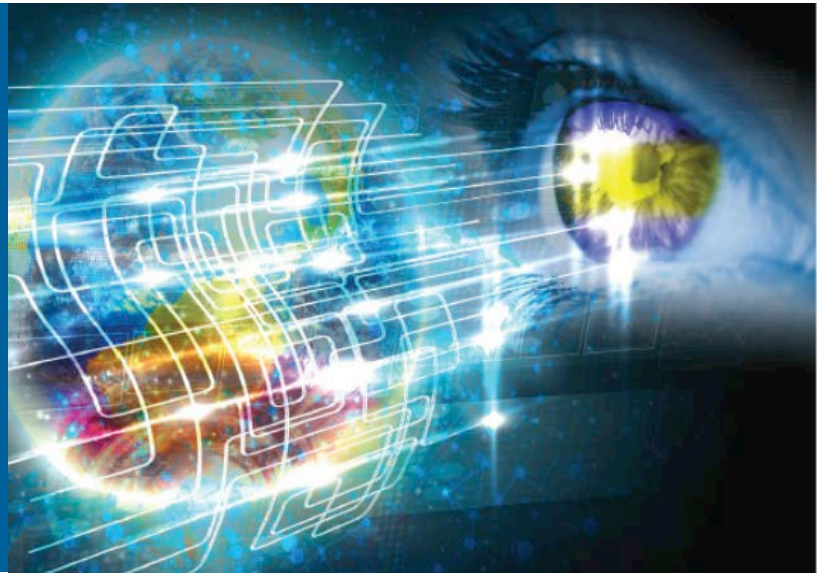
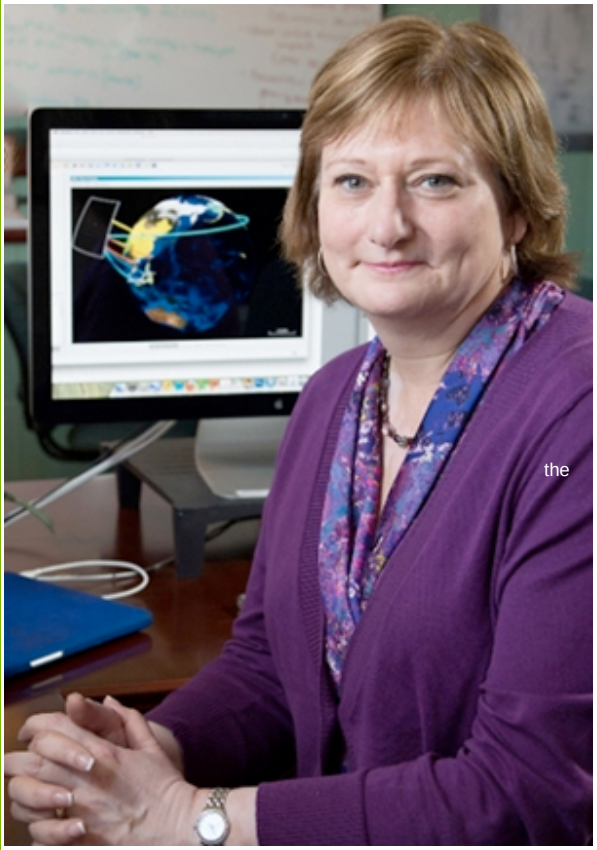
WEBS OF DECEIT: DETANGLING THE WICKED PROBLEM OF MODERN CRIME



For: 2016 Fram Applied Critical Thinking Speaker Series

PAMELA J. SYDELKO
DIRECTOR: SYSTEMS SCIENCE CENTER
GLOBAL SECURITY SCIENCES DIVISION
ARGONNE NATIONAL LABORATORY

Pamela J. Sydelko



Education

1982	1984	2004	Present
B.S. in Botany	M.S. in Soil Science	MBA	PhD Candidate Systems Science
North Dakota State University	University of Illinois	University of Chicago	University of Hull, UK

Experience

1985	1988	1994	2003	2004	2014
Environmental Science	GIS	Spatial Modeling	Integrated M&S	Executive Management	Systems Science
U.S. Army Construction Engineering Research Laboratory	Argonne National Laboratory				

OUTLINE

Systems Thinking

- WHAT IS A SYSTEM?
- EVOLUTION OF SYSTEMS THINKING
- HARD AND SOFT SYSTEMS THINKING
- CRITICAL SYSTEMS THINKING (CST)
- SYSTEMIC INTERVENTION

Wicked Problems

- WHAT IS A WICKED PROBLEM?
- PROPERTIES OF WICKED PROBLEMS
- COMPLICATED VS WICKED PROBLEM?

The Inter-agency

- STOVE-PIPED GOVERNMENT
- GOVERNMENT CZARS AND TASK FORCES

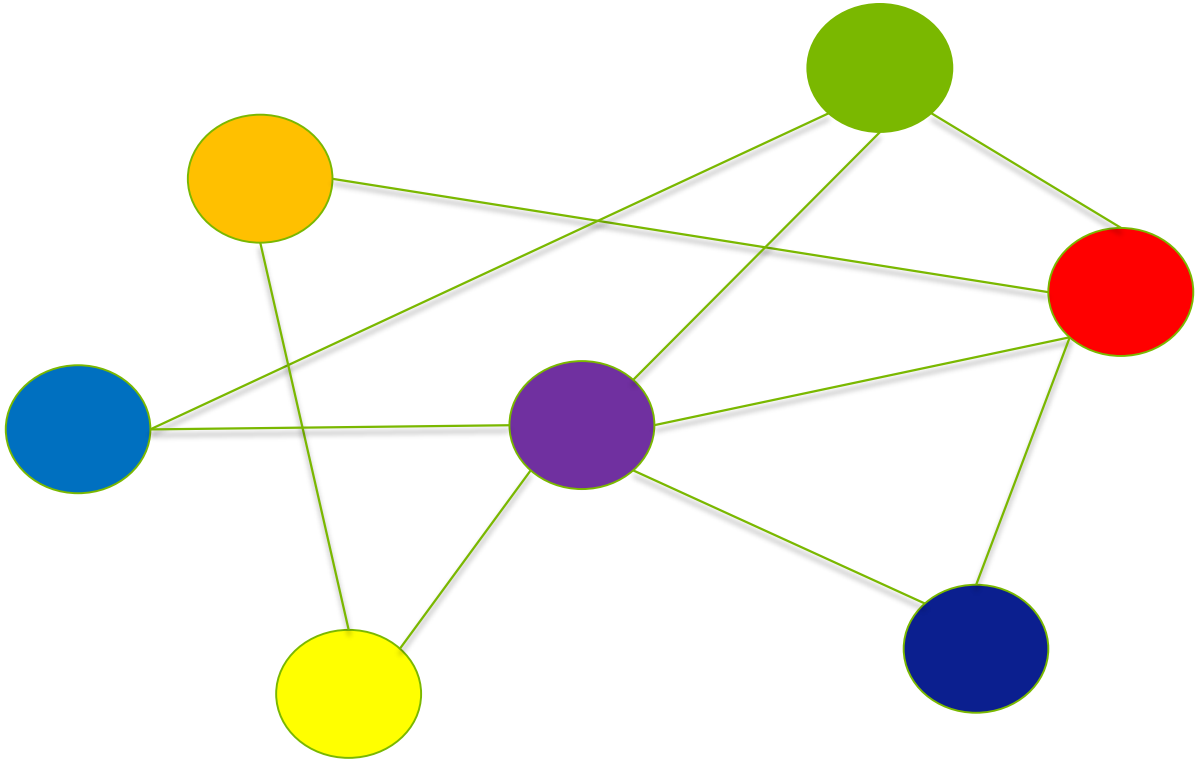
Crime at the Urban Edge

- PARTICIPATORY SYSTEMIC PROBLEM STRUCTURING
- ANTICIPATORY SYSTEMS
- SYSTEMIC ORGANIZATIONAL DESIGN
- EVALUATION OF METHODS AND PROCESS

SYSTEMS THINKING

WHAT IS A SYSTEM?

- **A *System*** is a set of interacting or interdependent components forming an integrated whole and serving a common purpose

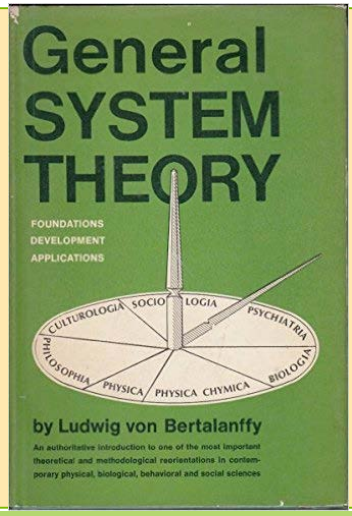


FOUNDATIONS OF SYSTEMS THINKING?

Ludwig von Bertalanffy

Systems thinking has roots in the General Systems Theory that was advanced by Ludwig von Bertalanffy in the1940's.

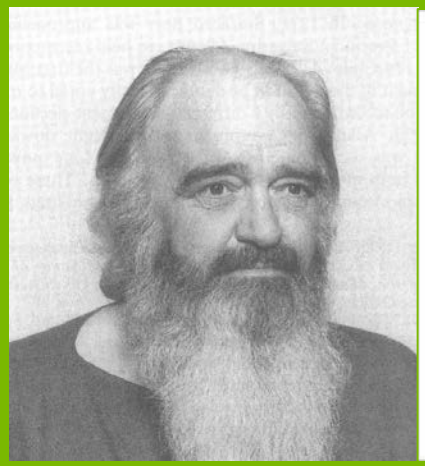
"Modern science is characterized by its ever-increasing specialization, necessitated by the enormous amount of data, the complexity of techniques and of theoretical structures within every field. Thus science is split into innumerable disciplines continually generating new subdisciplines."

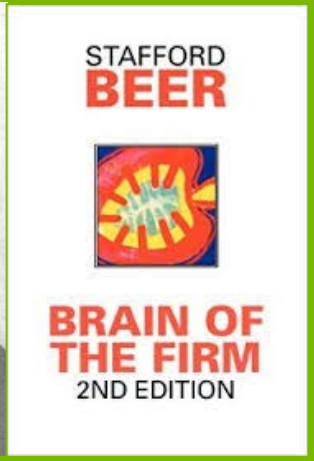


"There appear to exist general system laws which apply to any system of a particular type, irrespective of the particular properties of the systems and the elements involved."

Von Bertalanffy, Ludwig. "General systems theory: Foundations, development, applications." *New York: Braziller* (1968).

VIABLE SYSTEM MODEL (VSM)





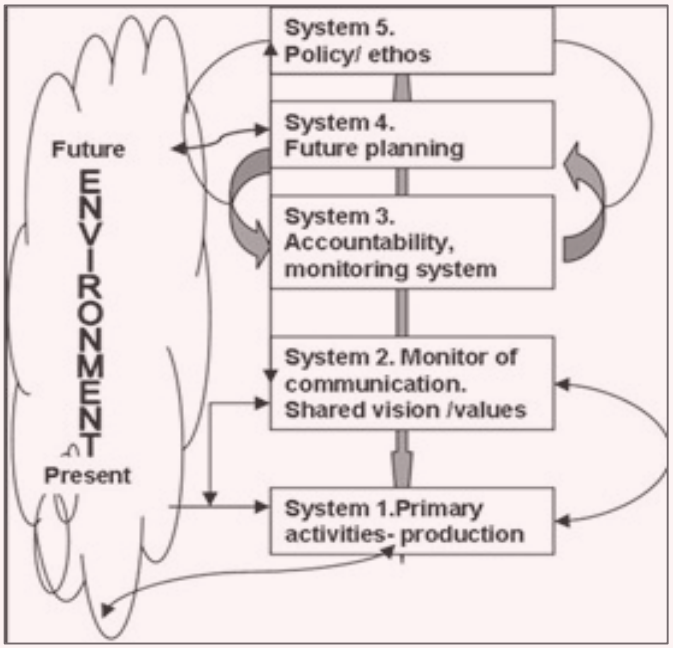
Stafford Beer

- In the 1960s and early 1970s Beer was a very influential practitioner in management cybernetics
- Norbert Wiener defined cybernetics in 1948 as "the scientific study of control and communication in the animal and the machine."[1]
- "the purpose of a system is what it does."

Stafford Beer's Viable System Model (VSM)

An organizational representation of the elements and interactions considered essential for any system to be viable or autonomous.

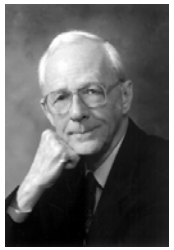
- Organized and operates in a manner such as to survive in its changing environment
- Adaptability is one of the prime features of systems that survive



Wiener, Norbert (1948). Cybernetics, or Control and Communication in the Animal and the Machine. Cambridge: MIT Press.

EVOLUTION OF SYSTEMS THINKING

Ashby



Forrester

Churchman

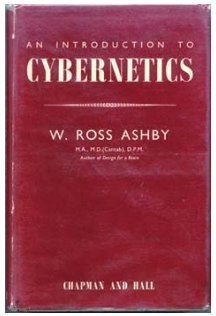
Checkland

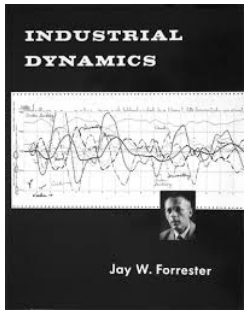
Jackson

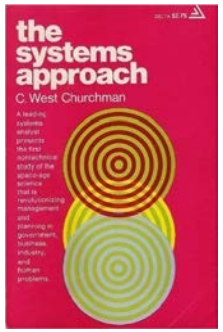
Midgley

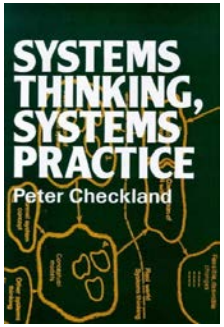
Cabrera

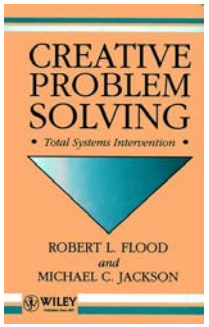
1957 → 1961 → 1968 → 1981 → 1991 → 2001 → 2015

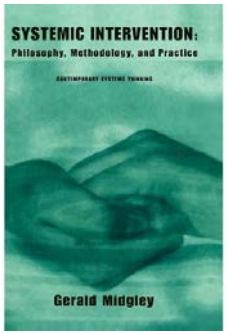


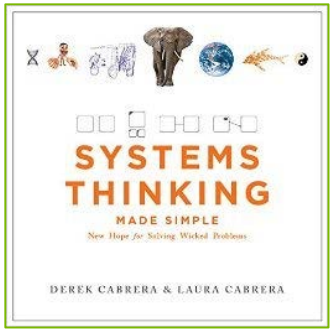








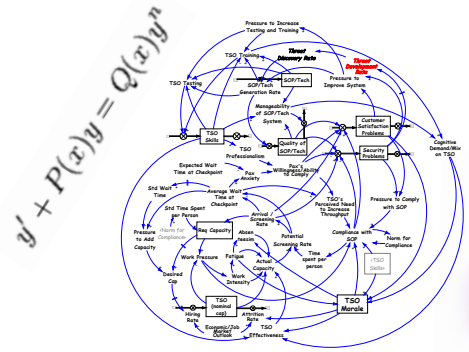




HARD AND SOFT SYSTEMS THINKING

Hard Systems (Quantitative)

- Critics found hard systems too deterministic and reliant of the judgment of "experts" (West Churchman, 1970; Ackoff, 1979; Richardson and Midgley, 2007)



Example Hard System Approaches:

- **System dynamics (Forrester, 1961)**
- **Systems analysis (Quade et al., 1968)**
- **Systems engineering (Blanchard, Fabrycky, & Fabrycky, 1990)**

HISTORICAL DIVIDE

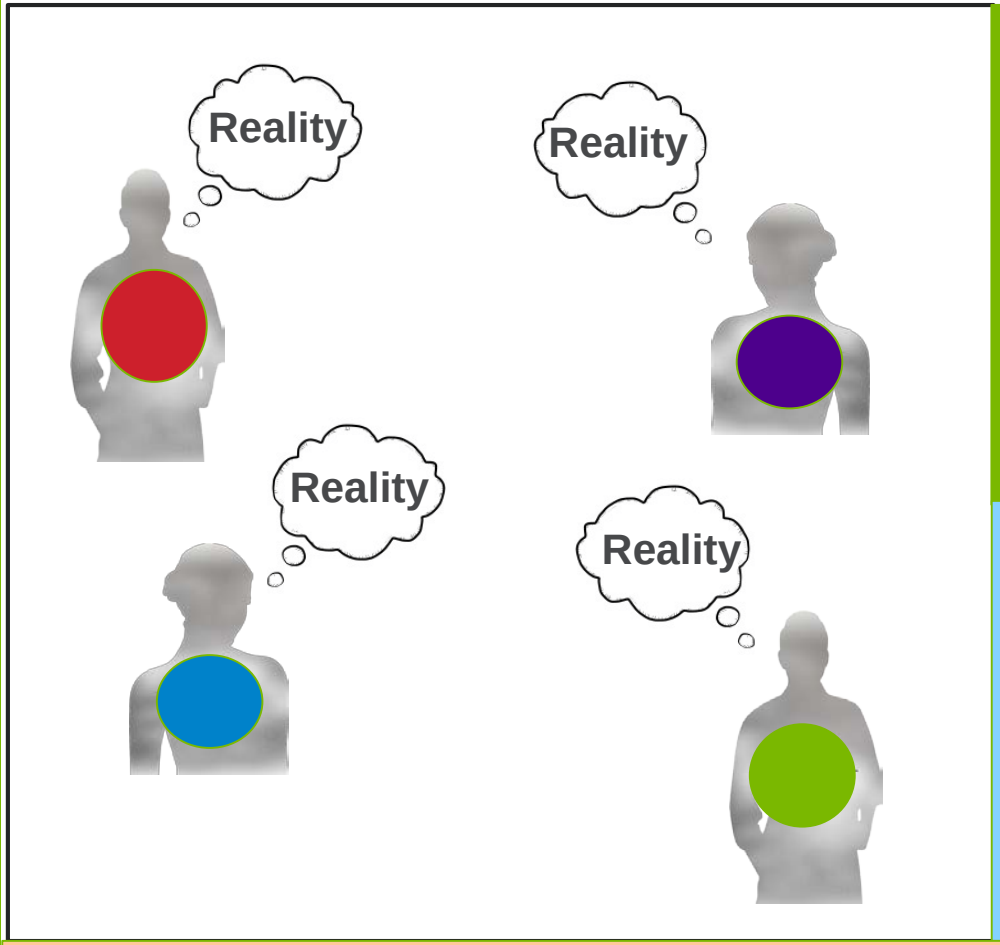
Soft Systems (Qualitative)

- Problem Structuring Methods (PSM):
  - Common understanding (not consensus) among stakeholders
  - Acceptance of differences (Checkland & Scholes, 1990; Checkland & Poulter, 2010)
- Systemic Problem Structuring:
  - Holistic, bigger-picture and diversity of perspectives (Midgley et al., 2013)
  - Explores the boundaries of inclusion and exclusion (Ulrich, 1983)

Example PSMs:

- **Cognitive mapping / Strategic Options Development and Analysis (SODA) (Eden & Ackermann, 2013)**
- **Strategic Choice (Friend & Hickling, 2005)**
- **Strategic Assumption Surfacing and Testing (Mason & Mitroff, 1981).**

SOFT SYSTEMS (CONSTRUCTIVIST)



Rely more on qualitative methods and a constructivist approach (i.e., appreciating that we inter-subjectively construct our social realities), multiple perspectives could be brought in to provide a diverse set of knowledge and experiences.

Participative methods were developed over many years by researchers wanting to better accommodate multiple perspectives in problem formulation for ill-defined problems

The term ‘problem structuring’ was contrasted with ‘problem solving’, and (Rosenhead, 1989) emphasized that they could be complementary PSMs being useful for wicked problems and problem solving approaches for tame ones (also see Jackson and Keys (1984)

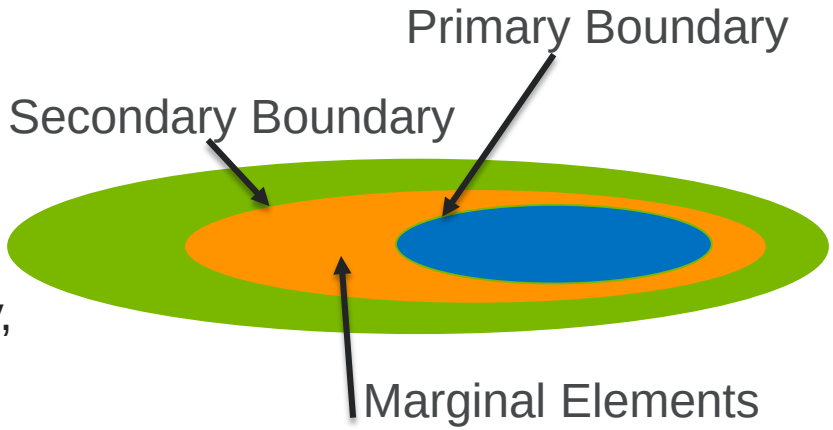
CRITICAL SYSTEMS THINKING (CST)

- Criticizes both hard systems (focused on optimization) and soft systems (focused on dialogue)
- View the two approaches as mutually exclusive and incompatible, instead of complementary (Flood & Jackson, 1991; Mingers, 2011)
- CST is more sophisticated in its understandings of power and how to address it through intervention
- CST emphasizes complementarism or (Methodological Pluralism)
  - It is legitimate to use multiple theoretical models and multiple methodological approaches within systems science practice
  - The key is to know which model or methodology to pull our of the “toolbox”

NEW WAVE OF SYSTEMS THINKING

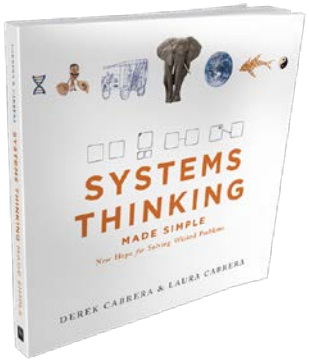
- **Systemic Intervention (Midgley, 2000)**
  - Advocates boundary critique and methodological pluralism together (Midgley, 2000)
  - Intended for use in practice to identify possible "action for improvement"
  - Theory of Marginalization (Midgley, 1992)

"Intervention" defined as purposeful action by an agent to create change."



- **DSRP (Cabrera and Colosi, 2008)**
  - consists of four interrelated structures (or patterns), and each structure has two opposing elements.
  - The structures and their elements are:
    - Making **D**istinctions – which consist of an *identity* and an *other*
    - Organizing **S**ystems – which consist of *part* and *whole*
    - Recognizing **R**elationships – which consist of *action* and *reaction*
    - Taking **P**erspectives – which consist of *point* and *view*

CABRERA RESEARCH



WICKED PROBLEMS

WHAT IS A WICKED PROBLEM?

- The term “wicked problem” was first used by Horst W.J. Rittel and Melvin M. Webber[1] as a way to describe and characterize social planning problems that are open-ended, contradictory, and have many stakeholders.
- Also called “tangled problems” or “messy problems”

[1] Rittel, H.J., Webber, M., 1973. Dilemmas in a general theory of planning. Policy Sciences 4, 155-169.

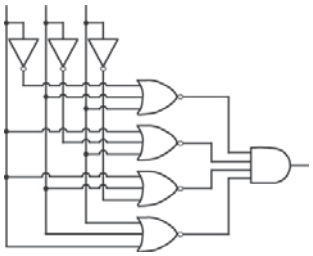
10 PROPERTIES OF WICKED PROBLEMS

1. There is no definitive formulation of a wicked problem
2. Wicked problems have no stopping rule
3. Solutions to wicked problems are not true-or-false, but good-or-bad
4. There is no immediate and no ultimate test of a solution to a wicked problem
5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered to be a symptom of another problem.
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution
10. The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).

Rittel, H.J., Webber, M., 1973. Dilemmas in a general theory of planning. Policy Sciences 4, 155-169.

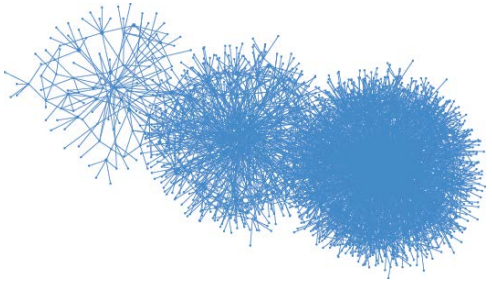
COMPLICATED VS WICKED PROBLEM?

- "Complicated (Tame) Problems



- Originate from isolated causes that are clearly identifiable and fall within distinct bureaucratic categories
- Can be dissected into isolated chunks addressed, and pieced back together;
- Consequences are generally proportionate to their causes (for every input, there is a proportionate output);
- Fixtures can be put in place for permanent solutions.

- Complex (Wicked) Problems



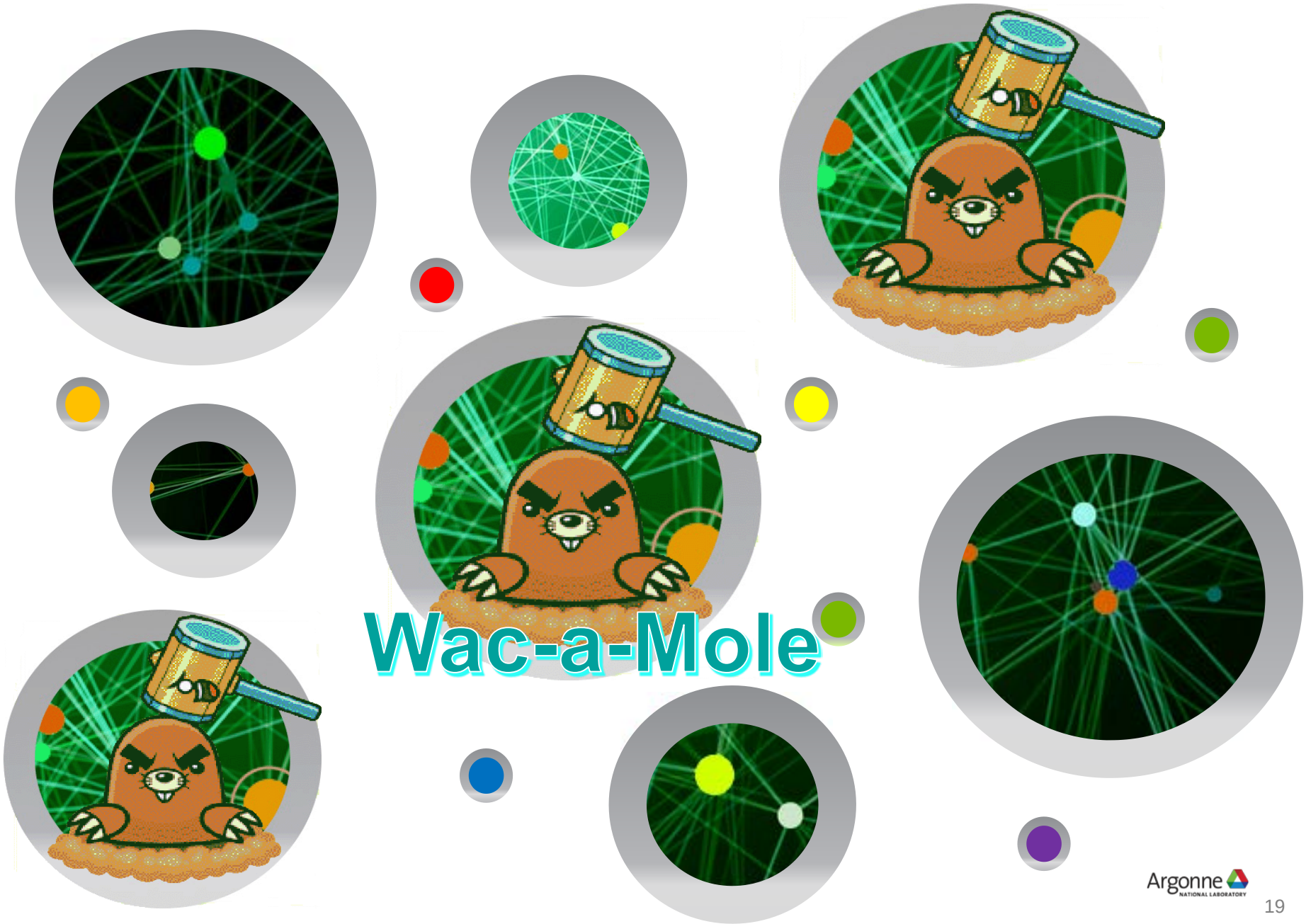
- Result from concurrent interactions among multiple systems of events, and they erode the customary boundaries that differentiate bureaucratic concepts and missions;
- Cannot be broken apart and solved piece-by-piece. They must be understood and addressed as a system;
- Do not automatically stabilize, but intrinsically unravel into chaos if not systemically managed;
- Cannot be permanently solved. Instead, they morph into new problems as the result of interventions to deal with them."

Fuerth and Faber, 2012

THE INTERAGENCY

Stove-piped Government

WICKED PROBLEM VIEWED DOWN PIPES



GOVERNMENT CZARS AND TASK FORCES

- **CZAR**: high-level officials who oversee a particular policy
  - Roosevelt first to appoint a czar
  - Currently 34 presidentially-appointed Czars
- **Government Task Force**: a temporary organization created to solve a particular problem
  - First used in DoD

EXAMPLE CZAR TITLES

- Foreign aid czar
- Anti-poverty czar, poverty czar
- Bank bailout czar, TARP czar
- Budget czar
- AIDS czar
- Cyber security czar
- Drug czar
- Ebola czar
- Asian Carp czar
- E-commerce czar, e-czar
- Intelligence czar
- Climate czar
- Weapons czar
- Weatherization czar

EXAMPLE TASK FORCES

- U.S. Preventive Services Task Force
- Fugitive Task Forces
- FBI's Joint Terrorism Task Forces
- Coral Reef Task Force (USCRTF)
- Countering Violent Extremism Task Force
- Internet Policy Task Force
- Ebola task force
- Task Force on Health Care Reform
- Financial Crimes Task Forces
- Presidential Task Force on Combating IUU Fishing and Seafood Fraud

INTERAGENCY COLLABORATION

- Challenges of interagency collaboration:
  - Not holistic
  - Long-term process
  - Too many meetings
  - Missed opportunities
  - Inaction, and too many poor solutions
  - Higher transaction costs

- "*Each agency seeks to preserve its autonomy and independence.*
- *Organizational routines are difficult to synchronize.*
- *Goals overlap but are not identical.*
- *Constituents bring different expectations and pressures to bear on each agency.*
- *Managers try to minimize the uncertainty of their own environments but are less concerned with minimizing uncertainty for others.*"
- *-- Weiss (1987, p. 3)*

- Example research into improving multi-agency collaboration:
  - Cause-and-effect methods and frameworks (Ansell Gash, 2008; Emerson et al., 2012)
  - SSM for activation in the event of a local disaster (Gregory & Midgley, 2000)

Very few governmental efforts to tackle wicked problems involve the design of a dedicated meta-organization to bring agencies together in a coordinated approach

WE NEED SYSTEM THINKERS

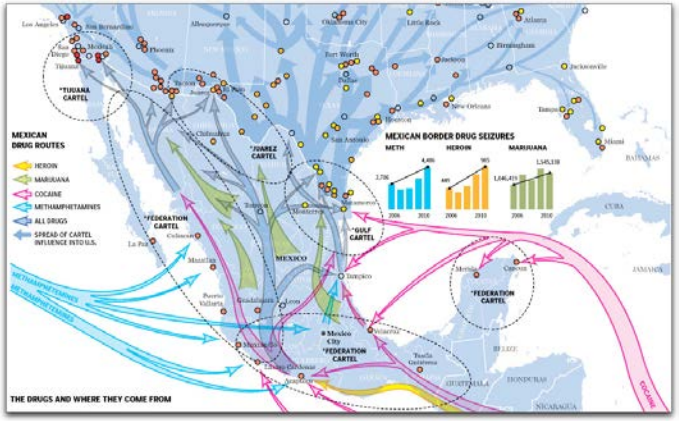
CRIME ON THE URBAN EDGE

CRIME ON THE URBAN EDGE (CUE)

- CUE is research project focused on designing a systemic approach to countering illicit drug trafficking by transnational organized crime organizations, U.S. urban gangs, and their potential for systemic interaction
- Constitutes a **Wicked Problem** with multiple stakeholders and perspectives from across local/regional/national/international agency divides.
- Study funded by Argonne's Laboratory Directed Research and Development (LDRD)

Countering Transnational Organized Crime (TOC)

- TOCs engage in many kinds of trafficking, including that of people, drugs, arms, dangerous chemicals, biological materials, nuclear materials, and funds.
- Study will focus on drug trafficking by Mexican cartels into U.S. (cocaine, heroin, marijuana, and methamphetamine)



Argonne NATIONAL LABORATORY

CRIME ON THE URBAN EDGE (CUE)

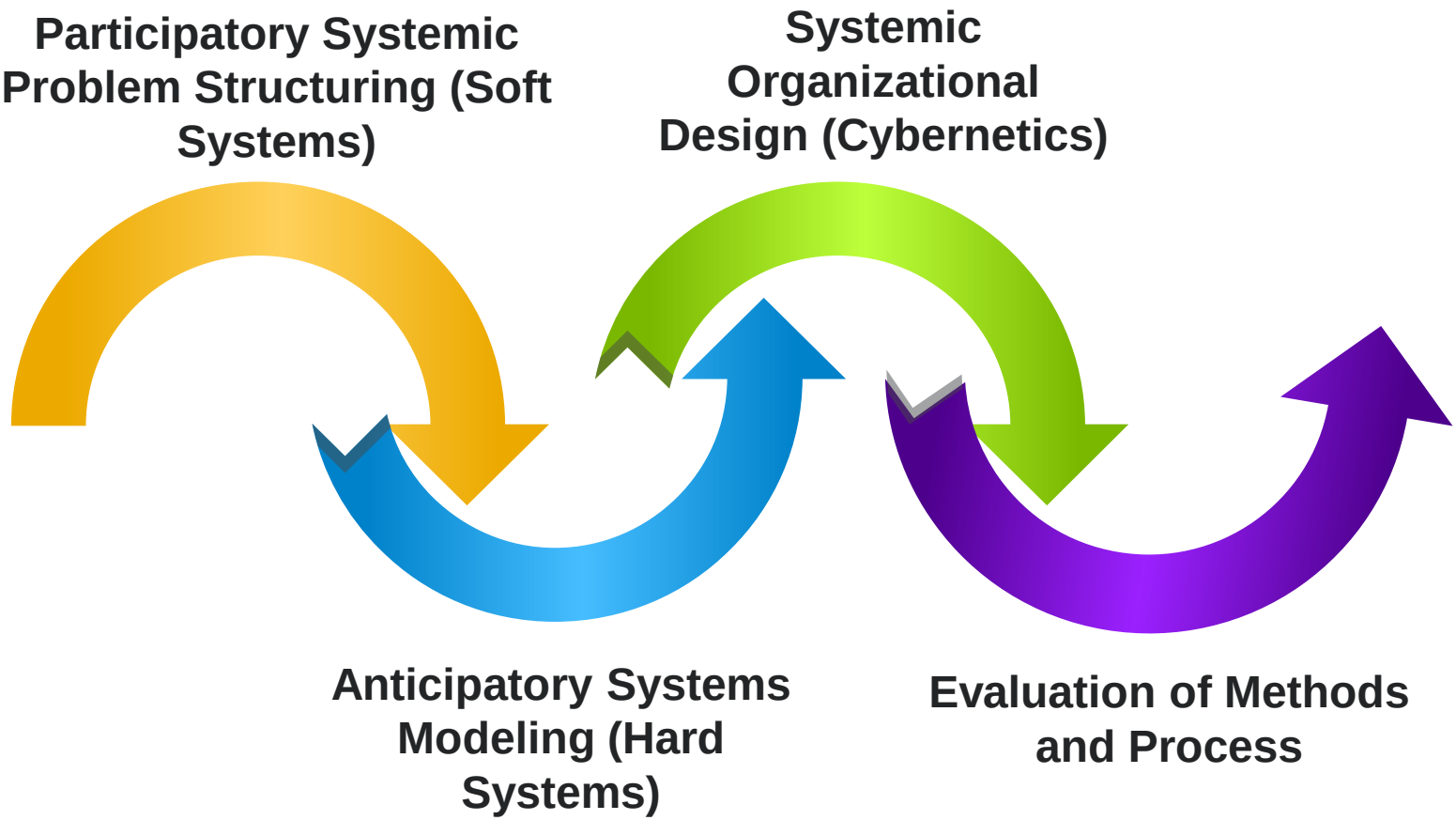
Convergence of TOC and U.S. Urban Gangs and Crime

- U.S. gangs play roles as enforcers during the cross-border trans-shipments and as proxies for the cartels on the street.
  - Street level sales, street enforcers, conducting kidnappings, and collecting the proceeds from sales.
- As TOC becomes more sophisticated, expanding influence in major U.S. cities is feared for all types of illicit trafficking
- Dynamics of the U.S. “Demand-side” impacts TOC behavior

TOC/Urban Gang Convergence

Study Focus on Chicago

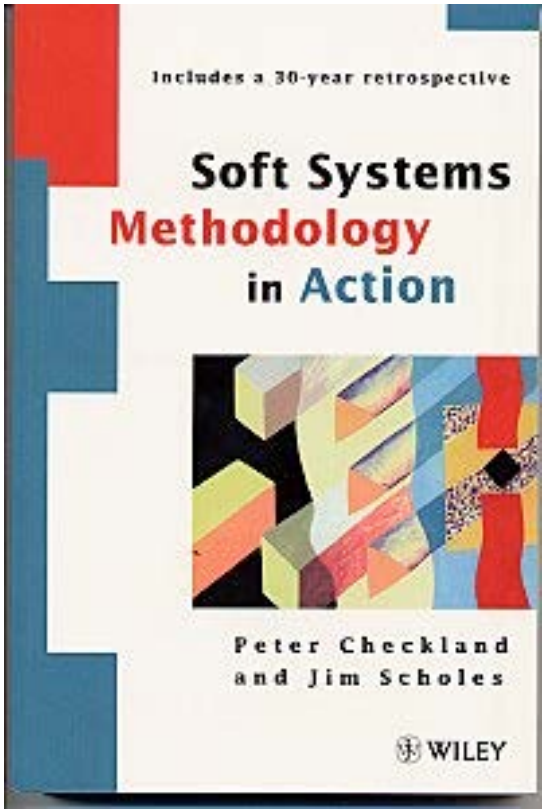
CUE: SYSTEMIC INTERVENTION APPROACH



Participatory Systemic Problem Structuring (Soft Systems)

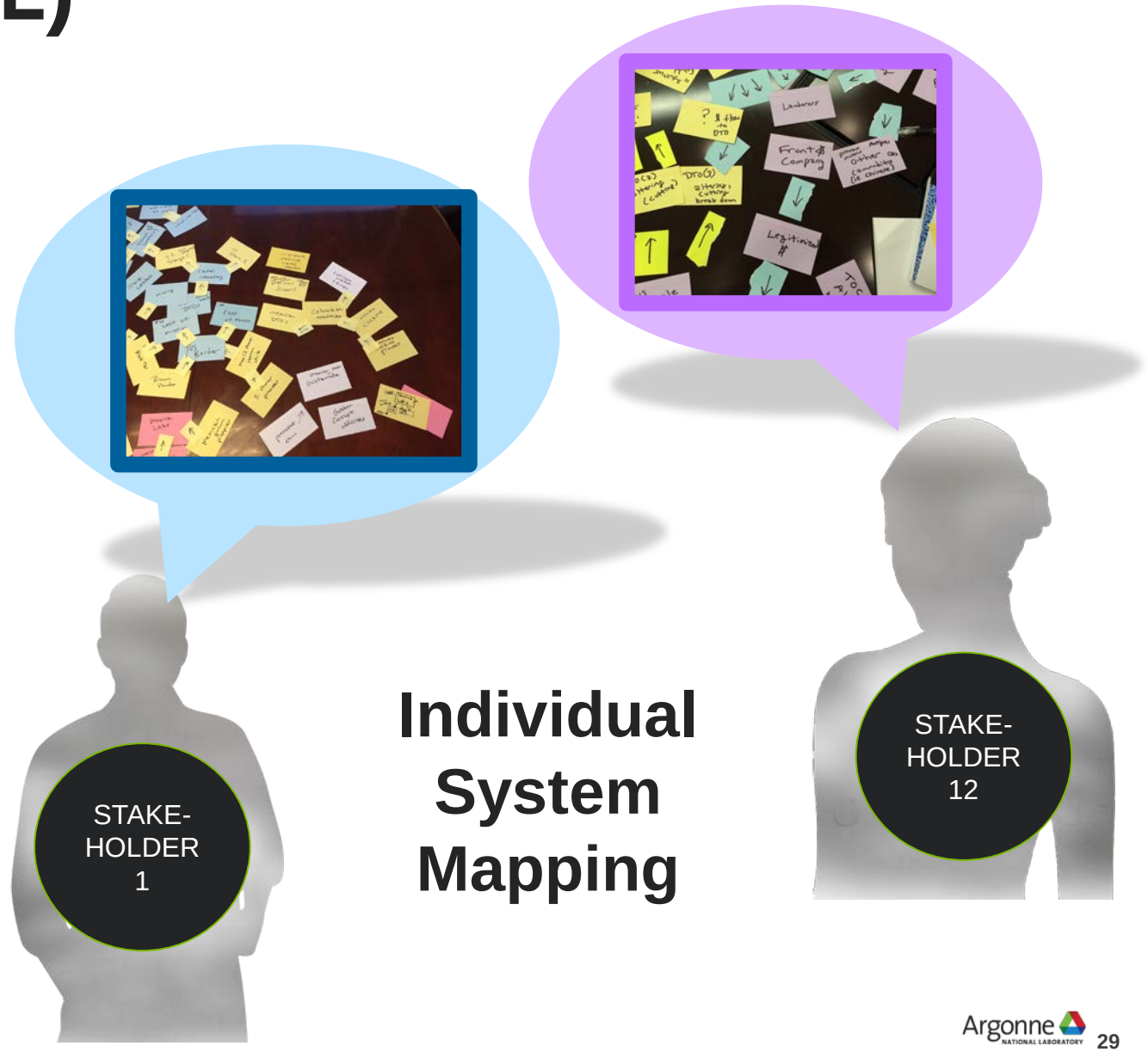
SYSTEMIC PROBLEM STRUCTURING

- Systemic Problem Structuring:
  - Holistic, bigger-picture analysis and diversity of perspectives (Midgley et al., 2013)
  - Who should be included in the decision-making and who should be excluded (Ulrich, 1983; Midgley, 2000)?
  - Finds ways to explore the boundaries of inclusion and exclusion (Ulrich, 1983)
- Collaborative process for evaluation, involving the researcher and selected stakeholders, looking at the context, purposes, methods, and outcomes of an intervention (Midgley et al., 2013)



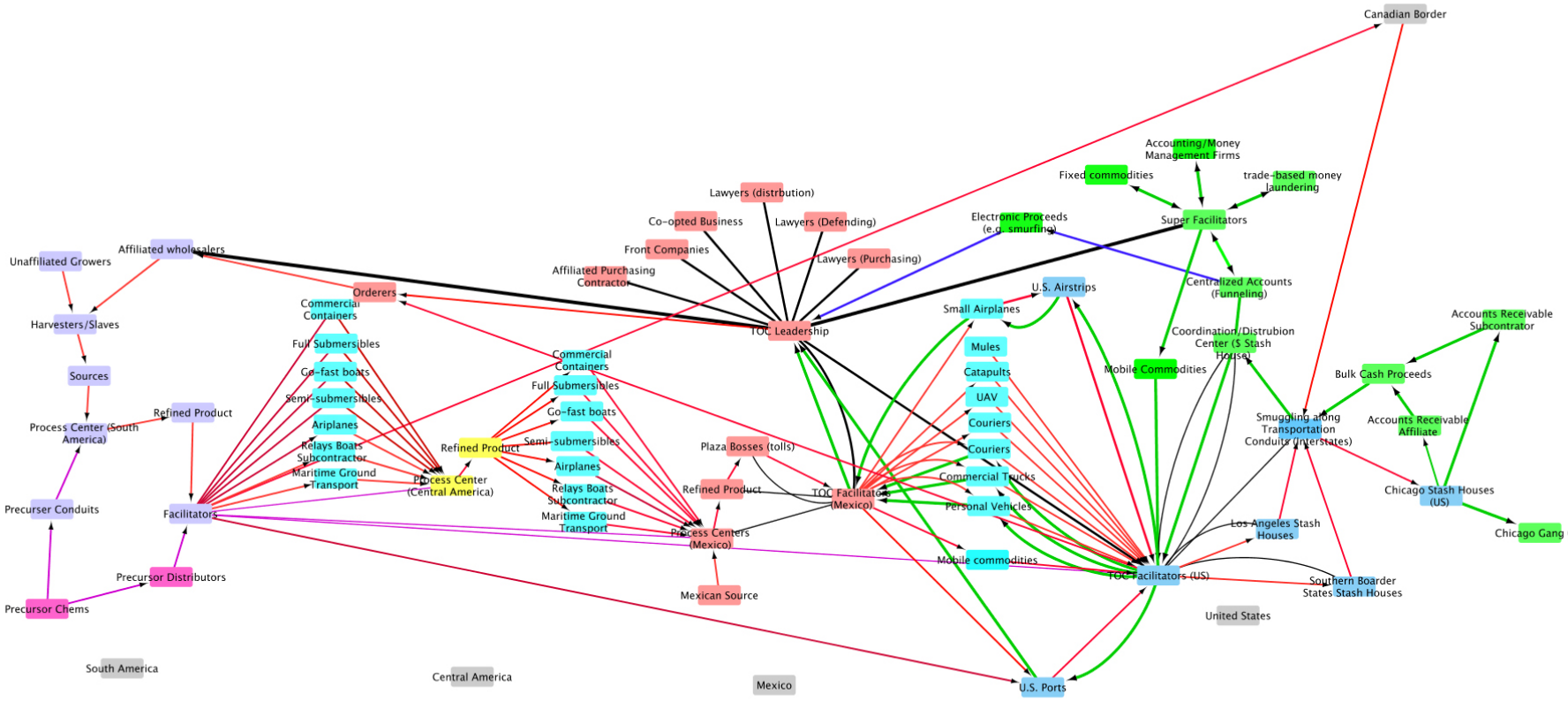
SYSTEMIC PROBLEM STRUCTURING (INDIVIDUAL)

- Stakeholder Selection
- Stakeholder Interviews
- Interview Questions



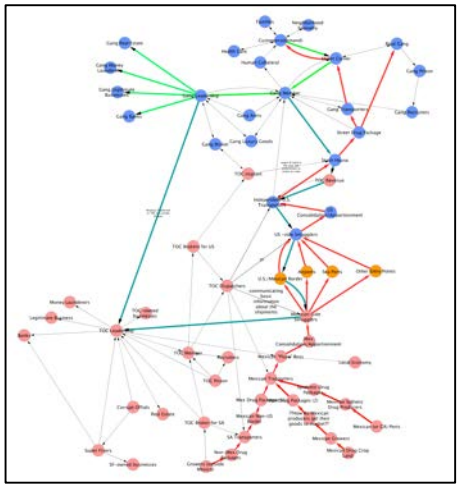
Individual System Mapping

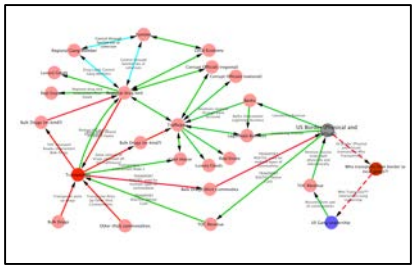
SYSTEM MAPPING FOR EACH STAKEHOLDER

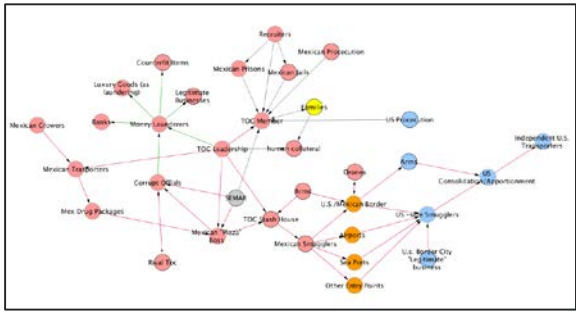


PARTICIPATIVE PROBLEM STRUCTURING (GROUP)

Merging System Maps

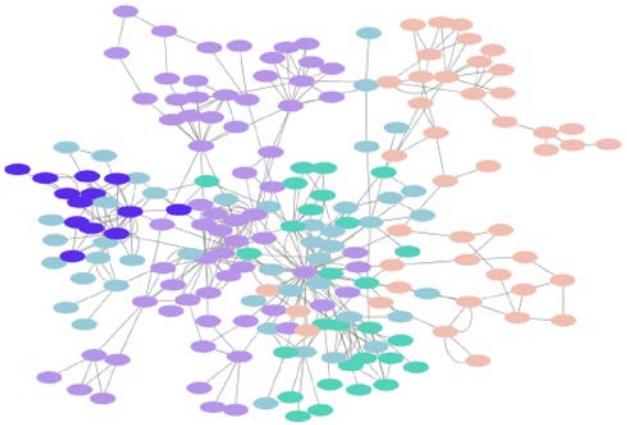






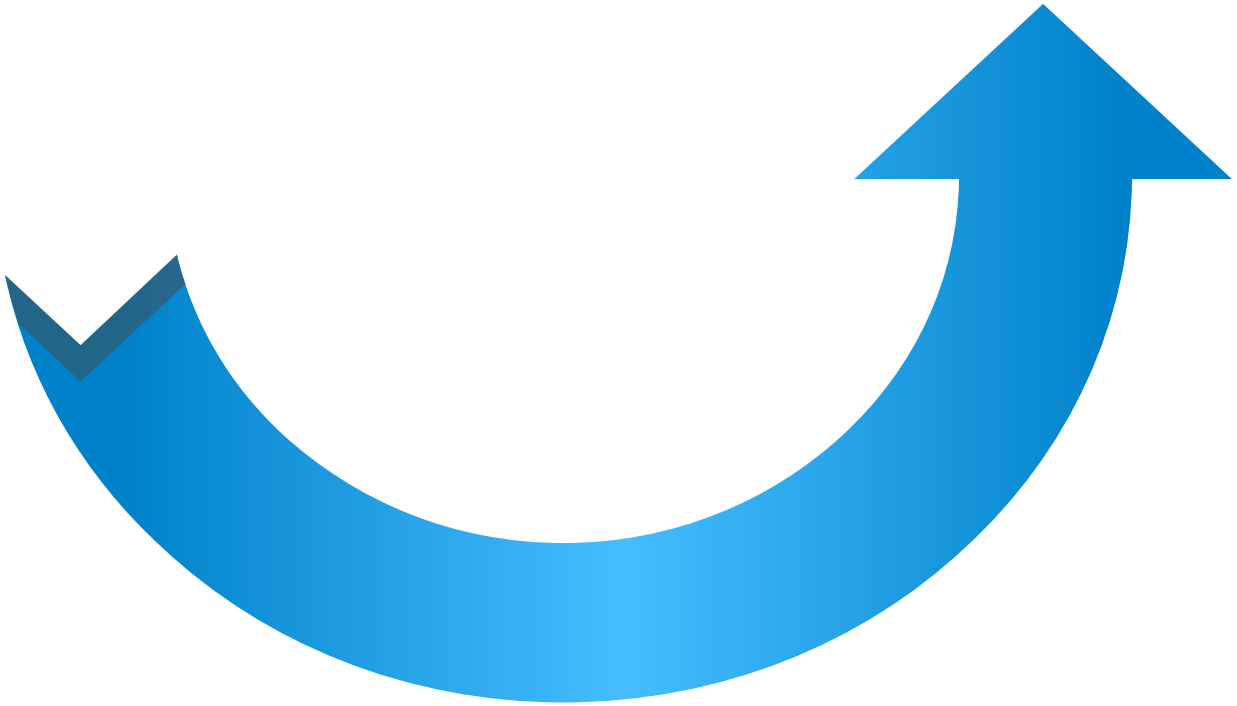
Participative Group Problem Structuring (Workshop in May)

Common Wicked System Map

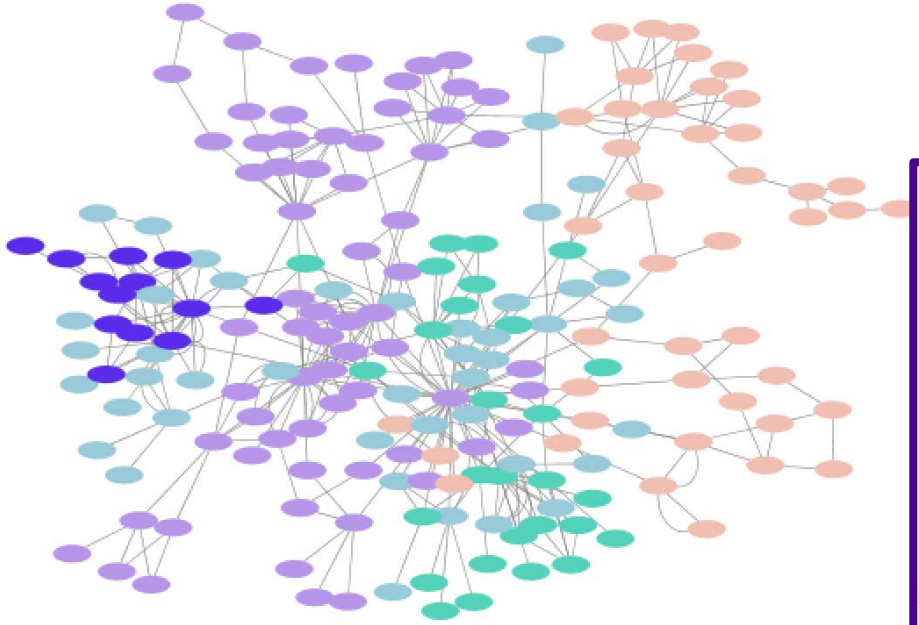


Boundary Critique

Anticipatory Systems Modeling (Hard Systems)



CONVERTING SYSTEM MAP INTO SYSTEM DYNAMICS MODEL



Common Wicked System Map

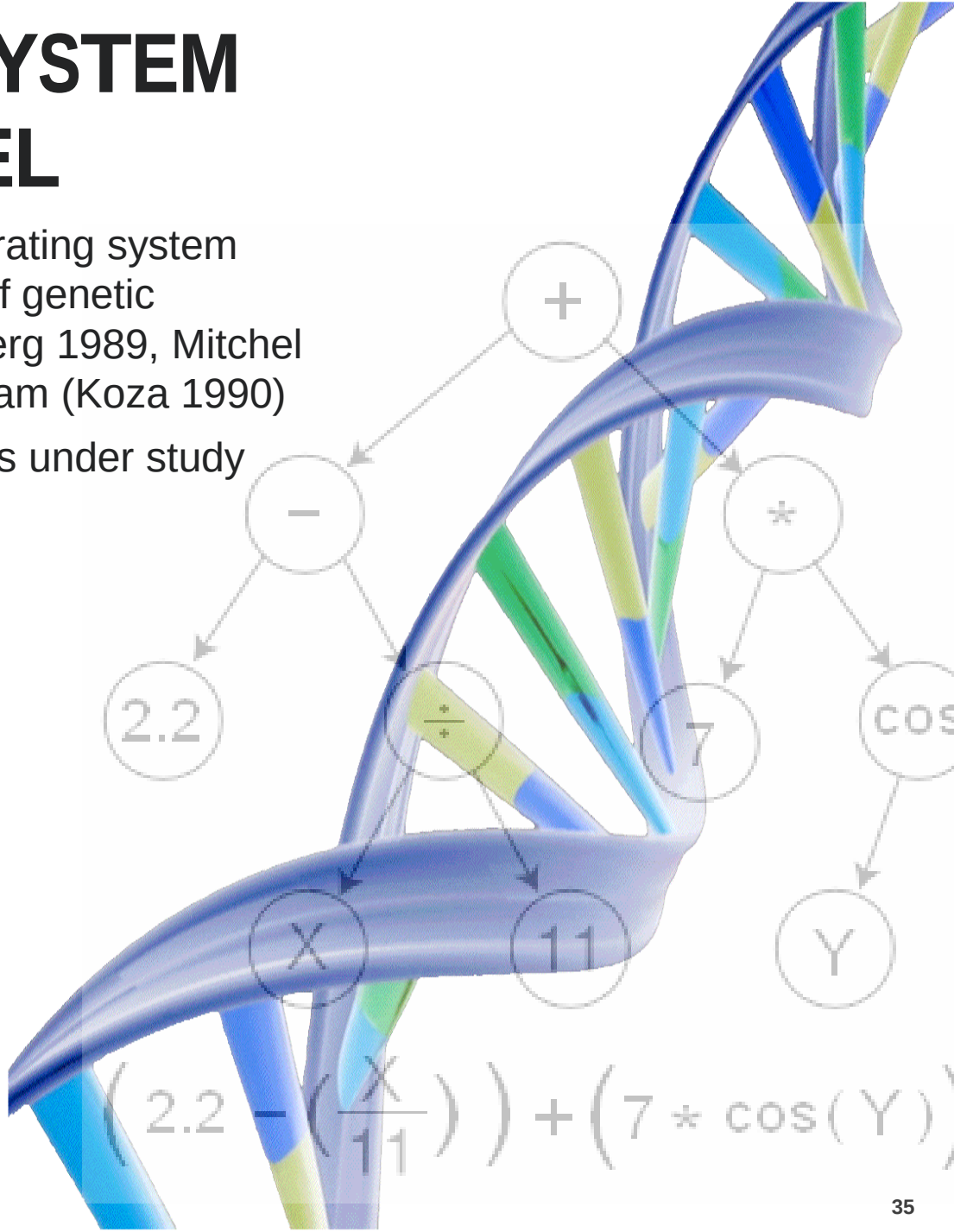
Base System Dynamic Model

COLLECTED SUPPLY CHAIN DATA

- U.S. Border Patrol Drug Seizures, 2005-2011
  - Seizures by drug type, amount, and ports of entry/border patrol checkpoints
- UN Individual Drug Seizures, 2009-2014
  - International seizures by country, city, and key variables such as producing country and destination country
- STRIDE
  - DEA drug seizures by weight, potency, and price
- UN Illicit Crop Monitoring, 2002-2010
  - Extent and evolution of illicit crops in key drug growing countries
- Mexico: Illicit Financial Outflows, 1971-2009
- UN Surveys of Crime Trends and Operations of Criminal Justice Systems, 1970-2006
  - Details the socio-legal and political context for key supply chain-related crimes (e.g. bribery, drug trafficking, etc.) at the country level
- ATF Firearms Trace Data and Firearms Recovered in Mexico, 2008-2014
  - Outlines top U.S. cities and states for arms trafficking and the total amount of firearms recovered in Mexico that were submitted to the ATF

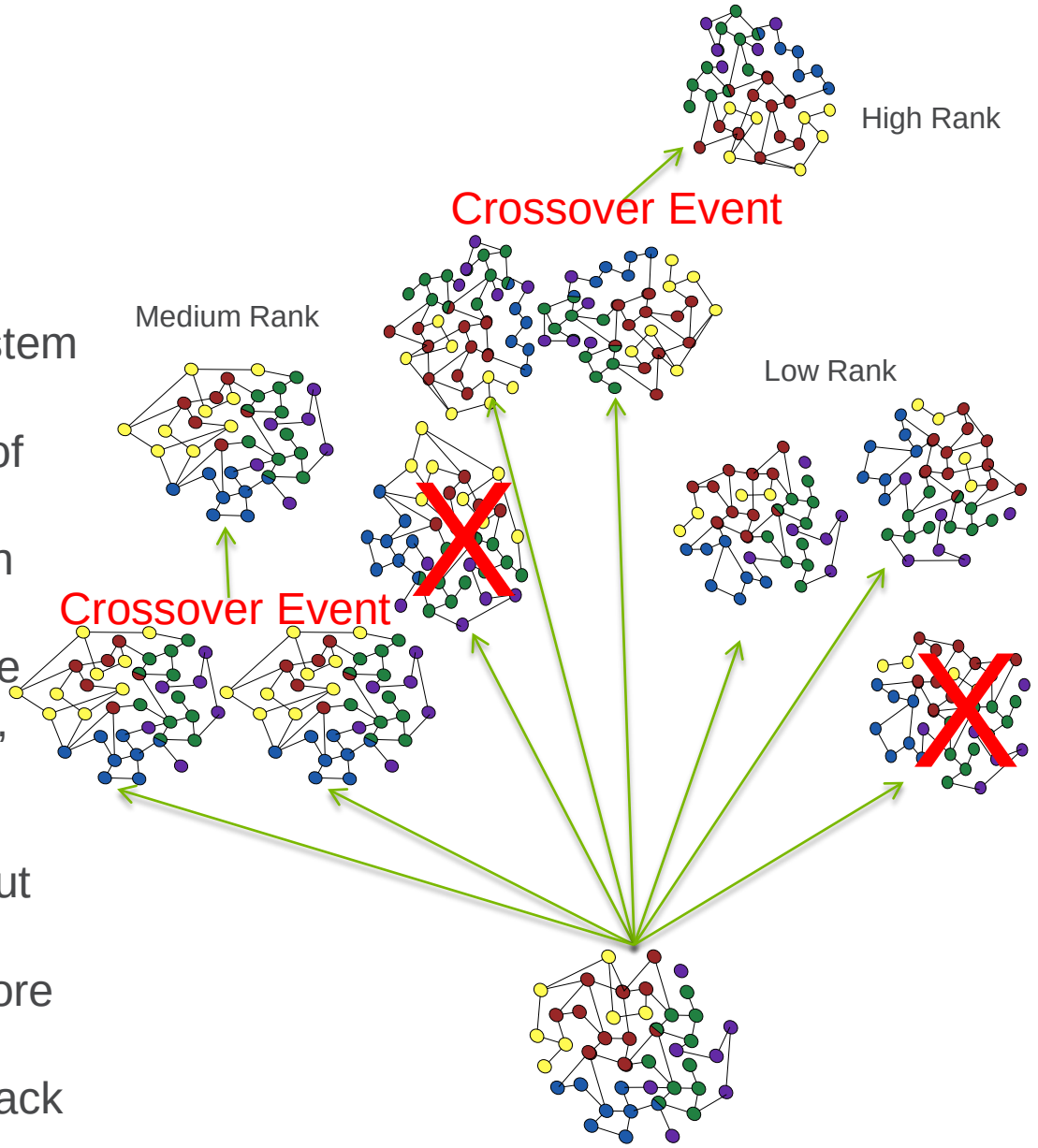
ANTICIPATORY SYSTEM DYNAMICS MODEL

- Software for automatically generating system dynamics models using a kind of genetic algorithm (Holland 1992, Goldberg 1989, Mitchel 1996) known as a genetic program (Koza 1990)
- For the system dynamics models under study this allows evolution of both the:
  - Structure
  - Parameters
- Building on previous work that introduced the use of genetic algorithms for managing system dynamics models
- Our contribution:
  - Automatically generate anticipatory system dynamics in weakly constrained, data-sparse domains



ANTICIPATORY SYSTEM DYNAMICS SIMPLIFIED

- Genetic algorithm to evolve system dynamics models with consistent units.
- Provides a new way to use system dynamics modeling to explore possible future configurations of complex systems.
- Works best on the supply-chain aspects of the problem
- Uses fitness functions to decide rankings for each model (profit, risk)
- The next steps include:
  - Receiving stakeholder input on fitness functions
  - Applying the method to more detailed scenarios
  - Getting stakeholder feedback



Systemic Organizational Design (Cybernetics)

VIABLE SYSTEM MODEL

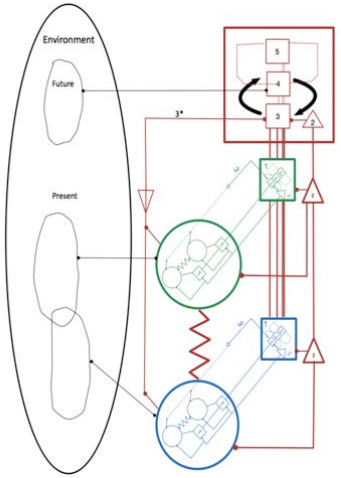
The Viable System Model (VSM) is a conceptual model for diagnosing or designing organizations to be highly adaptable to changes within the organization and with its environment

- Design of organizations at all levels (which includes meta-organizations made up of autonomous agencies)
- Dynamic model for continuous adaptation and self-organization in response to disturbances in the "environment"
- Inspired by the way the human nervous system regulates internal systems to keep in balance with their environment

Viable system: a system that maintains its identity while maintaining a co-evolutionary – but still balanced - relationship with their niche (Espinosa, Harnden, & Walker, 2008).

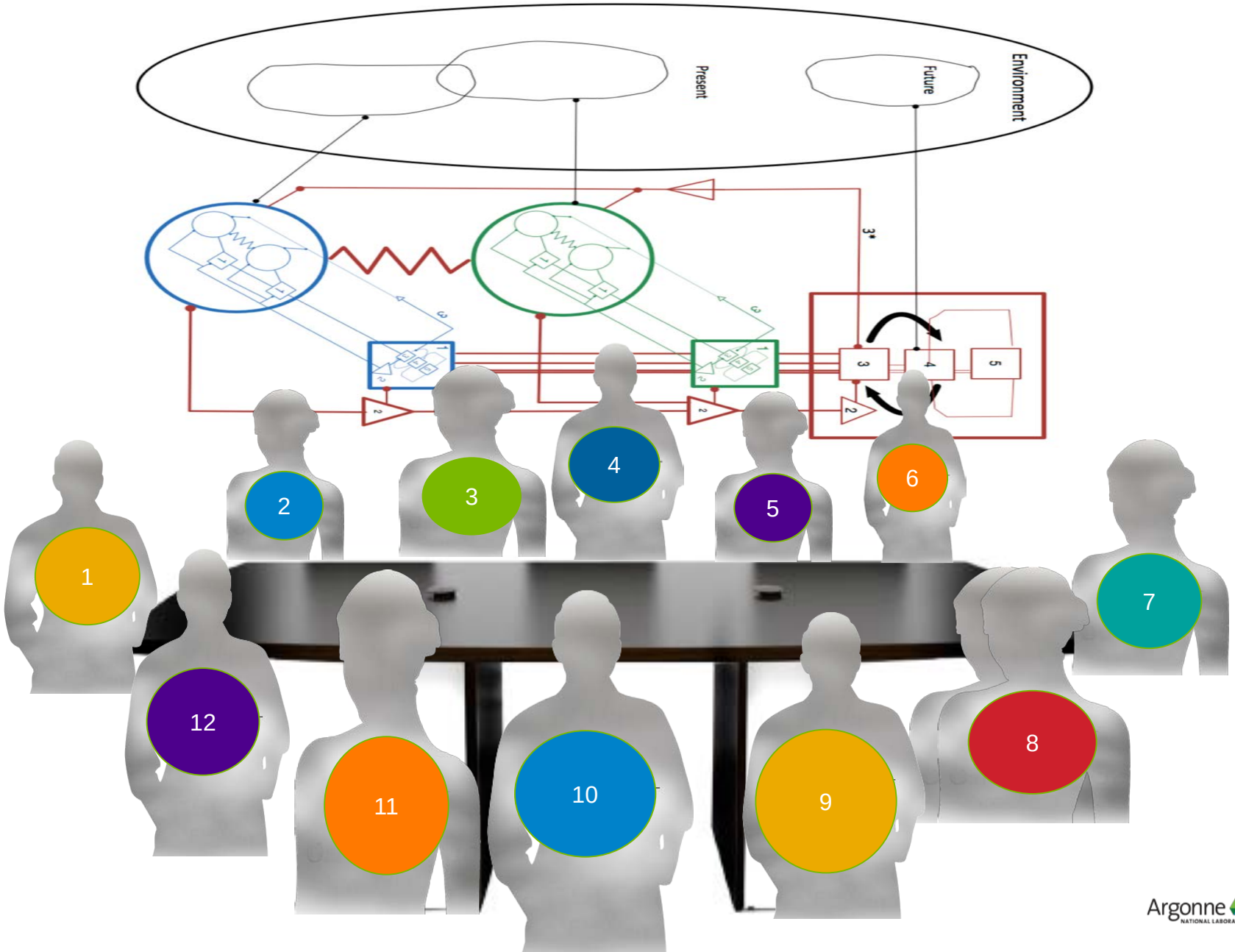
In order to design and maintain a viable organization capable of tackling the complexity of a wicked problem, the organization must be closely attuned to it's environment and dynamically adjust to disruptions to it (Beer, 1985).

THE FIVE SUBSYSTEMS OF THE VSM

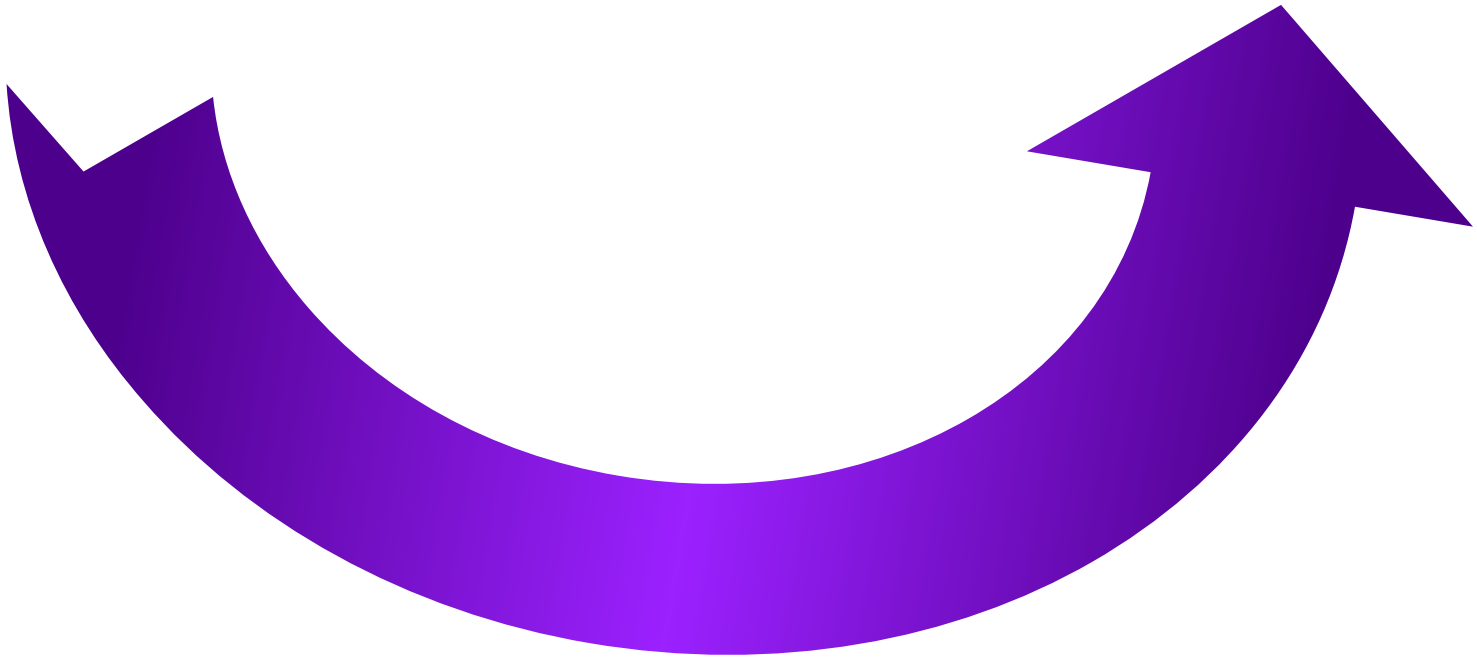


- **System 1 (S1)**: The operations of the organization where the production of products or services happens (Espinosa, Reficco, Martínez, & Guzmán, 2015). It is a viable organization itself.
- **System 2 (S2)**: Deals with the day-to-day operations, providing shared languages, protocols, procedures, and information. It is also involved in avoiding oscillations and providing conflict resolution when discord exists between S1s (Espinosa & Walker, 2006).
- **System 3 (S3)**: Responsible for regulatory issues such as resource distribution, accountability, and legal and corporation requirements (Espinosa & Walker, 2006). S3 also handles any resource bargaining to ensure all parts are running in the best interest of the whole organization.
- **System 3* (S3*):** The auditing system used by S3 to monitors the activities of S1s (Hilder, 1995). It can probe the details of the operations without taking over and micromanaging.
- **System 4 (S4): "**intelligence function of the organization". It is responsible for understanding the total environment in which the organization is embedded (Hilder, 1995). It is concerned with "outside and then" (Beer, 1979) and is the facilitating mechanism by which the identity of the organization adapts.
- **System 5 (S5)**: Defines the identity of the organization and provides its ethos and purpose (Leonard, 2009). It also supplies logical closure to the SIF.

VSM WORKSHOP (AUGUST 2016)



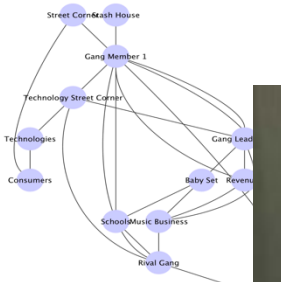
Evaluation of Methods and Process

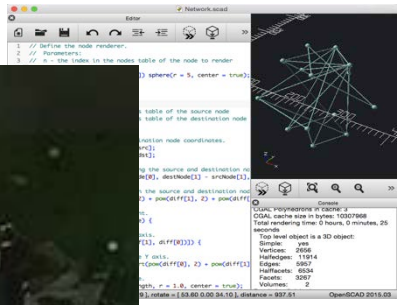


EVALUATING SYSTEMIC INTERVENTION

- A summary report describing the whole Systemic Intervention will be written up and distributed to all stakeholders. It will also be used as a reference for the evaluation process
- The Whole System Intervention will be evaluated using a questionnaire to collect data from stakeholder followed by a *reflexive* workshop (using a willing subset of stakeholders)

VISUALIZING COMPLEXITY





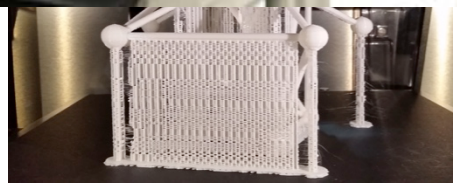
Create 2D N
In Cytosca

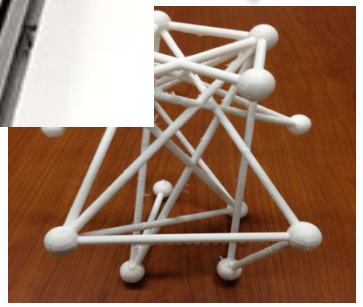
Convert
o SCAD

Compile
to STL

ean
nually

```
solid OpenSCAD_Model
  facet normal 0 0 0
    outer loop
      vertex 221.401 49.5005
      vertex 220.799 48.5993
      vertex 222.676 48.9726
    endloop
  endfacet
  facet normal 0 0 0
    outer loop
      vertex 221.401 51.6266 35.5061
      vertex 219.81 50.5635 36.2527
      vertex 221.613 50.5635 35.5061
    endloop
  endfacet
  facet normal 0 0 0
    outer loop
      vertex 223.739 50.5635 32.3242
      vertex 222.676 52.1545 34.1266
      vertex 222.992 50.5635 34.1266
    endloop
  endfacet
```





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QUESTIONS?

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