

GREATER PHILADELPHIA FUTURES GROUP

DIALOGUE. COLLABORATION. KNOWLEDGE-SHARING.



Complex Systems

September 4, 2020, 10:00am – 12:00pm

MEETING SUMMARY

Brett Fusco, Manager of Long-Range Planning at DVRPC, welcomed attendees, and noted that today's meeting wraps up a series of meetings that have explored the concept of Collaborative Planning Theory (CPT). In January, Dr. Lynn Mandarano of Temple University covered an overview of CPT, in July Dr. Robert Goodspeed talked about the role scenario planning plays in CPT. Central to the CPT philosophy is recognizing that urban areas are made up of overlapping complex adaptive (sub)systems (CASs). Mr. Fusco defined CASs as:

- Complex – Difficult to understand or predict.
- Adaptive – Constantly changing to respond to environment or conditions.
- Systems – A set of parts or things that work together as a unitary whole or interconnected network.

Complex Systems

Simon A. Levin, Princeton University, Lessons from Evolution for Anticipating and Coping With Extreme Events.

Dr. Levin started by noting that evolutionary biologists generally work on how species adapt and how organisms respond to unpredictability.

Dealing with extreme events will be one of our greatest challenges in the coming decades. These are low probability but high impact occurrences that are increasing in frequency. Big events are not occurring in isolation, and are interrelated and risk cascading system failures—and even outright system collapse. Climate change is one of those potentially big, catastrophic events. We can see all kinds of tipping points that tell us it is already happening such as melting of the Greenland ice sheet, Arctic Sea ice loss, a climate change induced Ozone holes over Europe and Antarctica, dieback of the Amazon Rain Forest, permafrost and tundra loss in Siberia, West Africa's monsoon shift, chaotic multistability of the Indian monsoon, instability of the West Antarctic Ice Sheet, and others.

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Robustness, also known as resilience, is the ability to bounce back from extreme events. Finance and ecosystems are similar in many ways, especially in their interconnectedness. They both face danger from systemic collapse, such as the 2008 recession. The world's longest lasting company was Kongō Gumi, which existed for more than 1,400 years before recently being absorbed into another company. One can draw lessons from evolution for regulating the financial system. For example, algorithmic trading has sped up the financial system beyond the ability of the regulators to keep up, and perhaps a one-cent tax per share traded could help slow the system back down.

Robust regulation relies on feedback loops. Negative feedback loops can be destabilizing if they are on the wrong timescale. For example, Cheyne-Stokes breathing, where patients fluctuate between apnea and hyperpnea and can die on a short timescale.

Unpredictability offers both challenges and opportunities. It may be the most predictable feature of our environment today. As a result, societies must be able to adapt. Complex adaptive systems usually employ two strategies to achieve robustness:

- Rigid design with robust components – works best in shorter timescales and in stable environments.
- Flexible and replaceable components – works best over longer timescales and in fluctuating environments.

While Influenza A as a virus is not considered a biological agent, it has proven to be highly resilient thanks to the number of different strains floating around. Dr. Levin is concerned that we will see more viral outbreaks in the future, thanks largely to airline travel. Hopefully, we won't see several pandemics at the same time.

There are three key structural features to robust systems:

1. Adaptive capacity – diversity and heterogeneity.
2. Redundancy and degeneracy – stockpiles of materials, multiple response measures, multiple producers.
3. Modularity / Compartmentalization – social distances, time breaks in financial trading.

Within complex adaptive systems macroscopic patterns emerge from microscopic interactions. Characteristics of CASs:

- Multiple spatial, temporal and organizational scales.
- Self-organization and consequent unpredictability.
- Multiple stable states, path dependence, hysteresis (lags between cause and effect or related phenomena).
- Contagious spread and systemic risk.
- Potential for destabilization and regime shifts through slow-time-scale evolution.

Our immune systems have evolved to help us respond to the risks caused by viruses and bacteria. We need to think about how to build better immune systems for our financial system and society.

- Preparedness
- Early generalized responses (quarantine) that buy time
- Development of antigen-specific responses (vaccines)
- Attention to over-response (cytokine storms)
+ Adequate planning for reopening
- Collective action

For the pandemic, testing and contact tracing can provide essential feedback. But we also need collective action. Elinor Ostrom's research on the commons provides a good example of non-market-based collective action. The primary challenge for climate change is not scientific knowledge, it's people and government will to meet the common good and find solutions that benefit all parties. Likewise, public health challenges raise public goods problems. See for instance, antibiotic overuse, vaccine hesitancy (which is on the rise even amidst the COVID pandemic), social distancing, and mask wearing. The good news is that social norms can change rapidly, for example attitudes on smoking and racial and gender equality. Cooperation and collective action lead to societal robustness.

Q&A

We often see the commons presented as an alternative to the global capitalist market. But historical examples of the commons were in small, closed societies. How can they be applied to our highly interconnected, global world?

At the end of her life, Ostrom was working on this through polycentric approaches. Build local communities that become global building blocks. This would take a hierarchical approach with bargaining agents.

Do you see any state of homeostasis being achieved in any way among urban systems or infrastructures?

At which level do you want homeostasis (which is the return to equilibrium)? There are more dangers in companies thinking about adaptability as a tradeoff for efficiency. Homeostasis may be too narrow of a concept because it means nothing changes. The focus should be on robustness. Technology should benefit everyone, but it often privileges some groups within society.

Adding systems for resilience reduces the efficiency of the system in stable times, as resources directed to resilience are protective, not productive. In a hyper-capitalist system, how do we get resources and systems directed to resilience?

There are clearly trade-offs between exploitation and exploration, as in strategies we will work versus new strategies we may be able to benefit from. Evolution has had to face tradeoffs between selection between recombination rates and selection rates. Redirection of resources to resiliency is a major challenge. Prior to the pandemic we had eliminated a lot of the adaptive capacity we had built up 3-4 years ago because it was decided that these costs weren't worth the investment. We must convince decision makers of the importance of robust preparations.

Within cities and placemaking there is often a discussion over the impacts of major/mega projects vs. an incremental approach. It seems like in nature and the economy that a single large event can cause massive disruption (hurricanes, pandemic, etc.). Are there examples in nature where a single major positive event has helped offset the disruption? Or does nature offer incremental, more complex answers to address a major disruption? And is there something to be learned from this on how we look at redeveloping cities?

Evolution generally proceeds by small changes through mutations. There are two modes of adaptation, there point mutations and there are small adaptations through environmental changes. There may be some changes to a major event—which could cause an extinction event—as evolution is about competition

between organisms and how they respond to changing environments. Niles Aldridge and Stephen Jay Gould's writings have focused on major transitions in evolution. How should societies transition? Should they attempt gradual transitions or occasionally shake everything up and completely reorganize every few years. There aren't easy, straightforward answers to this (Dr. Levin has a paper in review that deals with these issues).

Facilitated Exercise

Marisa Denker, Kiersten Mailler, and other staff from Connect the Dots (CtD), joined DVRPC's Futures Group to collect data from participants that will inform planning for future meetings that contribute to long range planning. Participants were split into breakout groups of 5-7 people for a concentrated discussion.

Exercise 1 focused on a discussion of Dr. Levin's lecture, and thoughts about what the future might look like in terms of solving some problems that face our region today. Participants were prompted with the following questions: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

Exercise 2 asked participants to dig deeper and make direct recommendations for WHOM should be included in future conversations and WHAT topics should be addressed, as well as HOW to go about addressing some pressing issues that face our region.

A complete workshop analysis and copies of the interactive mural sheets are included in the materials from this meeting.

Member Updates.

- Check out the Delaware County Housing Plan Draft <https://delcopa.gov/planning/pubs/delco2035/HousingPlan.html> Due for adoption in October
- Someone to talk about health equity work that is being done around COVID-19? Dr. Levine or David Saunders from the PA DOH. I bet NJ is doing a similar effort.
- Montgomery County has launched a restart Montco Plan for reopening from the COVID shutdown, <https://www.montcopa.org/3546/Restart-Montco>.
- Check out the newly redesigned Futures Group webpage, which has direct access to all of our scenario planning reports <https://www.dvrpc.org/LongRangePlan/FuturesGroup/>.
- Would like to hear from speakers who address why Philadelphia city and region small business formation is so low compared to other cities and metros (see recent Pew report, <https://www.pewtrusts.org/en/research-and-analysis/reports/2020/08/philadelphias-small-and-midsized-business-landscape>).
- Delaware County Planning Department has opened up our 2020 Transportation Improvements Inventory <http://www.delcopa.gov/planning/news/TII2020.html>.