coupled, with additional interfering independent variables	Explicit decision, then deal with unintended consequences
<b>Level III</b>	Uncertain and often conflicting; most important may be unconscious or implicit	Real time technology and policy assessment (RTTPA)

# Policy Response Matrix: Vaccine Example

<b>Policy Response</b> <b>Response</b>  <b>Technology Level</b>	<b>Goals</b>	<b>Policy Response</b>
<b>Level I</b>	Reduce individual's risk of disease	Agreement on goal, and therefore on technology: implement technology
<b>Level II</b>	Increase economic growth in developing countries by reducing costs of disease	Implement technology, but that policy alone may not lead to stated goal
<b>Level III</b>	Improve human well-being through vaccine technology	Real time technology and policy assessment (RTTPA) – what other systems are affected by vaccination programs; how do they respond?

# Implications of Different Levels

- Each Level contains all forms of complexity, but represents one dominating form, with corresponding dynamics
  - Level I: complicated and dynamic complexity
  - Level II: dynamic and wicked complexity
  - Level III: wicked and earth systems complexity
- Level I generally drives develop and deploy decisions (e.g., military tech)

# Implications of Different Levels

- Level II and III effects are real, but, especially at Level III, inchoate until they actually evolve
- Institutions and individuals are reasonably good at predicting Level I implications (e.g., business plans), somewhat adept at managing Level II implications as they evolve, and incompetent at perceiving and managing Level III effects (e.g., geoengineering)

# Implications of Different Levels

- In many cases, activists and partisans will produce hypotheticals at Level II or Level III, and use them to argue for immediate policy or governance mechanisms.
  - E.g., 2003 ETC proposal for complete moratorium on nanotechnology until it is proved safe; Roco and Bainbridge *Converging Technologies for Improving Human Performance*.

# Traditional Geoengineering

- “Deliberate large-scale intervention in the Earth’s climate system, in order to moderate global warming.”
  - Generic benefits: reduce climate change forcing, and **very** inexpensive (sulfur particle technology estimates as \$4/ton CO<sub>2</sub>)
  - Generic drawback: “moral hazard” and partial response to climate change.
- Two categories:
  - Carbon dioxide removal (CDR)
  - Solar radiation management (SRM)

# Geoengineering and Kyoto

- Both assume simple systems dynamics when the underlying systems are complex adaptive systems
  - Both assume anthropogenic climate change can be addressed as if it were separable from other human, natural, and built systems
  - Cf corn-based ethanol as biofuel
- Both assume climate change is a “problem” to be “fixed” rather than a condition to be managed
- Both show little understanding of the dynamics and characteristics of technological evolution
  - Geoengineering as silver bullet
  - IPCC curves going out smoothly for 150 years

# Geoengineering and Kyoto

- Both are ad hoc, inadequate and potentially dysfunctional responses
- Both are increasingly distrusted as social engineering dressed up as “objective science and technology”
  - Both assume environmental values take priority over others in policy and technology development and deployment decisions
- Most importantly, neither appreciates the breadth and power of technology systems: to meaningfully change the atmosphere, either by treaty or technology, you must significantly change a lot of other things.
  - Not to recognize this is either foolishness, or deliberate deceit

# Geoengineering and Failure to Understand Technology

- Technological change is not an isolated technocratic event, but movement towards new, locally stable, earth systems states.
- Any sufficiently powerful technology *unpredictably* destabilizes existing cultural, institutional, economic, environmental, and technological systems
  - Core assumptions underlying long range policy and associated S&T initiatives become increasingly contingent
  - Future trajectory models can be especially misleading, especially as reified by media and public

# What is to be done?

- Proposed solution (European and climate change community): no geoengineering steps to be taken until global, international governance mechanisms are in place.
  - Assures geoengineering cannot be implemented
  - If that's not the purpose, it's impractical: this would be more complicated than Kyoto Protocol, which already doesn't work

# What is to be done?

- Stop all simplistic responses, whether traditional climate change policy or geoengineering? No.
  - Pressure on topic generates adaptation innovation
  - Social and institutional lock-in
- Just continue simplistic responses, and pretend they'll actually work? No.
- Focus on creating option spaces, and implementing portfolio solutions acting synergistically across coupled systems

# Policy and Complexity

- The Anthropocene is characterized by conditions, not problems, and thus requires adaptability, not “solutions”.
- The Anthropocene is characterized by rapid change, not stasis, and thus requires agility, not stability

# Policy and Complexity

- Because of the need for agility, a critical institutional and social skill is the development of option spaces in relevant domains:
  - Technological
  - Social
  - Cultural
  - Institutional

# Policy and Complexity

- Because no internally coherent perspective is more than partial and arbitrary in regard to complex systems, pluralism at the decision level is more important than expertise.
- Learn to differentiate between scenarios and predictions: play with the former, and challenge the latter.

# Policy and Complexity

- Lower the amplitude and increase the frequency of decision-making.
- Evaluate major shifts in technology systems before rather than after they occur, using approaches that respect their unpredictability (e.g., informed environmental scanning).

# Policy and Complexity

- Ensure continual learning.
- Understand system boundaries: within what boundaries are policies valid, and when do they fail?

**“He, only, merits freedom and existence  
who wins them every day anew.”**

(Goethe, 1833, *Faust*, lines 11,575-76)