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A Toolkit for Modeling Dynamic Power Structures

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Modeling Dynamic Power Structures

Need: Understand the dynamics of power structures in "regions of interest"

Ali Abu Shish / Reuters

Approach: Capture the key factors of the political and social situation in a dynamic modeling environment for planning, experimentation, and analysis of alternatives.

Anticipated Benefits:

- Ability to test alternate "theories of the conflict"
- Try plans, evaluate, improve and iterate
- Discover complex interactions between actions

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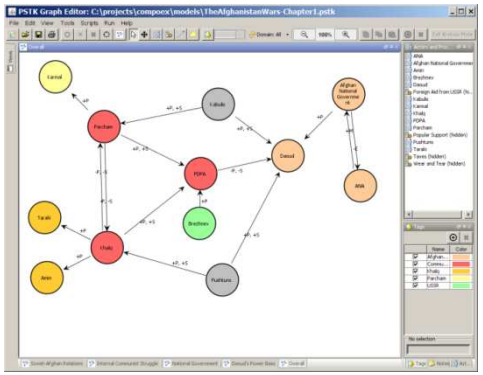
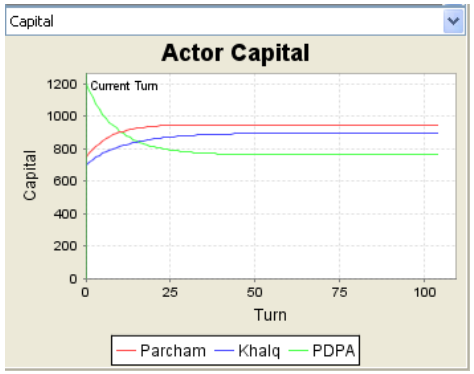
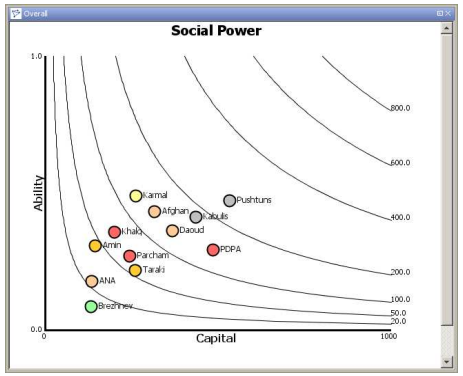
Technical Approach: Power Structure Toolkit

Approach: Develop a ***general modeling toolkit*** usable by analysts and ***grounded in theory***, but let them focus on their own ***theory of the conflict*** without needing to be experts in social power theory

Result: ***Power Structure Toolkit (PSTK)***







Supports power structure model building, execution, and analysis in a multi-model plan exploration environment.

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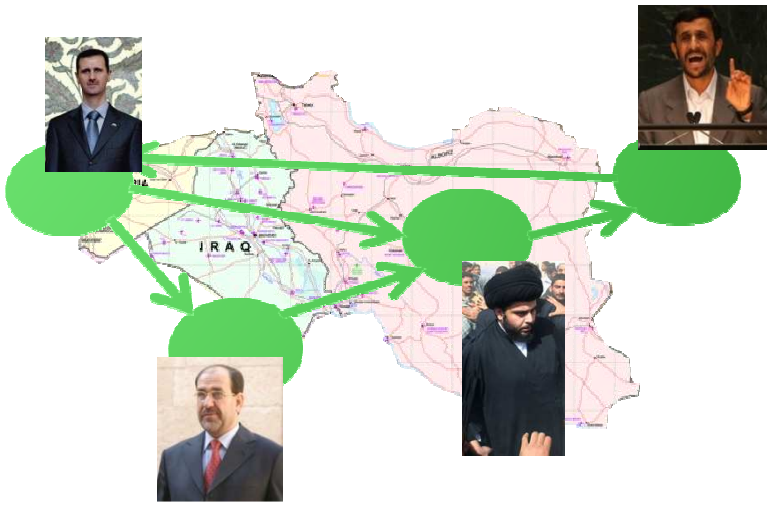
PSTK Theory and Framework

Power Structure Research

- About key individuals and organizations ("actors") that wield power (influence)



- Studies actors, their goals and inter-relationships, their sources of power, and how they use it.

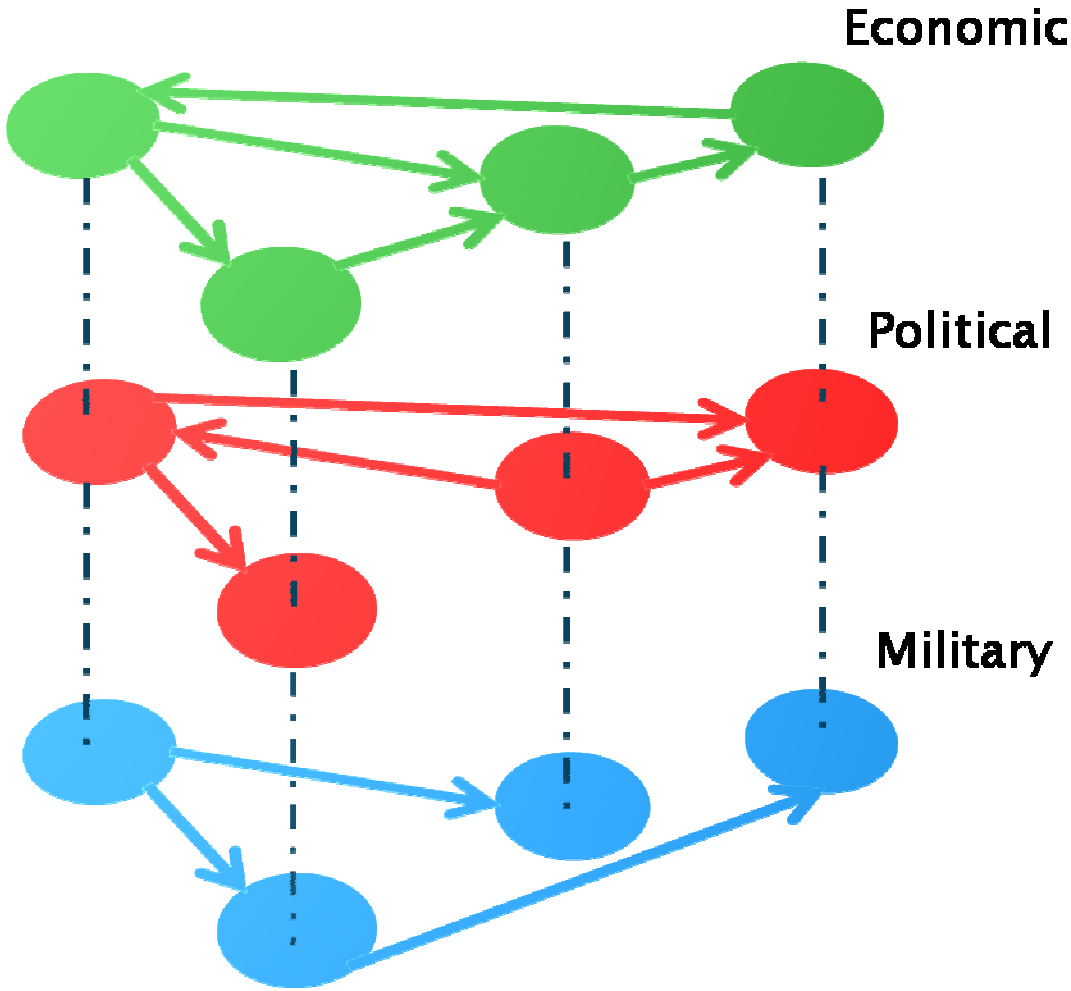
- Roots in sociology, psychology, political science, etc.

Hunter (*Community Power Structure)*, Mills (*The Power Elite)* and Mann (*The Sources of Social Power*).

"Multiple Overlapping Networks"

"Societies are constituted of multiple overlapping and intersecting socio-spatial networks of power."

(Michael Mann)



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Power… A tale of two literatures…?

- International Relations:
  - **Power** talked about as the total resources of the ***state*** and how states exert power on each other (Buena de Mesquita, et al)

- Sociology/Social Sciences:
  - **Power** in terms of ***social interactions***
  - *"Power …is a result of the activation and deployment of … political capital in social interactions." (Pozner and Ocasio 2005)*

- Synonyms: Capital … Influence …

Power Commonalities

- **Types of Power ("sources")** – political, economic, military, etc.
  - Different ways to describe these sources (see Mann vs BDM)
- **Instrumentality** – power is a means to an end; **actors** make decisions to employ power to achieve **goals**
  - Different ways to use power (coercion, reward, etc.)
- **Fungibility** – one kind of power can be converted to another
  - some debate on how fungible some types of power are, how issue-dependent (see BDM vs. Bourdieu)
- **Relativity** – power is only interesting in relation to others
- **Quantification** – how to measure power
  - Hard power (money, tanks) vs. soft power (social status, reach)

References

Actors and Decision-Making (Power Use)

- Game Theory and Rational Choice
  - Actors make decisions based on perceived utility within a multi-actor "game"
  - Rational = maximizing utility
  - Recognized flaws, but most widely used in social models

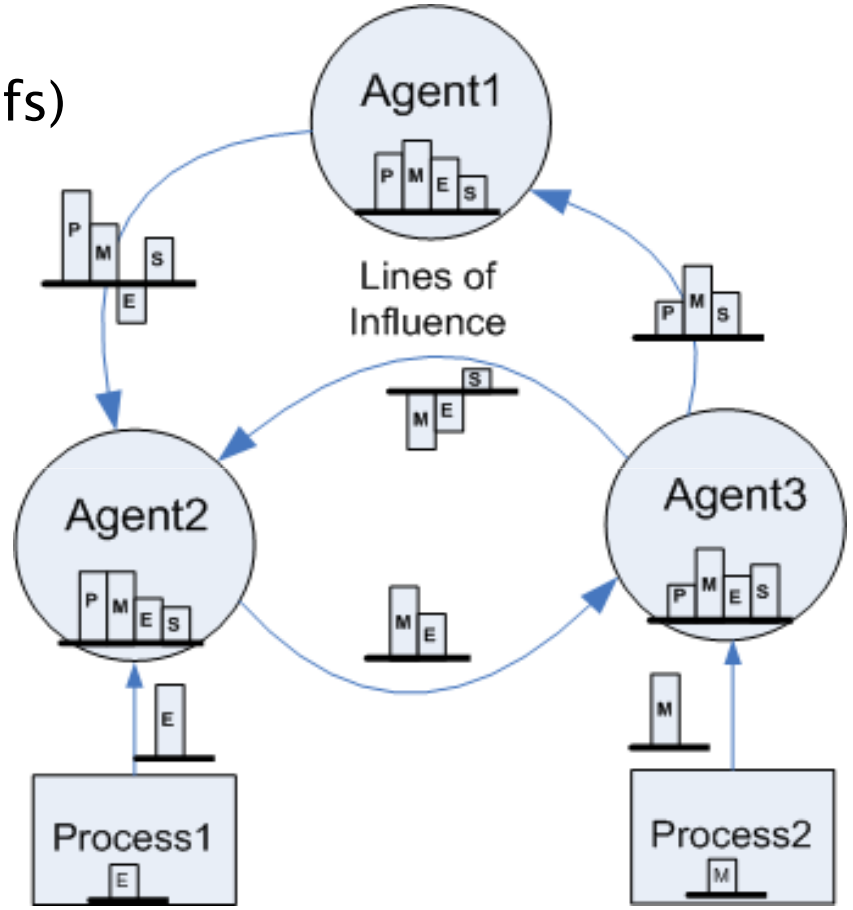
- Beliefs-Desires-Intents Model
  - Elements needed to support decision-making:

  - **Beliefs** – an understanding of the environment (including utility)
  - **Desires** – a definition of an idealized world (goal)
  - **Intents** – definitions of plans (actions) and commitments of resources to get to a desired state (choice)

(Allingham, 2002); (Allison & Zelikow, 1999); (Bratman 1987)

PSTK Conceptual Framework

- Actors (agents with goals and beliefs)
  - Deliberate over goals to decide actions
- Lines of Influence (relationships)
- Capital (core resources)
  - Political, Economic, Social, Military
- Power (usable resources)
  - Capital X Ability
- Processes (sources/sinks)
- Turn-based game



Actors *"accumulate and fight for capital"* (Bourdieu)

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PSTK as Toolkit

Support the Analytic Process

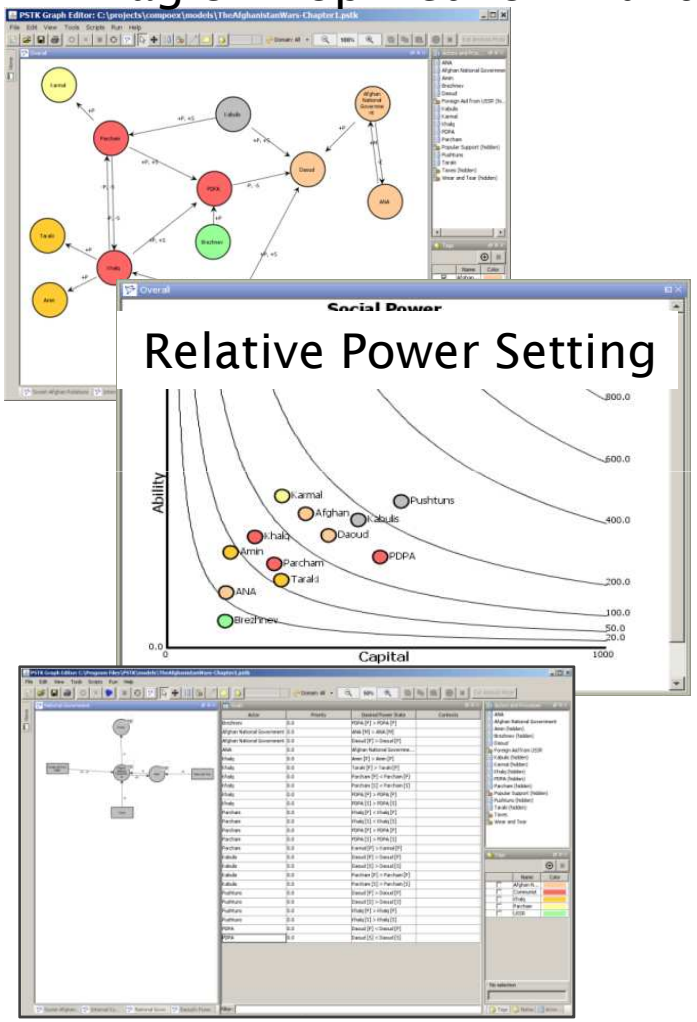
- Analysts do mental modeling and simulation
  - "What's the nature of this conflict?"
- Effectively "Hypothesize and Test"
  - "If we do this, what will the effect be?"

- Goals:
  - Allow analysts to make tacit models explicit
  - Give them tools to hypothesize ("build") and test ("run/analyze")

PSTK Model Building

- Identify key actors and relationships
  - Who interacts with who and in what ways?
- Rank relative power
  - Who has power in these areas?
- Set goals
  - What do the actors want to accomplish?
- Run simulation

Drag & Drop Network Building



Tabular Goal Definition

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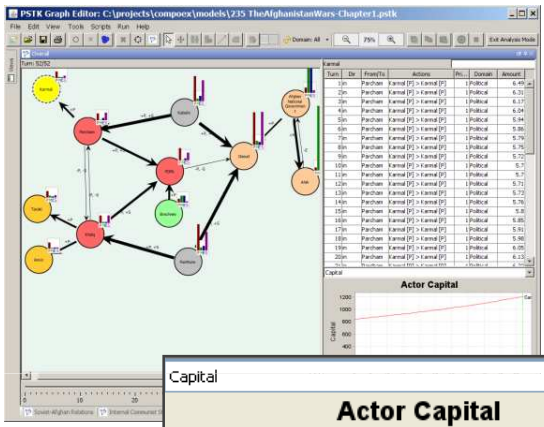
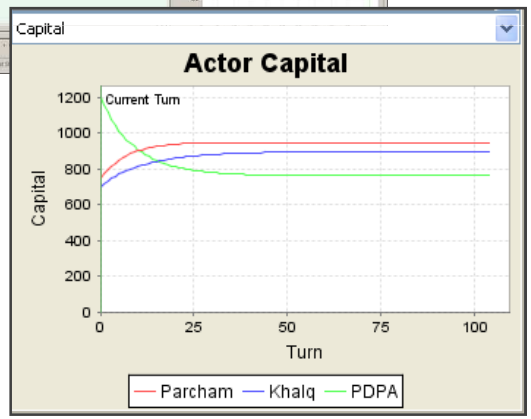
PSTK Execution and Results Analysis

- Analyze
  - Does the outcome match the expectation?
  - Does it seem reasonable?
- Refine
  - Is the model wrong?
  - Or the expectations wrong?
  - Iterate

Relative Power Results & Actions





Dynamic Power Time Series

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PSTK Usage and Evaluation

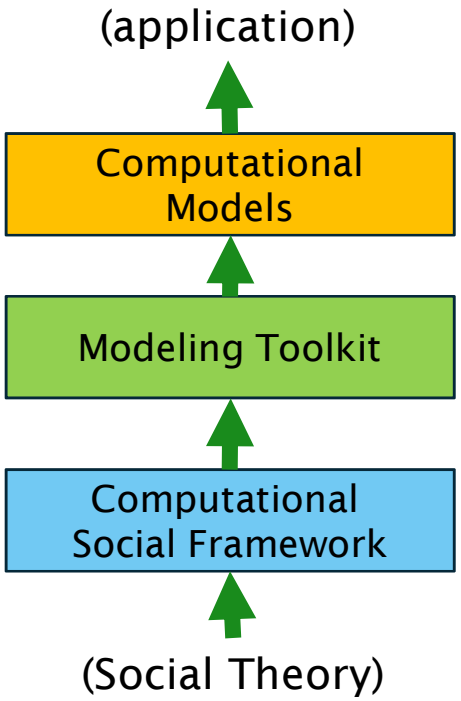
Usage and Evaluation

- Has been used in 3 DoD experiments in a multi-model environment
  - Models of sub-national, national, and international power struggles in three different regions of the world
  - Working on transition to field
- Models developers are SMEs
  - Area/domain experts rather than computer scientists
- Models vetted by other area experts/SMEs
  - University participation
  - Face validation so far
- Anecdotal user feedback
  - Ability to build and play with dynamic models "exciting and compelling"

	Model 1	Model 2	Model 3
Actors	69	91	148
Processes	79	42	71
LOI	216	445	1023
Goals	116	369	900
Contexts	0	0	1164

Of Models and Frameworks…

- Tradeoffs in *usability* and *framework complexity*
  - *Model building:* more levers, harder to build models
  - *Model explanation:* more levers, harder to explain results
  - *Model execution:* deeper models, longer runtime



Throughout field, each researcher fumbling with a few of these tradeoffs, no general coalescing on guidelines.
This is still an art.

On Computational Social Science…

- Plethora of *descriptive* theory that is difficult to put into a computational form
  - Where you fill in gaps to make the system turn over, you're *creating new theory* that *must be evaluated*

***Imperative:* include social scientists in the process**

- Computational modeling is a learned skill
  - Helps to have a bent toward scientific process

Conclusions and Future Work

- Power Structure Toolkit (PSTK) lets SMEs build computational models of power structures
  - "Runnable social networks"
  - Being evaluated in DoD experiments and by some university social science departments

- Future work:
  - Experimenting with different agent decision mechanisms and framework capabilities
  - Methods for automatic ingest of data to build models
  - Continued refinements to GUI for building/analyzing models
  - Further evaluation of framework and resultant models