

712CD

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Report Documentation Page

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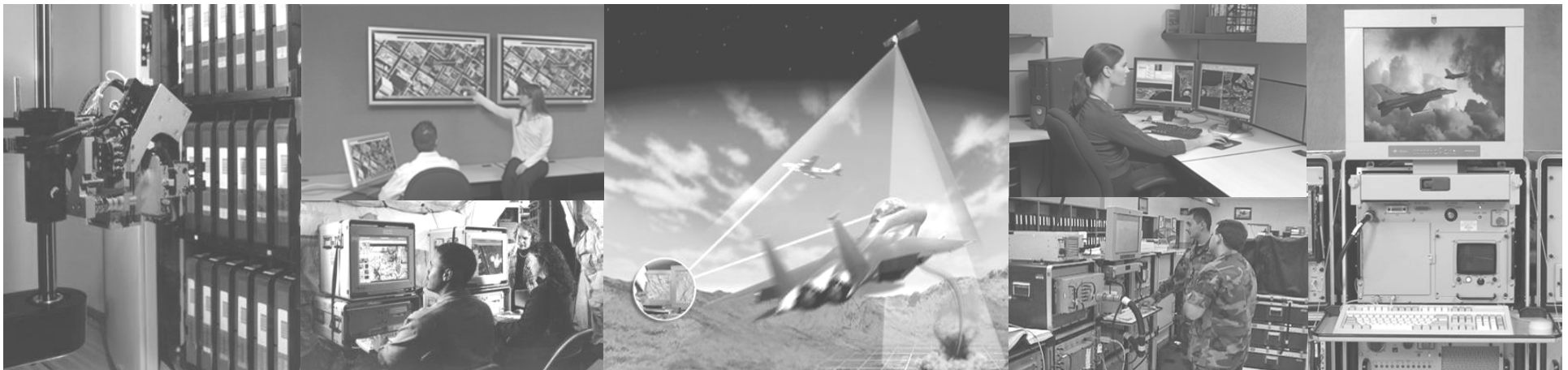
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Synthesizing Information for Interagency Decision Makers using Simulation

Corey Lofdahl

75th MORSS, US Naval Academy, Annapolis, Maryland



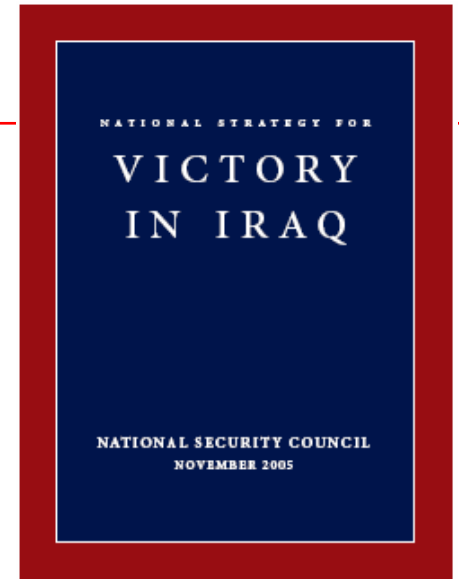
Overview



- The policy problématique
 - i.e., the problem (content)
- Policy consequences
 - i.e., an example
- Methodological considerations
 - i.e., simulation (technology)

A beltway debate (aka, tempest in a teapot)

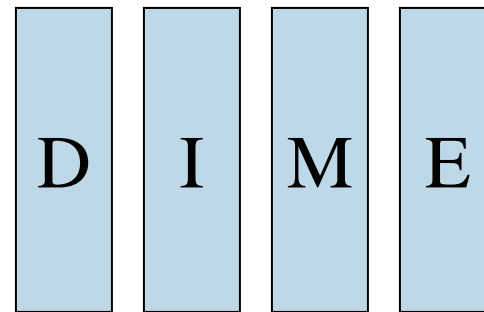
- Peter Feaver (Duke political scientist & NSC special advisor): Americans will support a war with mounting casualties on one condition: they believe that the mission will ultimately succeed.
 - Thus, *National Strategy for Victory in Iraq*. NSC (Nov '05)
(Download file, right click on properties, click PDF tab, author: feaver_p)
- Christopher Gelpi (Duke professor & Feaver colleague): “[*Victory in Iraq*] is not really a strategy document from the Pentagon about fighting the insurgency. The Pentagon doesn't need the president to give a speech and post a document on the White House website to know how to fight the insurgents. The document is clearly targeted at American public opinion.” (NYT, 4 Dec '05)
- Stephen Biddle (CFR): “The war efforts in Afghanistan and Iraq are adrift in the absence of a properly developed grand strategy to integrate military and nonmilitary elements of national power.” (WSJ, 15 May '07)



Elements of National Power

DIME:

- Diplomatic
- Informational
- Military
- Economic



Thanks to Col. Darrall Henderson, USMA
Academy Professor of Mathematical Science,
for creating this and related slides

i.e., how the USG reaches out & touches other countries

USG/DoD handles complexity w/ acronyms:

e.g., DIMEFIL, PMESII, EBO, ONA, SOSA,
that imply understanding & system decomposition

The policy problématique: Information synthesis at the macro-level



Richard Beal

BYU political scientist & NSC special advisor (1984):

“We spend billions and billions of dollars to collect information, to get it from the field to an analyst in the bowels of the bureaucracy. Don’t misunderstand me – that is very, very important. But having spent a lot of money to sustain an information collection, dissemination, and analysis process, we spend virtually nothing on direct support to a senior-level policy maker. Virtually nothing. This is a major theme I am going to talk about; we spend very, very little and we have very few analytic tools for the very high-level people. This leads me to my first major observation. I believe this society pays dearly, every single day, in terms of policy, for its failure to teach truly systems-oriented people to synthesize at the macro level. I daresay we could go through the length and breadth of this land and not find twenty people who have that capacity by virtue of training. A lot of people develop capacities by virtue of experience, but I’m talking about those who are both experienced and trained to synthesize information at the macro level. In my judgment the biggest problem in information processing is not sensors, not telecommunications, not CPUs not even analytic procedures. Very little work has gone into the synthesis process. I’m not talking about a partial system, a little economics and rational decision making and let’s throw a little more in the budget. I’m talking about big pieces.”

Problem statement

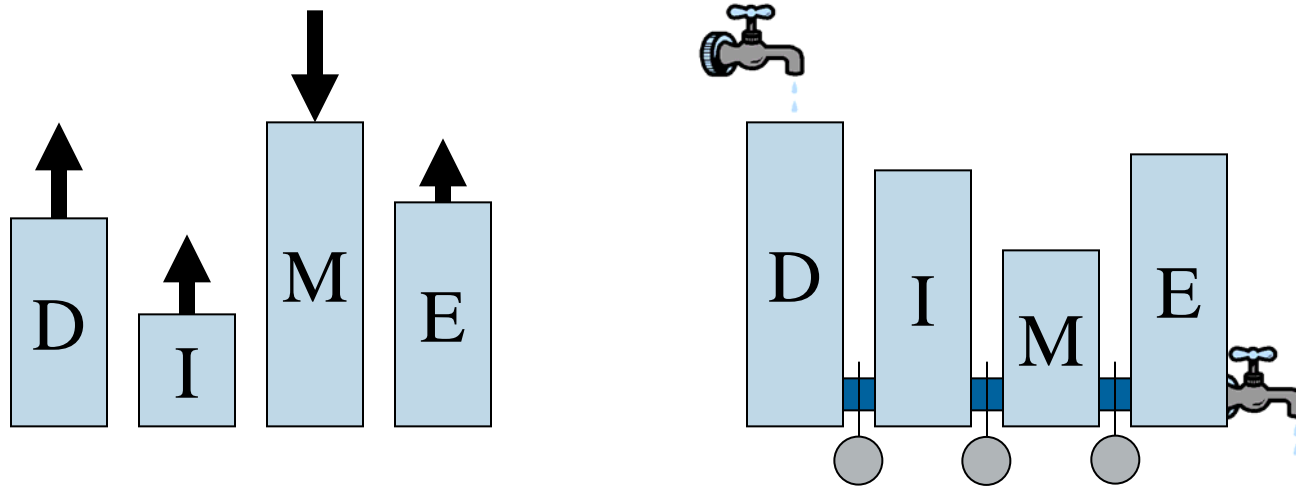
1. Senior-policy makers have a *key need*:
2. Current technologies and tools are *insufficient* because...
3. they don't *synthesize* information.
4. This has *policy consequences*.

The need for a policy relevant systems perspective is as great today as it was more than twenty years ago.



National Security Council (2001)

Is there a way to combine these elements?

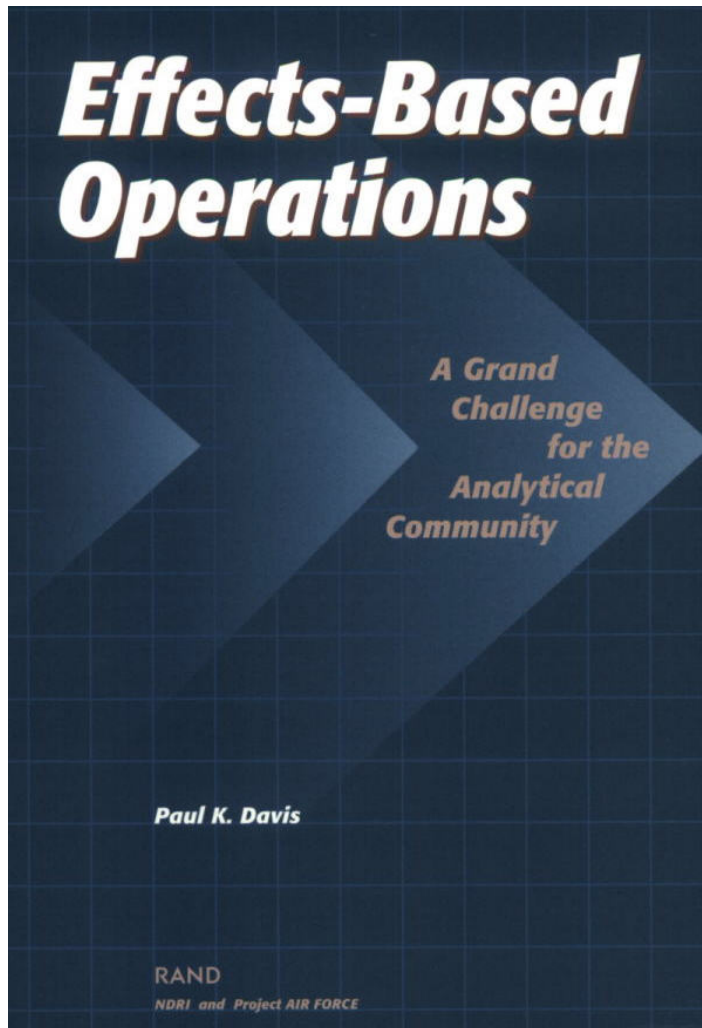


Elements usually applied independently

A methodology that ties elements together would improve policy decisions

Requires an interactive (i.e., *dynamic*) rather than a structural (i.e., *detailed*) systems approach

The modern, DoD view of complex social systems

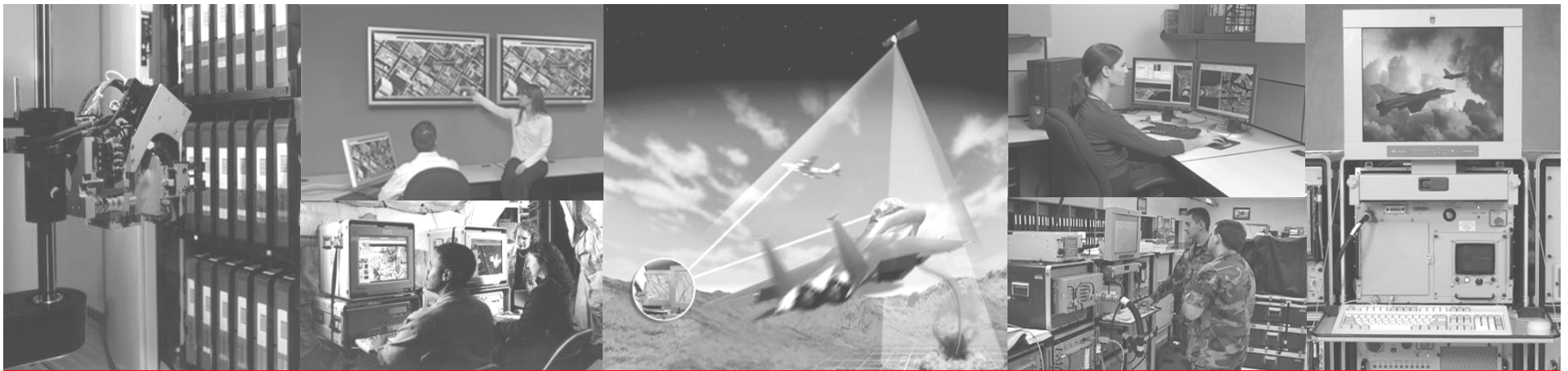


- “...defined as operations conceived and planned in a systems framework that considers the full range of **direct, indirect, and cascading effects** – effects that may... be achieved by the application of military, diplomatic, psychological and economic instruments.”
 - i.e., DIME elements of nat'l power
- Paul Van Riper's critique of EBO*,
 - Reductive, **detail** complexity vs.
 - Interactive, **dynamic** complexity
 - WRT Millennium Challenge ('02), Crisis vs. deliberate planning

* see Malcolm Gladwell. 2005. *Blink: The power of thinking without thinking.*

Policy consequences

i.e., An example



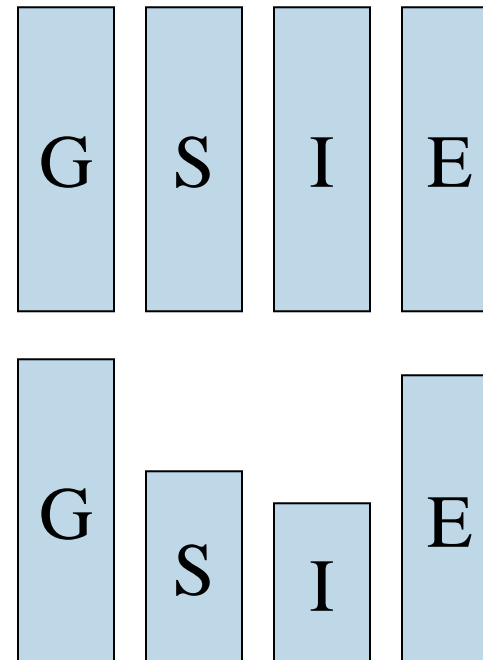
Foreign policy contexts



- Cold war strategic triad
 - Bombers
 - ICBMs
 - Submarines
- 21st century strategic triad
 - Failed states
 - Terrorism
 - WMD
 - CBRNE

Iraq example (failed states/nation building)

- Governance
- Security (COIN)
- Information
- Economic
(development)

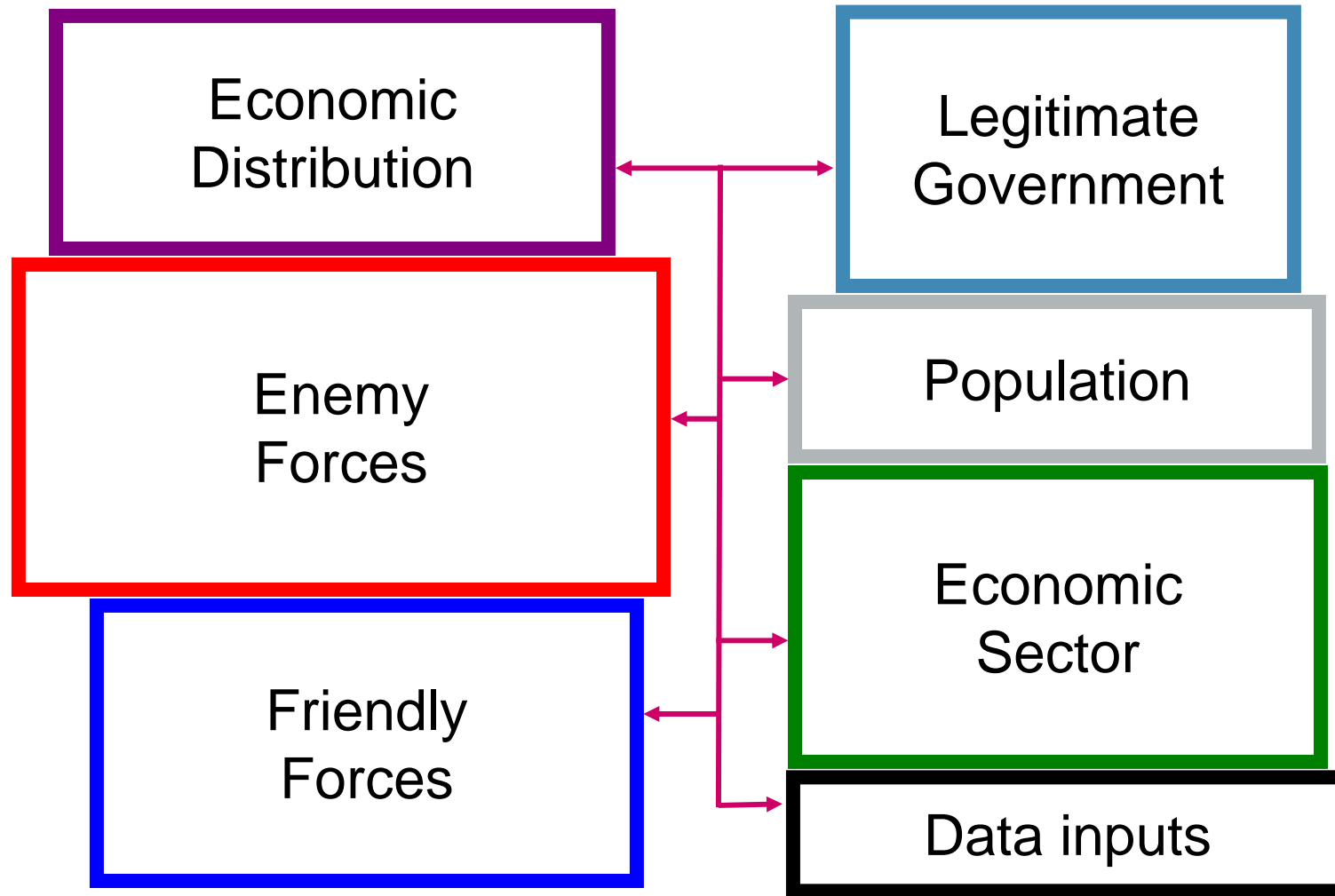


Is governance the main effort?

What comes first, security or development?

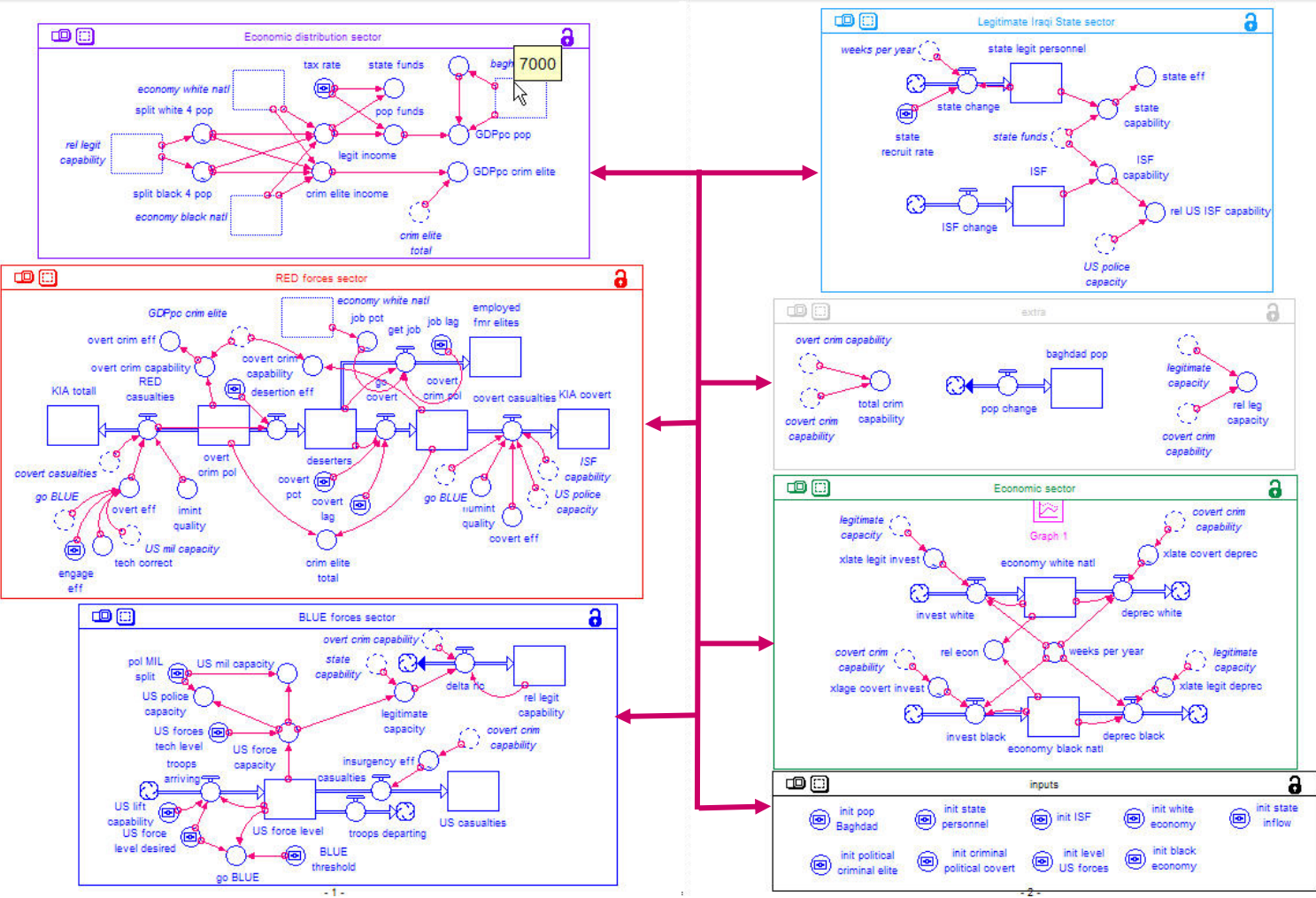
System Dynamics (SD) modeling

Military and non-military elements of national power are combined w/in a single analysis



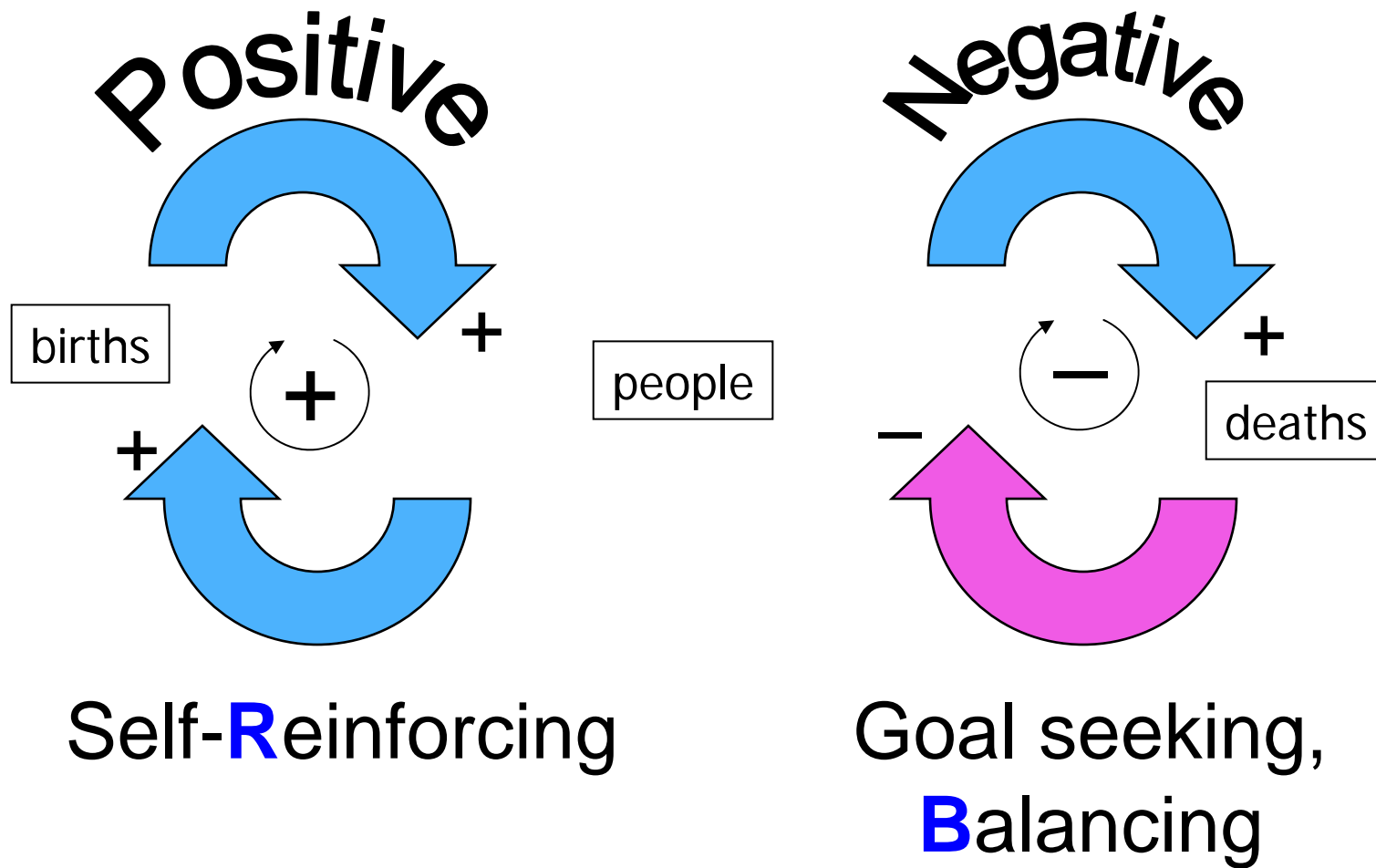
System Dynamics (SD) modeling

Primary, secondary, and cascading consequences are explicitly represented



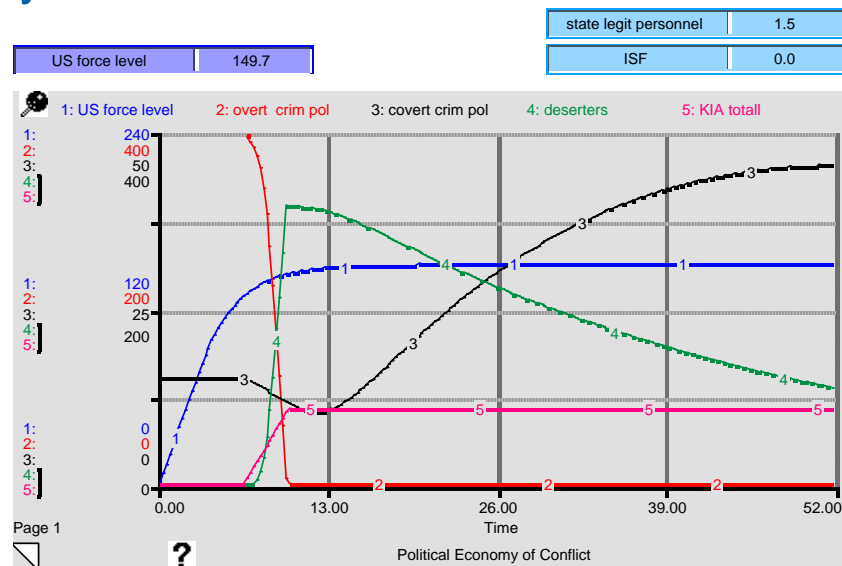
Cascading consequences lead to *feedbacks*

A central feature of dynamic complexity



Senior-level decision maker's interface (rev. A)

policy levers and dynamic results



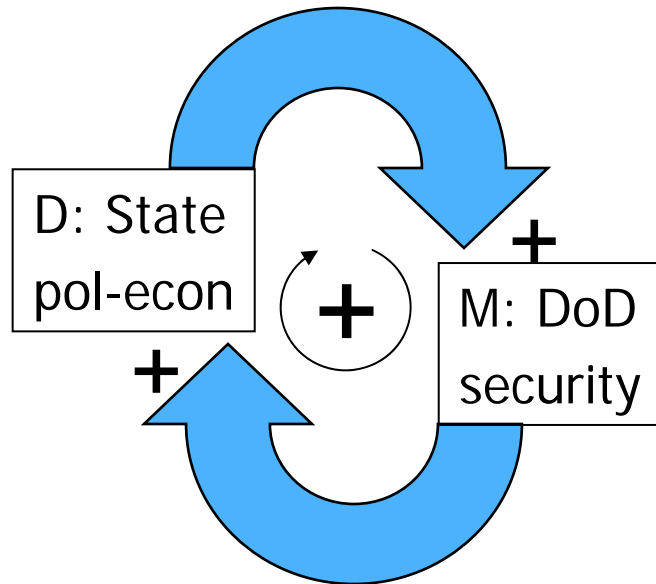
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Run Stop Restore All Devices

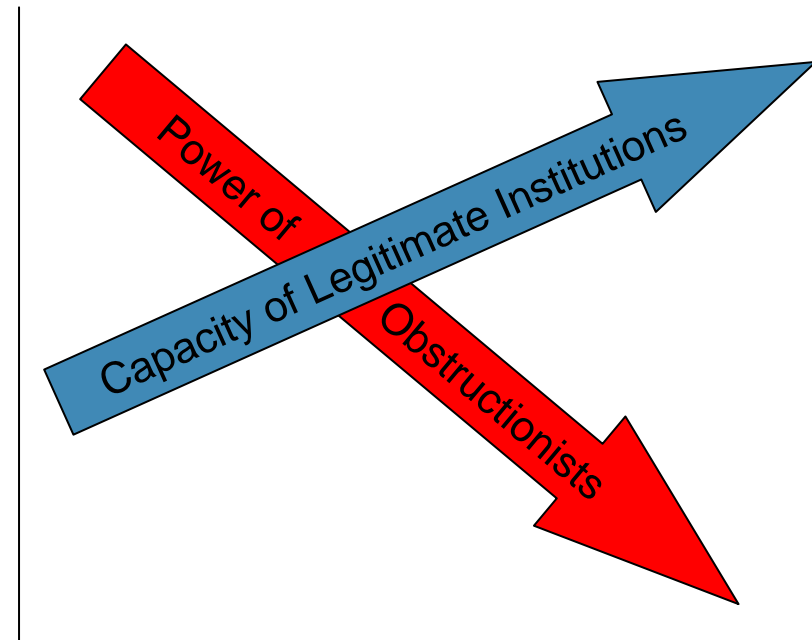
overt crim pol	0.0
covert crim pol	45.3

Data and expertise synthesized into a few contextualized metrics for senior decision makers

Information synthesis and strategic perspective



“synchronized v. separate lanes”
(i.e., *feedback*)



X-chart of flywheel effect
(i.e., *dynamics*)

- Military and non-military elements of national power can reinforce each other both helpfully when synchronized and unhelpfully when not
- Policy progress can be both planned and tracked using simulation’s scenario analysis capability

Conclusion

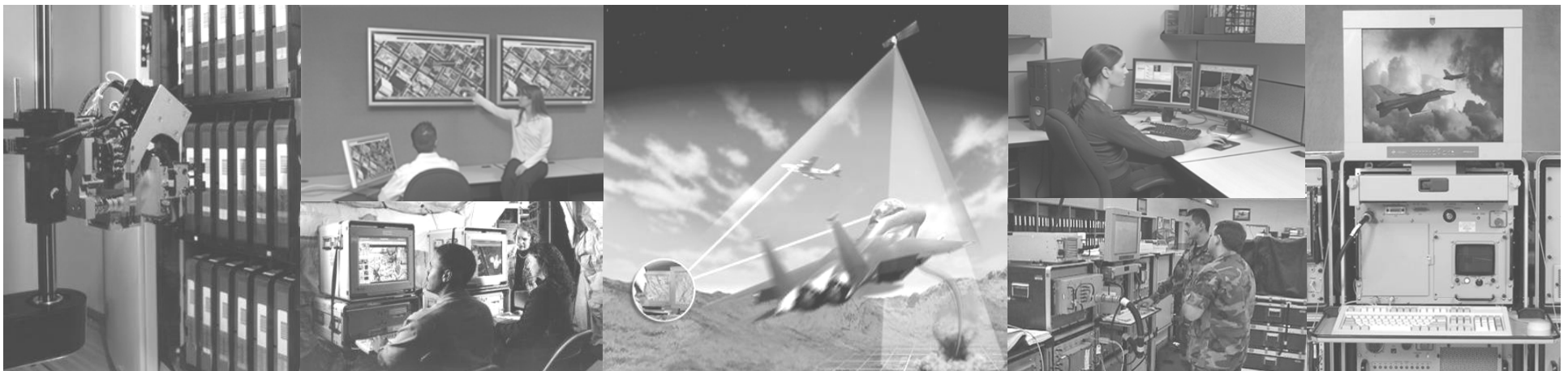


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- The policy problématique
 - Few tools for senior-level policy makers
- Policy consequences
 - Failed state example
- Methodological considerations
 - Simulation synthesizes information

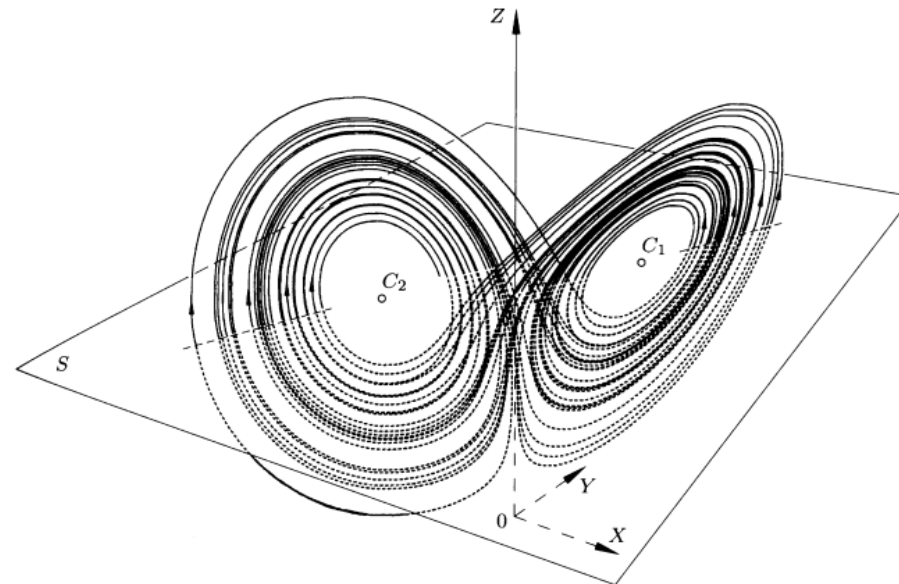
Methodological considerations

i.e., Simulation generally and System Dynamics specifically



Complexity and methodology

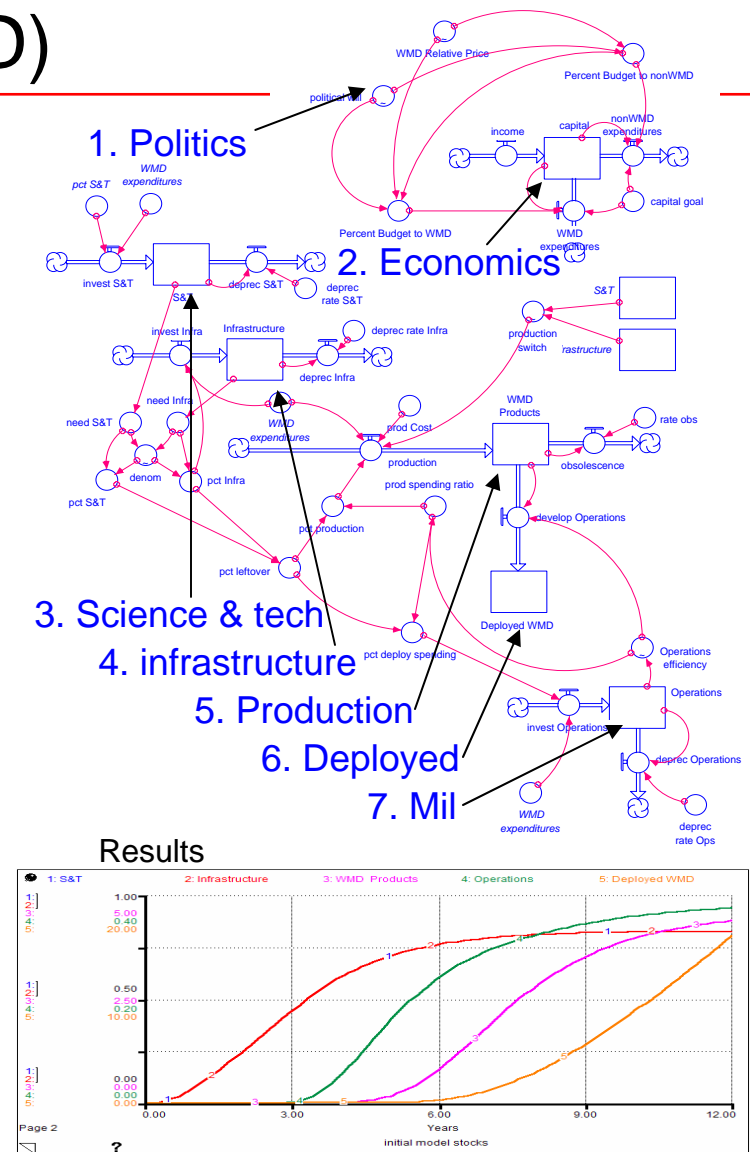
- Policy implies interactive, dynamic complexity
 - Rather than reductive, detail complexity
- The System Dynamics (SD) simulation represents and captures the complex, “real world” causal relationships that tend to confound policy analysis:
 - Stock-flow
 - Nonlinear
 - Feedback



Lorenz-Attraktor für $r = 28$, $\sigma = 10$ und $b = 8/3$.
Der Trajektorienbereich, den die Ebene $Z = r - 1 = 27$ verdeckt, ist punktiert
(Lanford, 1977)

Policy and System Dynamics (SD)

- Dynamic simulation provides high-level, strategic perspective
- Provides scenario analysis capability
 - Big benefit, not the model but modeling
- Provides information synthesis capability
 - Non-physical and physical
 - Social and natural
 - Political-economic and military
- Provides data reduction capability
- Complex Social Systems feature both physical and non-physical aspects
 - SD simulation allows for the crafting or architecting of policy
- A reliable methodology
 - Business policy lessons are transferable



System Dynamics (SD) overview: How does it work?

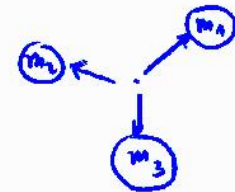
- People tend to be good at describing complex system structures, but bad at figuring out what will happen – SD gets the computer to help
- Simulation allows for low-cost experimentation and modeling without onerous data requirements, expertise is paramount
 - Causal relations rather than correlations
- Complex social systems where ‘complexity’ means 1) stock-flow, 2) nonlinearity, & 3) feedback
- Not financial, but operational modeling
 - For example, price AND time delay
- Development of system measures
 - Craft statistics & metrics w/ SD
 - Identify units and ranges
 - Arrays, abstraction, and data hiding

3-BODY DECAY

Before

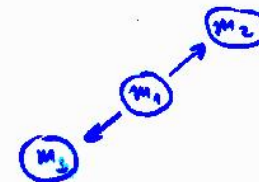


After

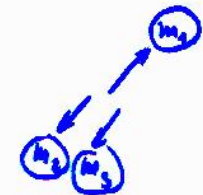


Distribution of energies

from



$KE_1 = 0$



$KE_1 = \text{a maximum}$

Physical systems

e.g., Lorenz curves

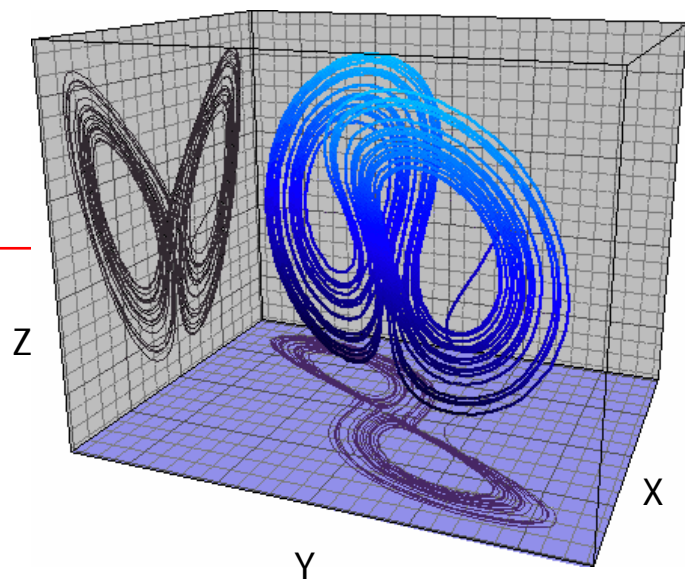
$$\frac{dx}{dt} = \sigma(y - x)$$

$$\frac{dy}{dt} = x(\tau - z) - y$$

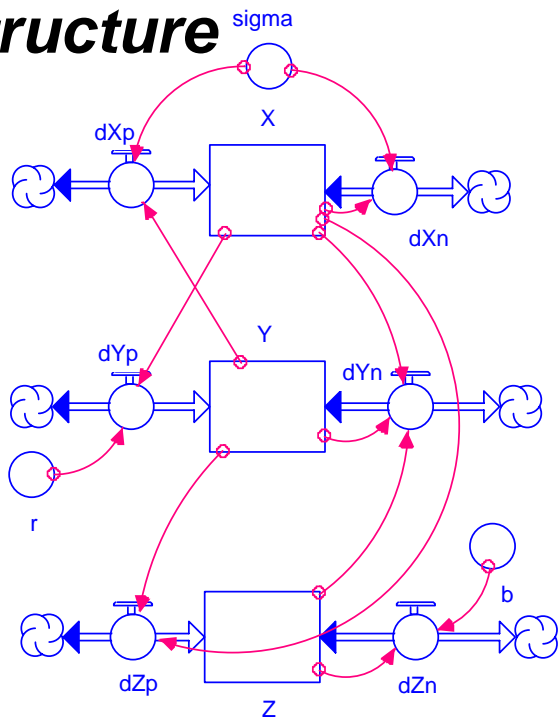
$$\frac{dz}{dt} = xy - \beta z$$

Physical analogs:

upper atmosphere convection rolls, lasers, batteries, waterwheels

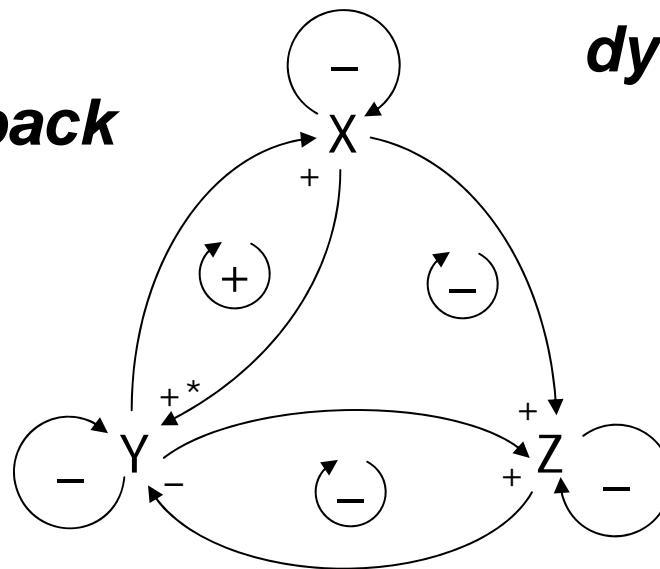


structure



dynamics

feedback

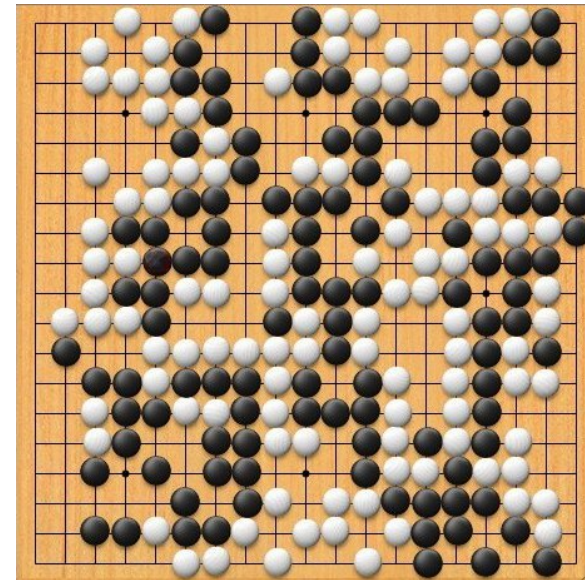


Lorenz causal loop diagram

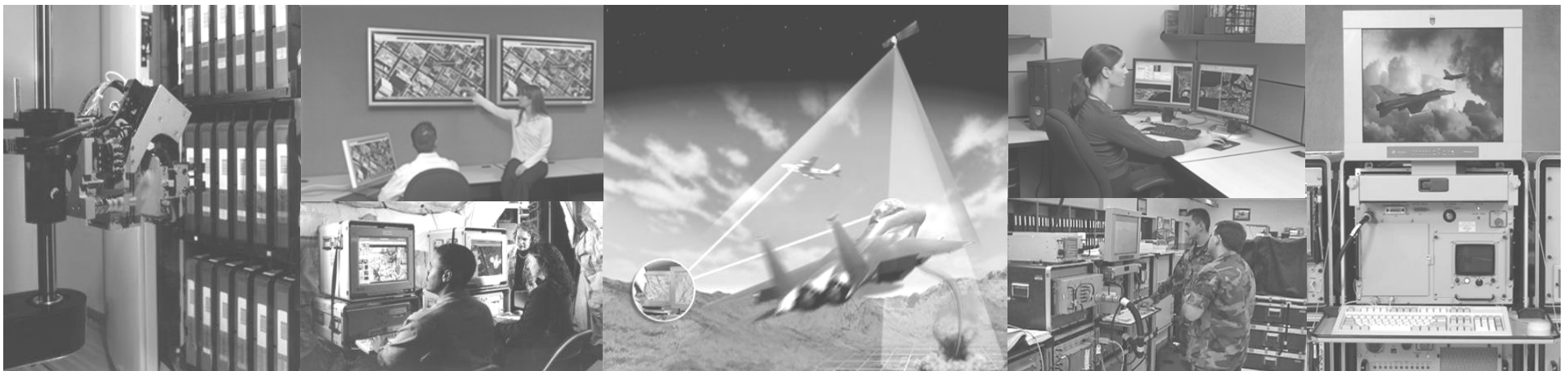
* the sign of this causal connection can change over the course of the simulation

Closing policy benefits

- Contributions from multiple subject matter experts can be integrated using simulation
- Resulting simulation evaluates the complex consequences of proposed policies through scenario analysis – i.e., true EBO
- Allows for low-cost learning about complex policy contexts
- Ops-friendly (i.e., *low*) data requirements
- Identifies key data leading to true *Requirements-Based Collection* (RBC)
- Metrics creation and contextualization – i.e., “What do these numbers mean?”
- Policy VV&A: standard tests, extreme value tests, plausability, history re-creation, etc.
- Helps senior-level policy makers grasp and grapple with the 21st century strategic triad: Failed States, Terrorism, WMD



Questions?
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Policy Consequences:

i.e., how foreign policy goes wrong

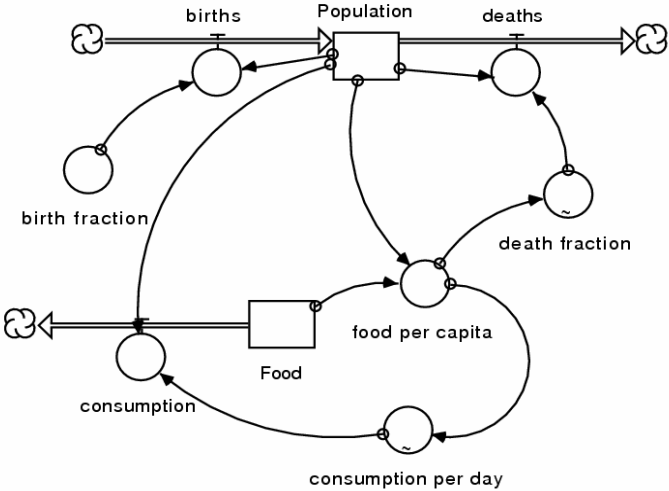
- “Counterintuitive behavior of social systems” Jay W. Forrester (Tech Review, Jan 1971)
 - First, social systems are inherently insensitive to most policy changes that people select in an effort to alter the behavior of the system. In fact, a social system tends to draw our attention to the very points at which an attempt to intervene will fail.
 - A second characteristic of social systems is that all of them seem to have a few sensitive influence points through which the behavior of the system can be changed.
 - As a third characteristic of social systems, there is usually a fundamental conflict between the short-term and long-term consequences of a policy change.



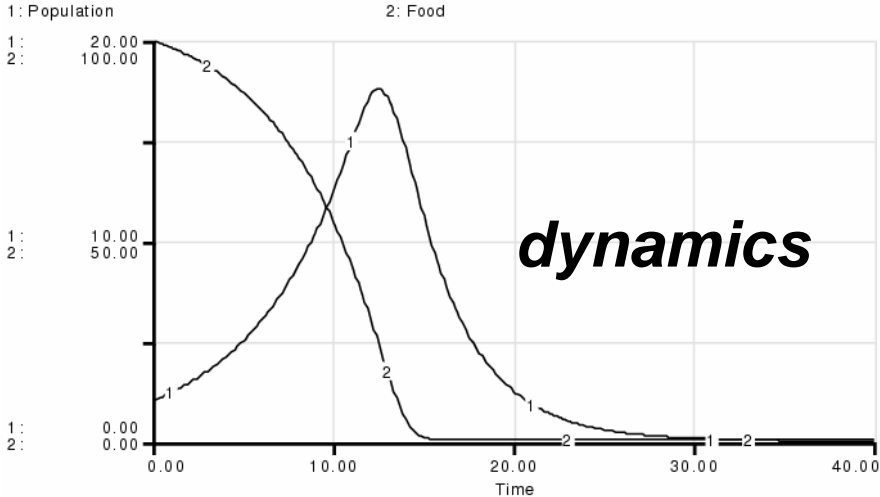
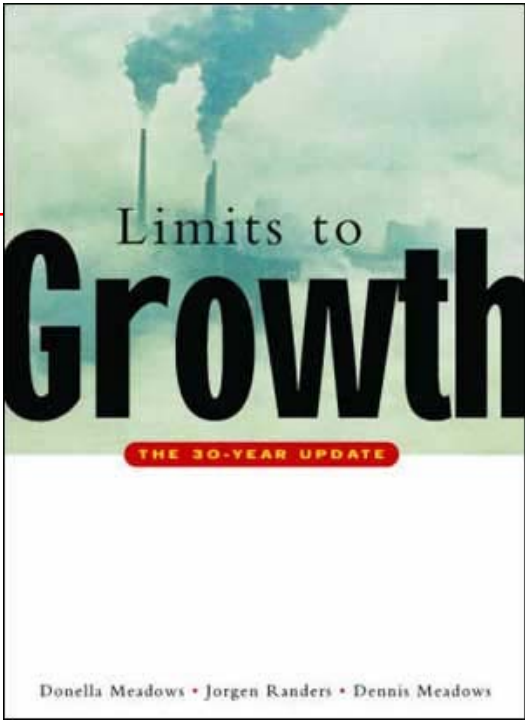
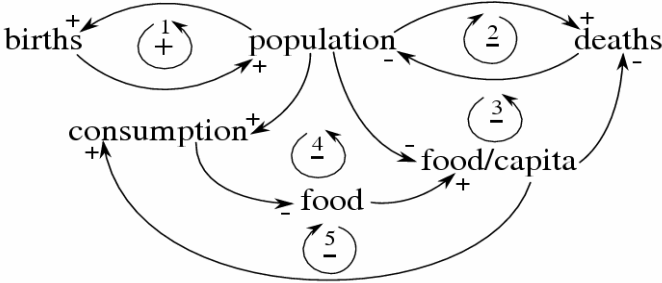
Physical and non-physical systems

Limits to Growth (Meadows et al. 1972; 2004)

structure



feedback



National Strategy for Victory in Iraq – argument structure

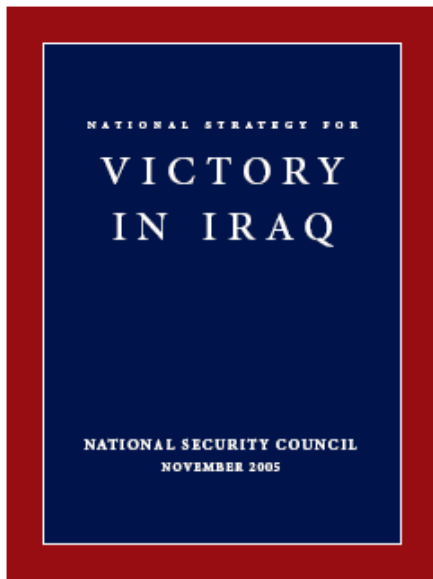
- **PART I – Strategic Overview**

- Victory in Iraq Defined
- Victory in Iraq is a Vital U.S. Interest
- The Benefits of Victory in Iraq
- The Consequences of Failure
- Our Enemies and Their Goals
- The Strategy of Our Enemies
- Our Strategy for Victory is Clear
 - A. The Political Track
(Isolate, Engage, Build)
 - B. The Security Track
(Clear, Hold, Build)
 - C. The Economic Track
(Restore, Reform, Build)
- This Strategy is Integrated, and its Elements are Mutually Reinforcing
- Victory Will Take Time
- Why Our Strategy Is (and Must Be) Conditions-Based
- Our Strategy Tracks and Measures Progress



- **PART II – Strategy in Detail**
 - The Political Track in Detail
 - The Security Track in Detail
 - The Economic Track in detail
 - Organization for Victory
- **APPENDIX**
 - The Eight Pillars

National Strategy for Victory in Iraq – eight pillars

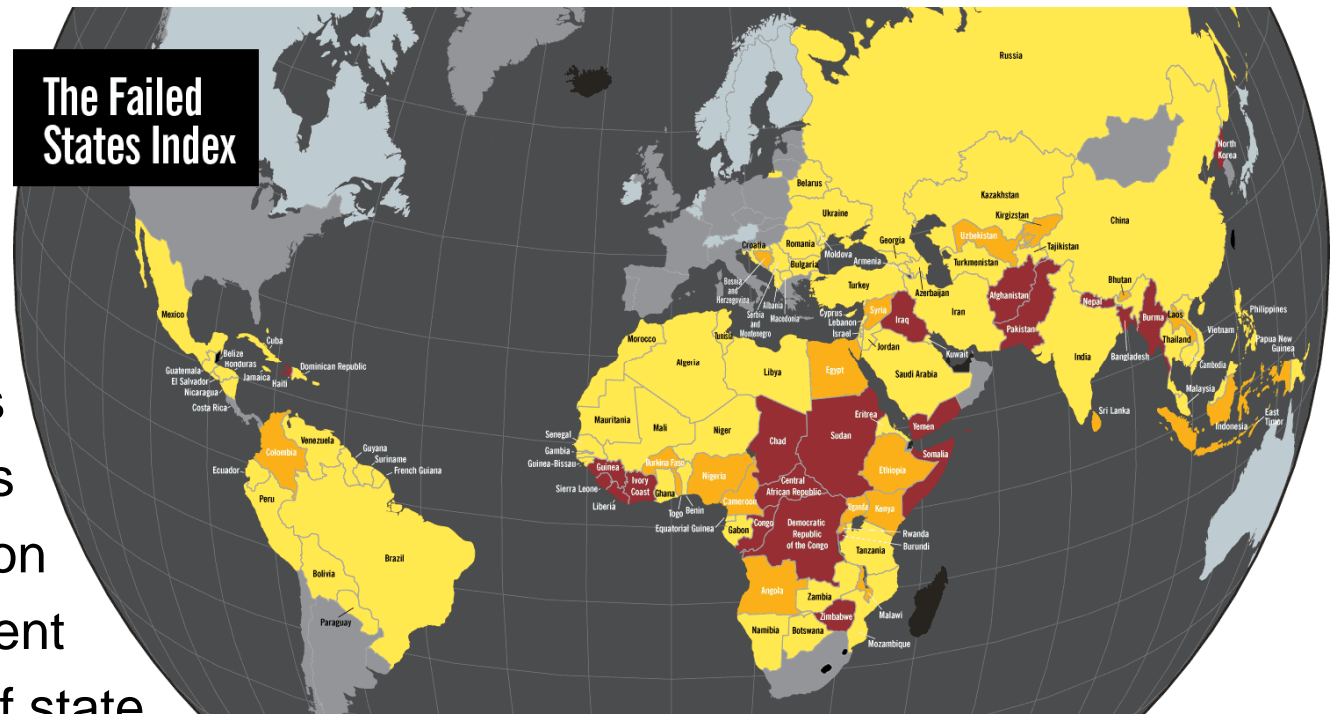


1. Defeat the Terrorists and Neutralize the Insurgency
2. Transition Iraq to Security Self-Reliance
3. Help Iraqis Forge a national Compact for Democratic Government
4. Help Iraq Build Government Capacity and Provide Essential Services
5. Help Iraq Strengthen Its Economy
6. Help Iraq Strengthen the Rule of Law and Promote Civil Rights
7. Increase International Support for Iraq
8. Strengthen Public Understanding of Coalition Efforts and Public Isolation of Insurgents

Failed states

Metrics:

- Demographic pressure
- Group grievance
- Human flight
- Economy
- Human rights
- Public services
- Security apparatus
- Factionalized elites
- External intervention
- Uneven development
- Delegitimazation of state
- Refugees and diplaced people



see http://www.foreignpolicy.com/story/cms.php?story_id=3420

Terrorism/insurgency

- Incorporate counterinsurgency (COIN) insights (May '06)[†]
 - Integrate DIME elements in support of US policy
 - Illuminate possible complex, counterintuitive policy outcomes
 - Support planning (e.g., pol-mil planning)
 - Transform data, knowledge, and expertise into foresight
 - Identify investments for intelligence and force overmatch
 - Account for time as it influences freedom of action
 - Recognize the importance of perception
 - Acknowledge that perseverance must be resourced
- FM 3-24 “Counterinsurgency” (Dec. '06)
 - The “graduate school” of warfare (per Lt. Col. John Nagl on NPR)
 - Counterinsurgency is counterintuitive
 - Understanding of complex, long-term consequences is key
 - Counsels against particularistic thinking – i.e., Saddam, Zarqawi



[†]Hix, William C. 2006. “Intervening Successfully in the 21st Century – The Campaign in Iraq: Prospects for success and strategic lessons for future decision makers.” Master’s Thesis, Hoover Institution, Stanford University, Stanford, CA 94305.

WMD/CBRNE

- Counter and non-proliferation require a combination of long-term diplomatic and short-term military policies and capabilities
 - That is, pol-mil, interagency, NSC-level policy, which is traditionally hard to reconcile, synchronize, and coordinate
- WMD has gone from the superpower weapon to that of the poor and dipossessed
 - Motive: “to be peer competitor on the cheap”
- Level of analysis
 - Generic, particular country, particular threat



Yongbyon, DPRK

Answering the question

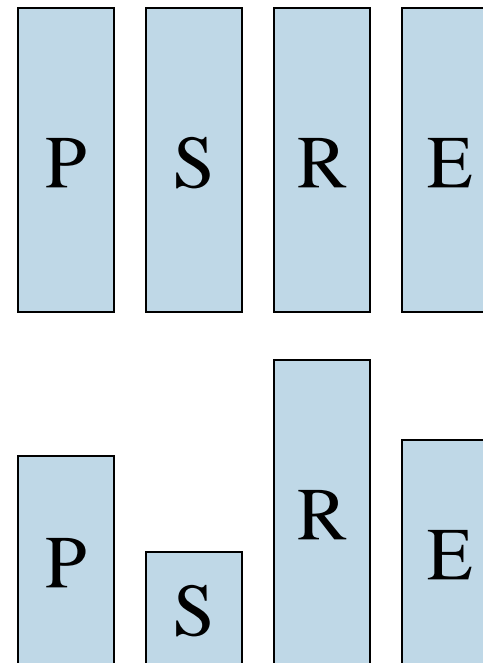
To answer the question effectively we must,

- Understand the interactions
- Understand the *effect* of changes – i.e., primary, secondary, and cascading – in one element on the other elements

System Dynamics simulation provides a means to *synthesize* separate analytic elements

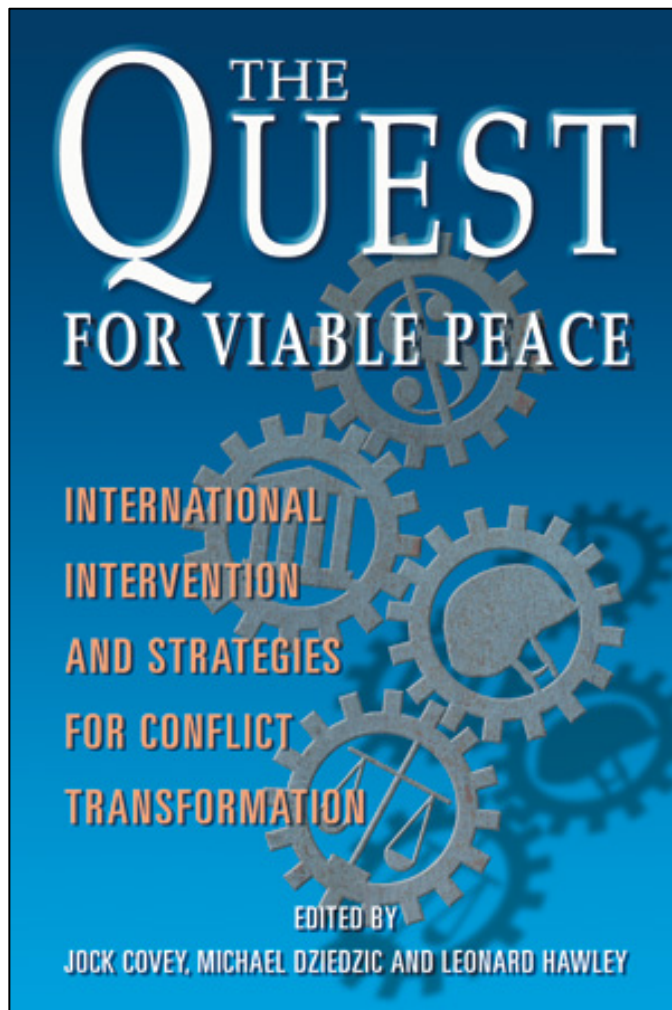
Kosovo example

- Policy
- Security
- Rule of law
- Economic



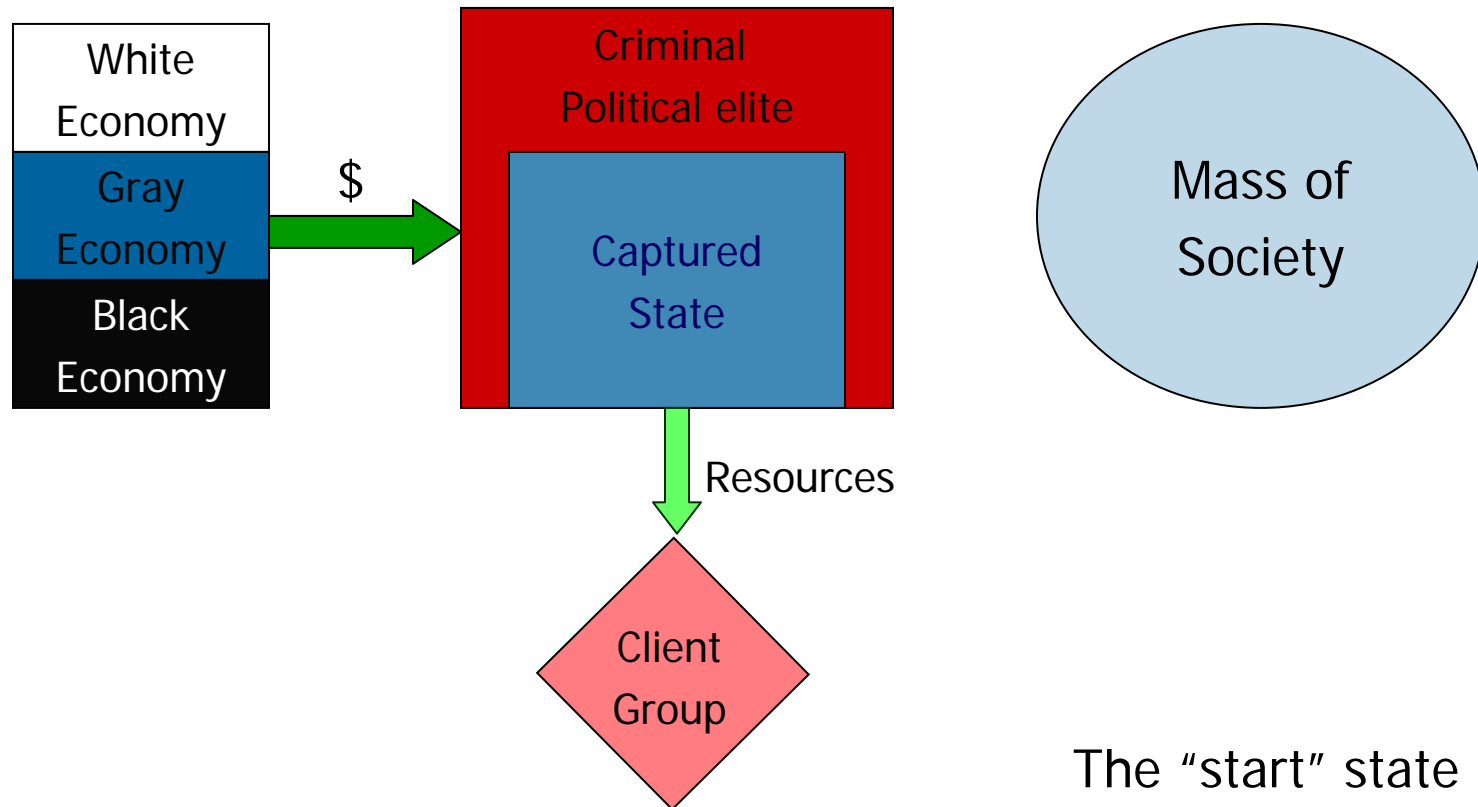
Their application is not usually coordinated...

Failed states & nation building

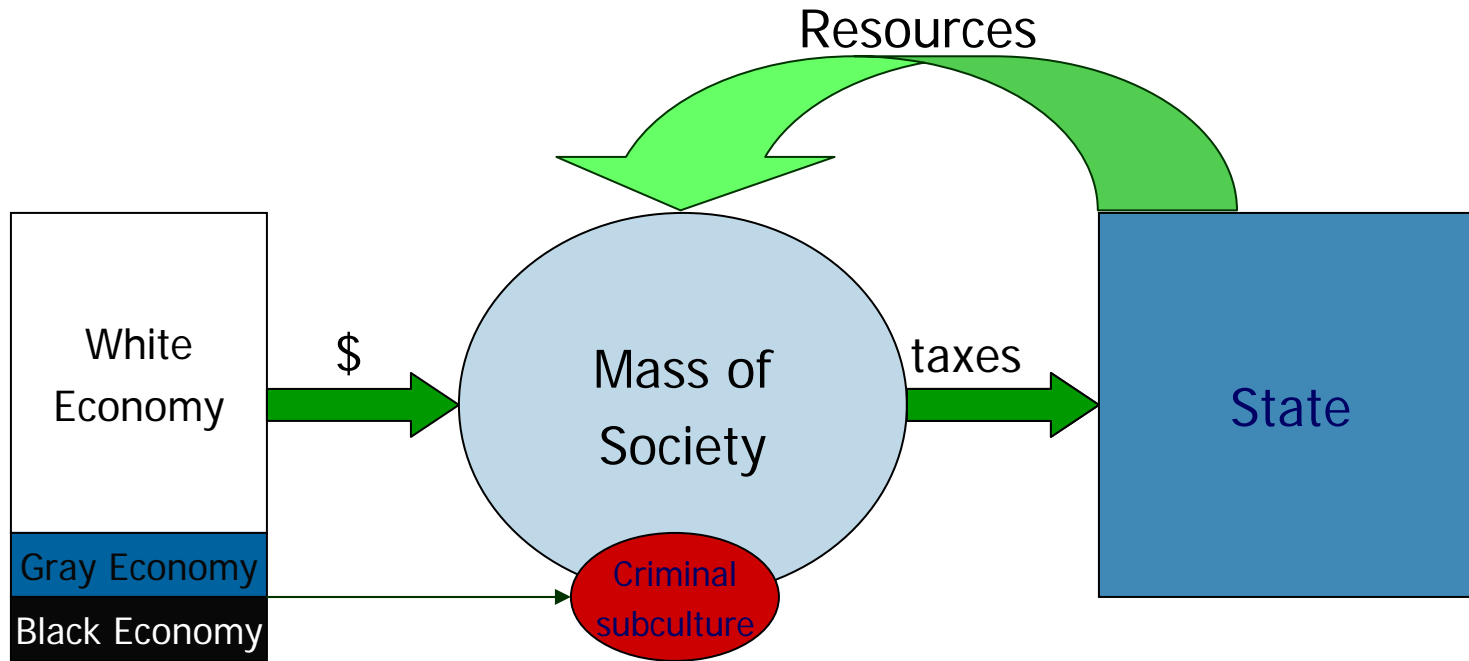


- Political strategy
- Security strategy
 - i.e., DoD
- Rule of Law strategy
- Political-economic strategy
 - i.e., State Department

I. The Political Economy of Conflict (ch. 8, Blair et al.)

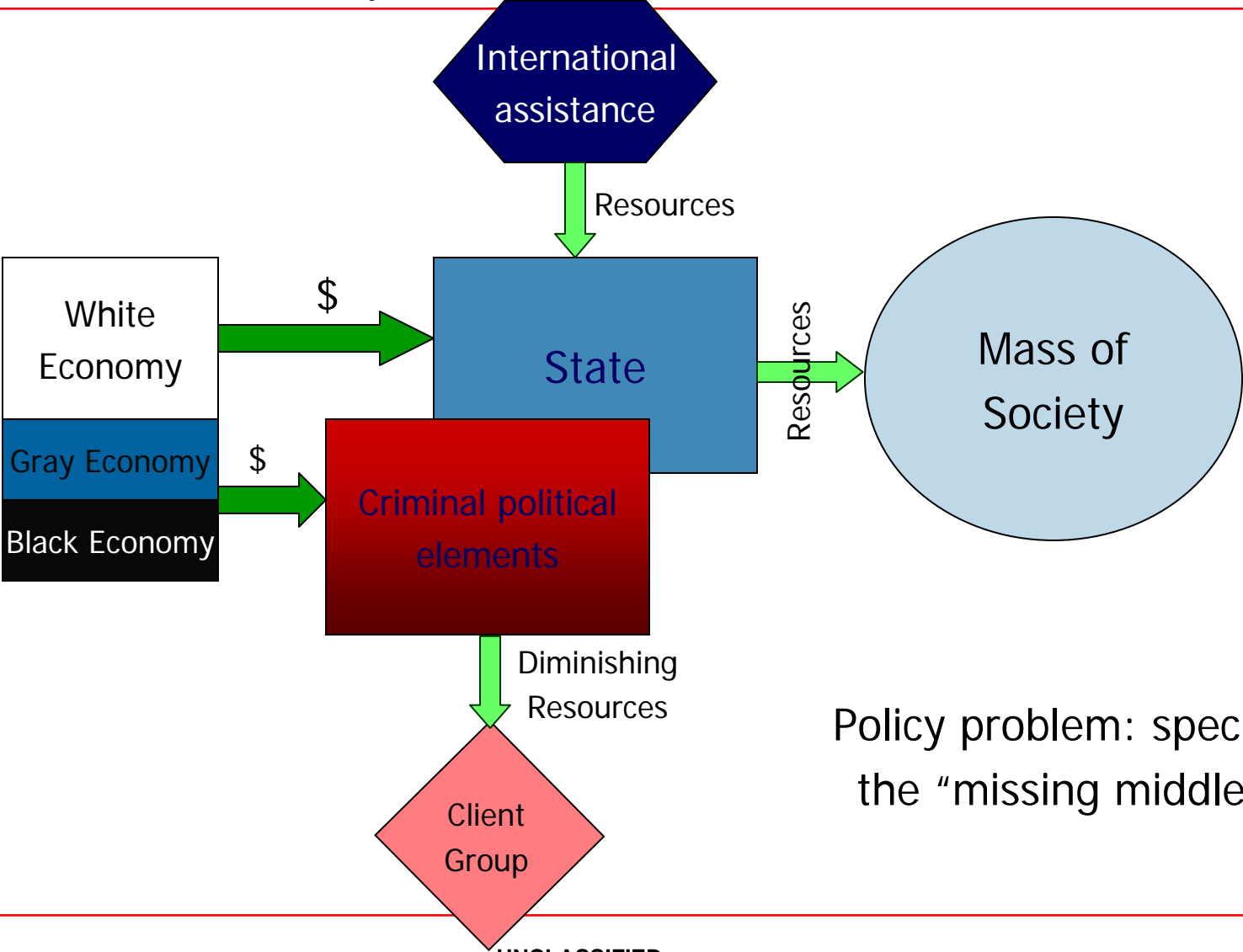


II. The Political Economy of Self-sustaining Peace



The "goal" state

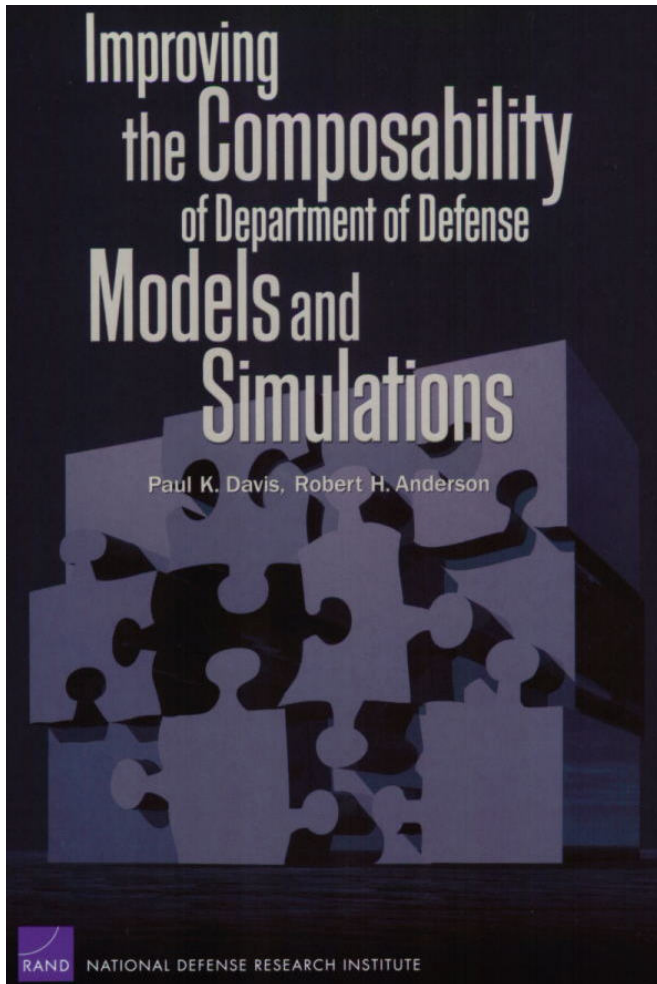
III. The Political Economy of Viable Peace



Policy problem: specify the "missing middle"

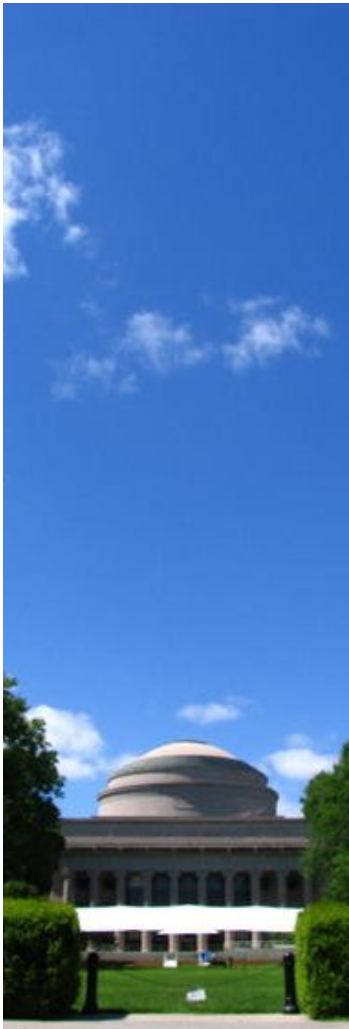
State of DoD M&S per Paul Davis

Davis, Paul K. and Robert H. Anderson. 2003. *Improving the Composability of Department of Defense Models and Simulations*. Santa Monica, CA: RAND.



- The appealing imagery of arbitrary **plug-and-play is fatally flawed** for complex models.
- While the engineering of pure software composition is notoriously difficult, **model composition is much more difficult**, something often not appreciated by even good software engineers: Models are different.
- **DoD should focus its composability efforts** on those domains and circumstances in which they actually make the most sense – not for their own sake, but in a “business-case” sense.

Davis recommendations (con't)



- DoD should mount military-science programs to assure a strong base of M&S knowledge in key domains
- DoD should encourage and support M&S education and training programs that reflect this science well
- The time is ripe for DoD to revisit the standards, much as it did in the pre-HLA days of 1994
- DoD should hurry to realign its direction better with that of the commercial marketplace (rather than patching HLA/RTI)
- Higher-level representations would simplify characterization of components, communication among individuals and groups about components and possible compositions and evaluation of alternatives
- Retrodocumentation could be valuable in some projects

Policy M&S VV&A (Verification, Validation, and Accreditation)

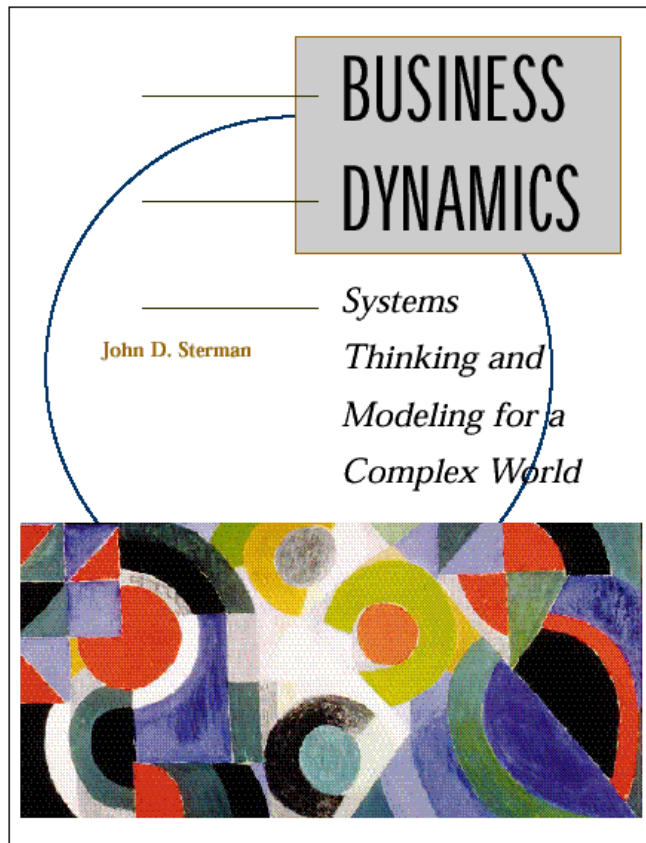
Sterman, John D. 2000. *Business Dynamics: Systems thinking and modeling for a complex world*. Boston: McGraw-Hill. Chapter 21.

- Boundary adequacy
- Structure assessment
- Dimensional consistency
- Parameter assessment
- Extreme conditions
- Integration error
- Behavior reproduction
- Behavior anomaly
- Family member
- Surprise behavior
- Sensitivity analysis
- System improvement

Acceptance/error bounds are wider for
policy models than physical



System Dynamics (SD) simulation for foreign policy



- An established methodology
- Developed at MIT's Sloan School of Management
- SD traditionally used to examine business policy questions
 - Thus, SD examples and experts are traditionally business directed
- SD business policy methodology is transferable to foreign policy
 - The scholar who most significantly combines international relations (IR) and SD, Nazli Choucri, works in the same building as John Sterman (E53)