

ESD.84 Doctoral Seminar – Session 13 Notes

Session Overview:

- Welcome and Overview and Introductions (5-7 min.)
- Initial Identification of Questions from Readings (7-10 min.)
- Global Environmental Systems – Presentation by Marcus Sarofim (10-15 min.)
- Reflections on Global Economic Systems – Presentation by Chris Magee (15-20 min.)
- Discussion (30-45 min.)
- Break (10 min.)
- Global Production Systems and Global Supply Chains – Presentation by Chris Musso (10-15 min.)
- Book review of Jay Forrester's *Urban Dynamics* by Troy Downen
- Exploring the Architecture and Operation of Engineering Systems that Function on a Global Level (15-20 min.)
- Next Steps (10-15 min.)

Discussion Questions:

- Stiglitz alternates between criticism and support for free-market ideology – How to answer the question around the degree of control by IMF, World Bank and other international agencies in the context of a free-market system? How to resolve issues around unbalanced power and the inherent selfishness of the more powerful?
- In the context of soft and hard power – how to understand a systems perspective around the role of the most powerful nations?
- Senge uses nature as an analogy for a zero-waste system – but that is nature as a whole as compared to individual engineering systems that are never the system as a whole – how to reconcile this?
- What is the role of the internet in shaping ideological splits – resulting in more fragmentation of information cultures? How to think about the role of Chinese as the dominant language on the internet – or the growing degree of Spanish content?
- Role of human values in context of dialogue among finance ministers, WTO, World Bank, IMF and stakeholders who are not focused on these issues
- Countries such as China seem to be succeeding by having certain periods of isolation or protectionist boundaries – how to incorporate this into global economic planning?
- When applying soft power there are still streams of people who are more contented and others more discontented – is that an inherent conflict that results in pressure later? How stable is that approach? How real is the strategy for applying soft power? What of issues of interdependence between hard and soft power?
- Say more about historical development of sustainability as a concept – particularly the shifting mindset around the role of growth – is the drive for growth conflicting with new views on sustainability (even if it is not material growth)?
- Bridging Stiglitz and Nye on the training of engineers – standard engineering curriculum does not prepare people – concept of preparing engineers for the “T” with depth in one specialty and breadth in other domains – so how wide and how deep and what does the “T” consist of?
- Personal reflections on tough times for family as a result of globalization – is globalization necessary? Why can't individual countries operate as relatively distinct sub-systems?

Global Environmental Systems – Presentation by Marcus Sarofim

Definitions of Global Environmental Systems (GES)

- “Major interactions between the Earth’s biosphere, atmosphere, hydrosphere and lithosphere”
- Earth systems contain “feedbacks and synergisms between the ecosphere and the anthroposphere” (Claussen)

What GESs do we care about?

- Characteristics of global systems:
 - Physical: Changes in one region may be caused by changes in another region
 - Social: Cross-boundary issues add significant complexity to political solutions
- Human-Environmental Boundary
 - Systems which have an impact on humans
 - Systems that are impacted by humans
- Systems which are currently or are predicted to be problems
 - Where change in systems has the potential to cause economic damages
 - Anthropocentric approach: ecosystem damage that does not have broader consequences is often ignored.

Tickell list of Environmental Crises

- Population Growth
- Deterioration of Land Quality / Accumulation of Wastes
- Water issues
 - Oceanic: fisheries, waste
 - Fresh: 18% consumed, 54% appropriated, drawing down aquifers.
- Species loss
- Atmospheric Chemistry
 - Ozone, Acid Rain
 - Climate Change

(Sir Crispin Tickell, talk)

Common Features Important in GESs

- Multiple national interests
 - Free Rider
 - Upstream-Downstream
- Temporal issues
 - Perceptual: stock-flow (Sterman)
 - Discounting
 - Intergenerational balance
- Uncertainty
 - Complex interactions
- Valuation Problems
- Tight coupling between pollutant and economic interests (CFCs (Montreal Protocol where companies own patents for replacements too) vs. CO₂)

When Wait and See Fails (Sterman)

- Long time delays
- Accumulations
- Multiple feedbacks
- Non-linearities
- Other dynamic complexities

Delays in a Dynamic System

- Temporal delays are common in many GESs for several reasons:
 - Size of systems leads to inertia
 - Complexity of systems leads to difficulty in discerning signals: Signal may emerge from noise too late to fix problem.
- Examples:
 - Delay between pollutant exposure and effect (carcinogens, ecosystems, hormones)
 - Delay between solution implementation and result (Population control, temperature change, sea level rise)

Discussion:

- If 4 billion people are at about \$2 per day and 1.5 billion people are at less than \$1 per day, that means that about 1 billion people are gaining the benefits of globalization – is this stable? Issue of equity in the context of efforts to “grow the pie”
- The issue in the developed world is not population growth – it is more the rapid increase in extraction technologies in the developed world
- Add to this picture issues of the diffusion of extraction technologies
- Appreciate the context for \$1 or \$2 per day – what is the “cost of living” broadly defined?
- Why should we assume that the developing world will always begin with “dirty” technology – experience in Guatemala with massive clean power plants based on turbine technology
- Technological change may or may not be transformative – in positive or negative

Reflections on Global Economic Systems – Presentation by Chris Magee

The Paradox of Economic Power

- 3 scales/planes for Power
 - Economic
 - Military
 - “Soft”
- U.S. Overwhelming Dominance likely perhaps 50+years if strong “soft power” not ignored/wasted (unilateralism?)
- Information Revolution is increasing importance of “soft” power and is fragmenting sources and connections
- *Dominant Power must lead in attention to “Issues in Commons” (Global economy, environment, etc.)*
- *U. S. political Process Thus of Prime Importance*
- *His assessment is mixed but favorable on IMF, trade*

Globalization and Discontents

- Stiglitz apparent assessments:
 - Broken Promises
 - East Asia, Russia were harmed by our Institutions
 - Trade “liberalization” negotiations have harmed the poorest people and only the relatively rich (U.S., Europe and strong Asian) have apparently done well
 - IMF, world trade organizations and even World-Bank (post McNamara) have been disastrous (my summary word) for global common economic development and particularly for wealth distribution
 - IMF- *in Stiglitz’s opinion unknowingly*- has served Wall Street Interests rather than world/commons interests

Sustainability Goals

- Human Designed Systems and Broad Sustainability Issues (e.g., Sussman and Hall)
 - Human Wants – improved fulfillment at rate of past 200 years but measured more broadly
 - Natural Impact ~0
 - Safety losses ~ 0
 - Economic Equity – much improved globally???
 - Economic Growth- as past 200 years ???

Sustainability Status

- Safety losses > 1.5 million lives lost per year
- Natural Impacts
 - 99+% of large mammals are domesticated
 - 99+% of all mammals (other animals?) are domesticated or synergistically dependent upon human developments
 - Non-domesticated plant life is rapidly disappearing
 - 90+% of natural water “captured”
 - Ocean-life depletion
 - Cell-phone towers on **all** hills??, airplane noise at **all** locations, snowmobiles

Sustainability Status – 2

- Economic Equity is rapidly diminishing globally and locally
 - U. S. distribution returning to 100 years ago status
 - University endowments explode
 - Human Material Want Fulfillment continues unabated for wealthy (Travel has the most important natural impact and higher speed travel is the most destructive and growing most rapidly for wealthy) while healthcare, food, shelter and other systems are non-ideal for poor even in the most powerful nation
 - Population Growth greatest for poor

Related Factors

- U. S. Political Process
 - Dominated by money for all relevant competitors
 - “Policy by Overnight Poll” seems to be the norm
 - People largely vote their short-range self-interest
 - Taxes are only acceptable for defense and security
- People
 - “Self-Deception is humanity’s greatest skill”
 - Competition and cooperation co-exist everywhere
 - 24x7 apparently worst where freedom to compete for prestige and fame are the biggest drivers
 - Tradeoffs are hard
 - Environmentalism defined by “Change others-not me”
 - Desire for “magic”

Sources of the solution

- Industry – Transparency and *real measures not PR or self-deception* are potential keys-particularly if people vote/buy for the common good and can avoid their own self-deception
- People – “seamlessness” seamlessly arrived at that affects *their use of (as well as their work in) engineered systems*
- Technology – “magic” desperately wanted such as air-travel on natural energy (battery energy density and flight..)
- Government/Regulation – Taxes on Use and ever increasing taxes on natural impact until there is none
- *It will take a combination of all of these as significant people and industry behavior change is required. Thus incentive structure changes are needed and the political process is an essential element.*
- *We may not have time to wait for “magic” if one wants to be pessimistic.*

Discussion:

- Dialogue on the importance of sensitivity to institutional dynamics
- Should increased equity be a global goal? Inequity does drive instability – not just social unrest, but migration and other imbalances
- Note the implication of free trade also involving the free movement of people
- If the pie is growing – should we worry about an even faster growing gap between privileged and the less privileged? How “plastic” are the social institutions?
- How can we think about ourselves as embedded in engineering systems – such as our individual and collective responsibility for the functioning of these systems – in favorable and unfavorable ways
- Concern about the human genome project – the role of a few biologists in creating new forms of life – which is public knowledge in the world – all kinds of catastrophic implications are possible, as well as some favorable impacts on global food production and other matters
- The role of biological engineering in addressing many environmental challenges
- Self-reinforcing instabilities associated with social inequity
- What of the growing university endowments, for example – do they reinforce conservatism on the part of the universities?
- Issues of social mobility – it was increasing and it is now decreasing in the U.S.
- Issue of allowing early isolation as seems to be succeeding in allowing China to grow: According to some observations **all developed countries** have used trade protection early in their evolution from “non-industrial” status to allow development of their own competitive technical base. The record on this is clear with respect to Japan, Korea, Taiwan, Australia and Germany, U.S.A. and Britain. Perhaps excluding others from using this could be perceived as “unfair”.

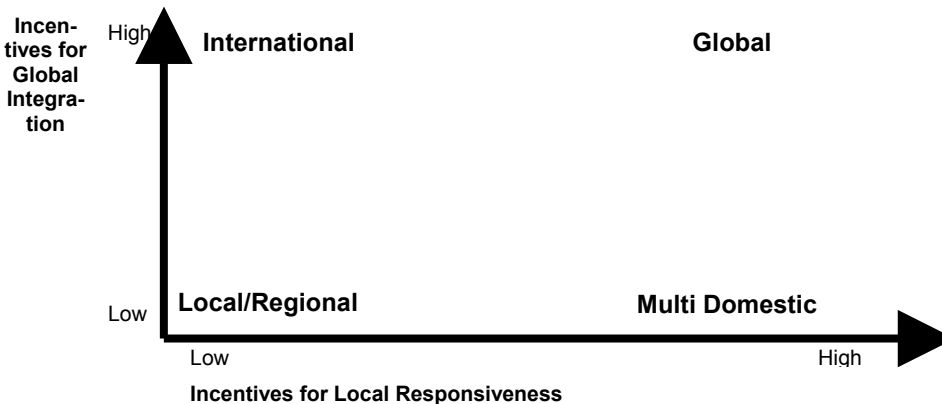
Global Production Systems and Global Supply Chains – Presentation by Chris Musso (10-15 min.)

Term Definitions:

- Globalization:
 - “Increasing integration of economies around the world, particularly through trade and financial flows...also refers to the movement of people (labor) and knowledge (technology) across international borders”¹
 - Corporate entry into new markets
- Global Production Systems:
 - “Activities performed in various locations (that) are closely coordinated through a diverse array of intrafirm and interfirm arrangements...they allow firms to meet a new set of challenges under current competitive conditions.”

Main Drivers for Globalization:

- Growth
 - Shareholder value contingent on company growth
 - Attractive, untapped international markets
- Competition
 - Economies of scale from larger markets
 - Potential dominance of large multinationals



International Strategy: Alcoa . . . BMW

- Little product differentiation in many countries
- Large economies of scale
- Inherent incentives to place own factories in several countries

Global Strategy: ABB . . . Nestle

- Large economies of scale with inputs
- Different products in each country
- Small own factories meet local needs

Multi-Domestic: CitiGroup

- Strong pressure to grow
- Required to meet needs of local population
- Local organizations under local laws
- High value in affiliation, knowledge, capital

Global Production Networks and Supply Chain Networks

- Economic efficiency
- Local responsiveness (transportation issues)
- Offsets/international relations

Porter's Diamond of National Advantage

- Firms subject to competitive pressures and macroeconomic factors
- Every nation has "Factor Endowments"
 - Labor
 - Location
 - Infrastructure
- Ideal use of Factor Endowments creates efficiency
- Frustrated by tariffs, national interests

Economic Efficiency Depends on the Business Model

- Dell:
 - Worldwide outsourced parts, regional assembly
- Intel:
 - Worldwide materials, US dies, worldwide outsourced packaging
- Nike:
 - Worldwide outsourced finished good manufacture
- BMW:
 - Worldwide outsourced parts, worldwide own factories, JV in Brazil

Local Responsiveness:

- Nestle:
 - Commodity food ingredients bought in bulk
 - Finished products made to taste at local (Nestle owned) factories
- GM:
 - Regional automakers (Opel, Daewoo, etc)
 - Leverages purchasing power, knowledge base

Offsets – giving to get:

- Boeing Commercial:
 - Allows Japanese, Chinese suppliers to make airplane parts in order to secure airplane sales¹⁰
 - Transfers knowledge, gains suppliers, cash
- Defense Companies:
 - Contracts with suppliers from allied countries to secure favorable status with government

Social Issues of Globalization

- Enrichment/oppression of peoples
 - Depends on macroeconomic factors
- Worker interests
- Social, environmental responsibility of global companies
- Sovereignty/national defense
- Cross cultural diffusion/conflict

Conclusion:

- Global Market Entry
 - Usually driven by growth needs, competition
 - Strategy depends on business model, products, competitive environment
- Global Production Networks
 - Driven by cost, local responsiveness, offsets
 - Exact strategy depends on business model
 - Very complex due to extraneous (economic) factors such as tariffs
- Social issues must be handled carefully

Discussion:

- What explains why some industries are or are not global – such as the example of aluminum versus steel – US doesn't have bauxite and cheap power needed for aluminum in contrast to the situation in steel – contrast between history of steel being nationalized and also the unique IP associated with aluminum
- There are competitive drivers behind globalization, which raises complex issues around the management of globalization
- There seem to be few controllable levers
- Contrast the economic and military importance of steel relative to aluminum and the contrasting role of the labor movement in steel versus aluminum industries
- Consider issues in the role of women across global enterprises
- Distributed supply chains do raise standards of living
- The fundamental issues of the appropriate “rules of the game” for globalization
- The challenge of individual self interest and individual global responsibility

Book review of Jay Forrester's *Urban Dynamics* by Troy Downen

- A highly accessible analysis of how urban centers grow and decline
- An example of the application of systems dynamics to a practical set of challenges
- Many counterintuitive policy recommendations – not building low-cost housing, not training the poor, etc.
- Greatest strength is large system dynamics model, but that is also its greatest weakness – model is well documented, but it is essential to understand to model to appreciate the recommendations
- Issue around how to engage people around counter-intuitive findings without their utilizing the model? Note that all models are always incomplete – so a challenge in knowing when a model is a valid representation of a system
- The process of building a model can't be separated from the model itself – best if built by stakeholders – Forrester paper on model versus modeling process