

Toward an Extensible Repository of Socio-Cognitive Models: Challenges for Synthesis

"If sociological game theory is not to end up as an artificial exercise, ..., it is absolutely essential that the beliefs, ideas and experiences of the actors themselves are moved onto center stage"

R. Swedberg (2001), p. 325

Barry G. Silverman, Director of ACASA
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Overview

- Gallery of Past Projects
- Challenge: 3 Universal Dilemmas (in Human Socio-Cultural Behavior M&S)
- Response: Systems Social Science Defined
- Software Design Patterns To Think About
- Example Model of Models Library
- Case Studies: Training & Analysis
- Conclusions, Lessons Learned, Next Steps

Gallery of Some Past PMFserv Agent Studies



Crowd Behavior Emergence (Bio-Affect-Values-Panic)

- WTO Talks in Seattle -- Protesting/rioting crowds: Males (employed/unempl.), females, instigators
- Rioting/looting crowds at food distribution station (impact of cultural norms upon crowd behavior)
- Scale up to 1,000 agents in Sony OpenSteer
- CROWDSIM & VILLAGESIM

Asymmetric Plots (Culture/Emotions)

- Recreate Black Hawk Down: Four types of Somalians
 - Women/Kids, Civilian Males, Militia, Clan Leaders
- Intifadah dynamics – cell leader, suicide-bomber, Mayor, populace reactions
- INSURGISIM - Al Qaeda & Iraqi Insurgency, SE Asia, Elsewhere



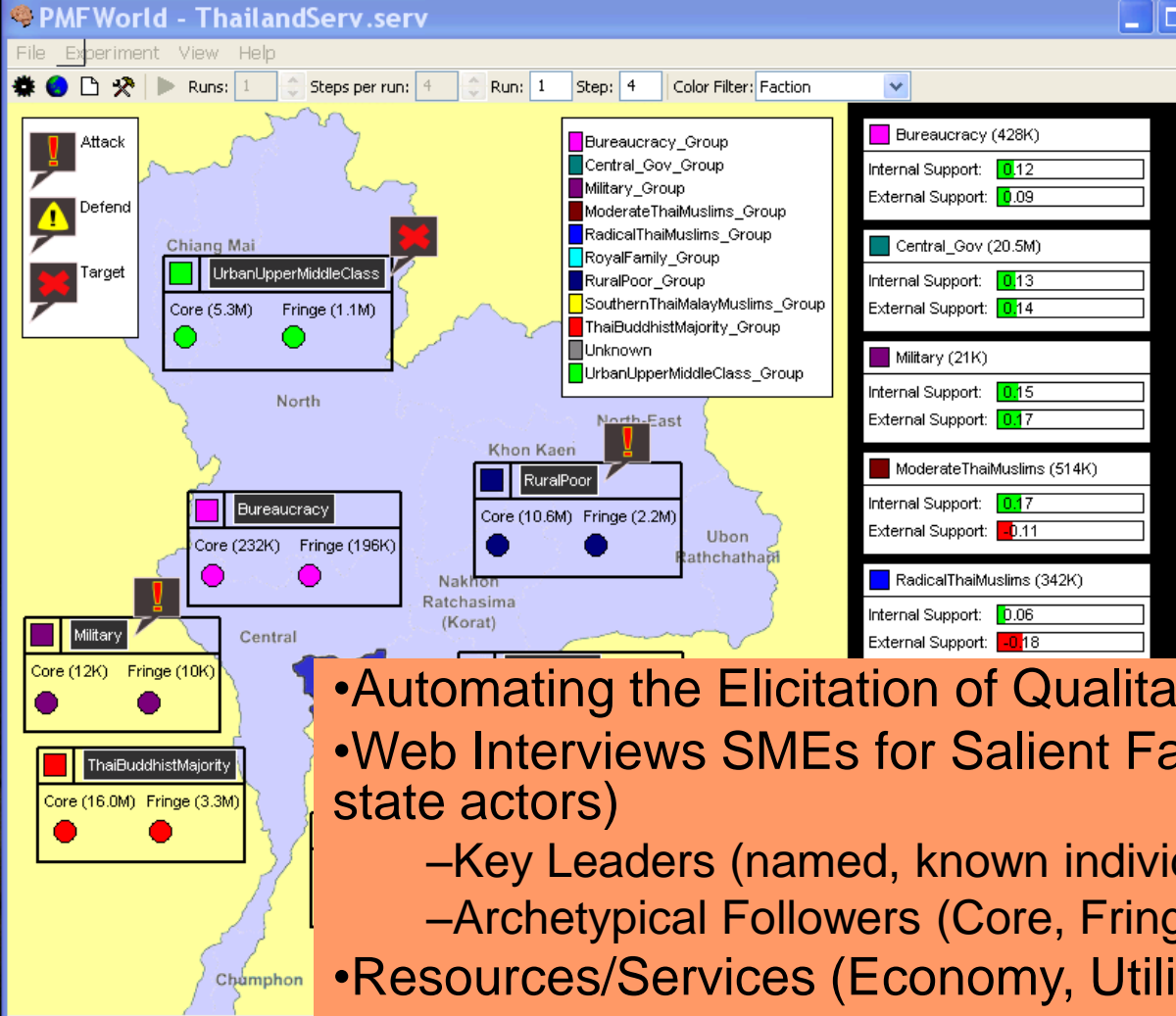
Political Agents for RPGs

- STATESIM
- World leaders in diplomatic strategy role playing games
- Hookup to social network models
- Group membership dynamics

Game vs. Gaming Theory: Assumptions

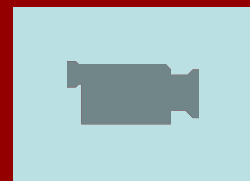
Agents might play many games, redefine them

- Rational Actors
 - Normative
 - Perfectly informed
 - Purely logical
 - Max expected payoffs
(Resource Wins - CostBattle)
 - Identical to each other
 - Computable Equilibria
- Descriptive Agents
 - Best-of-breed models
 - Select what they attend to
 - Heuristic coping, emotion
 - Max moralistic payoffs
(Resource Wins – CostBattle – $\Delta K + emV$)
 - Individual differences
 - Play roles in groups/nets
 - Infinite Equilibria Possibilities



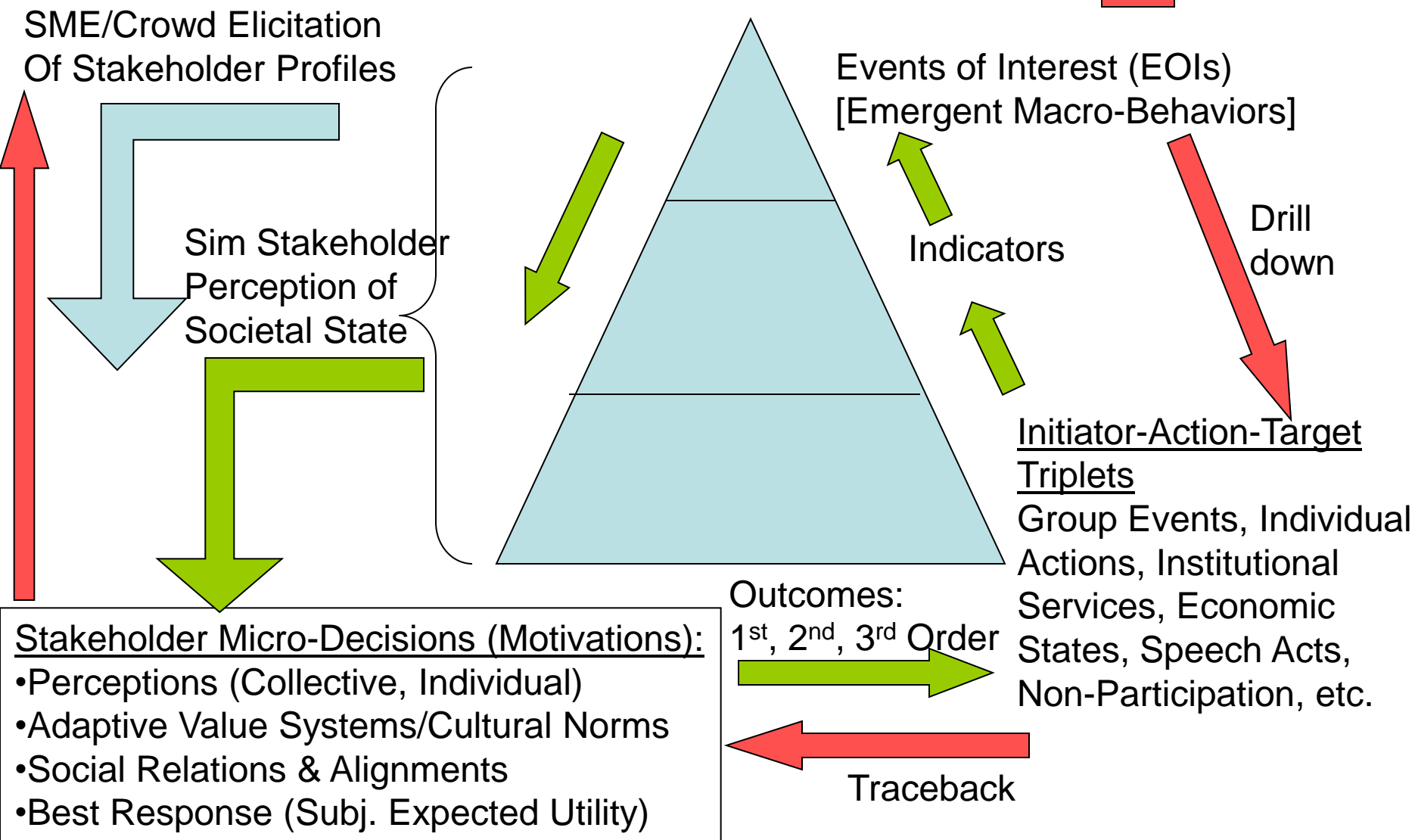
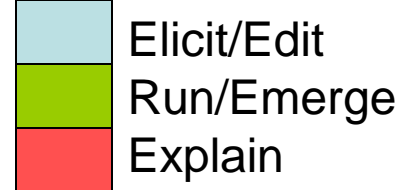
Ackoff Collaboratory
for Advancement of the Systems Approach

StateSim: Modeling State & Sub- State Actors of Asia

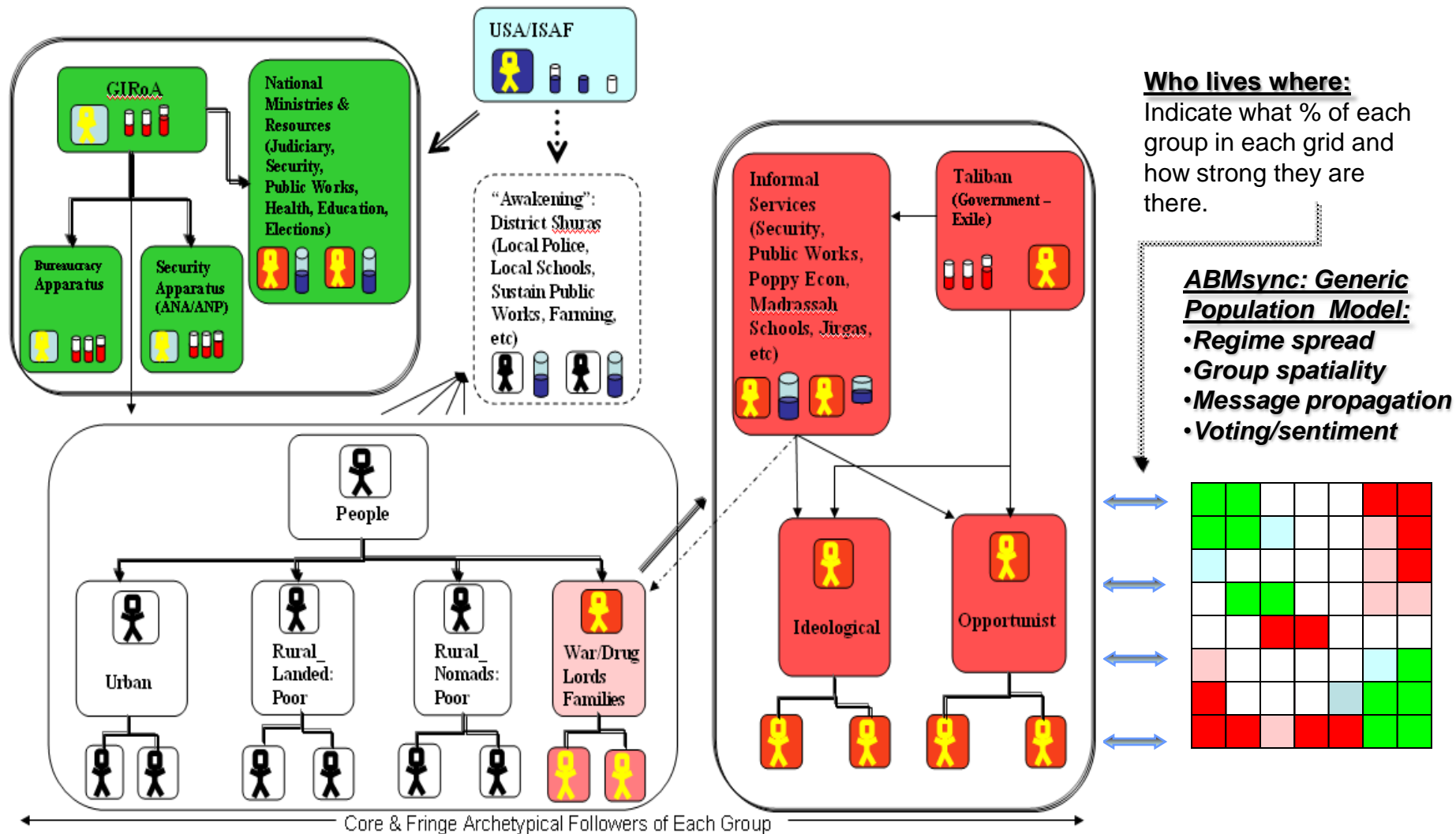


- Automating the Elicitation of Qualitative Models from SMEs
- Web Interviews SMEs for Salient Factions (macro-groups, sub-state actors)
 - Key Leaders (named, known individuals)
 - Archetypical Followers (Core, Fringe) = Sub-Leaders
- Resources/Services (Economy, Utilities, Health/Educ, Law)
- Population Model (simple agents, identity repertoires, voting)
- Country Models Elicited for DARPA and COCOMs
 - 2005 – Thailand
 - 2006 – Iraq
 - 2007 – Bangladesh
 - 2008 – 4 Countries S. Asia (accuracy estimates from 240 forecasts)
 - 2010 – Afghanistan (generic district in South)

Metrics in a Loop

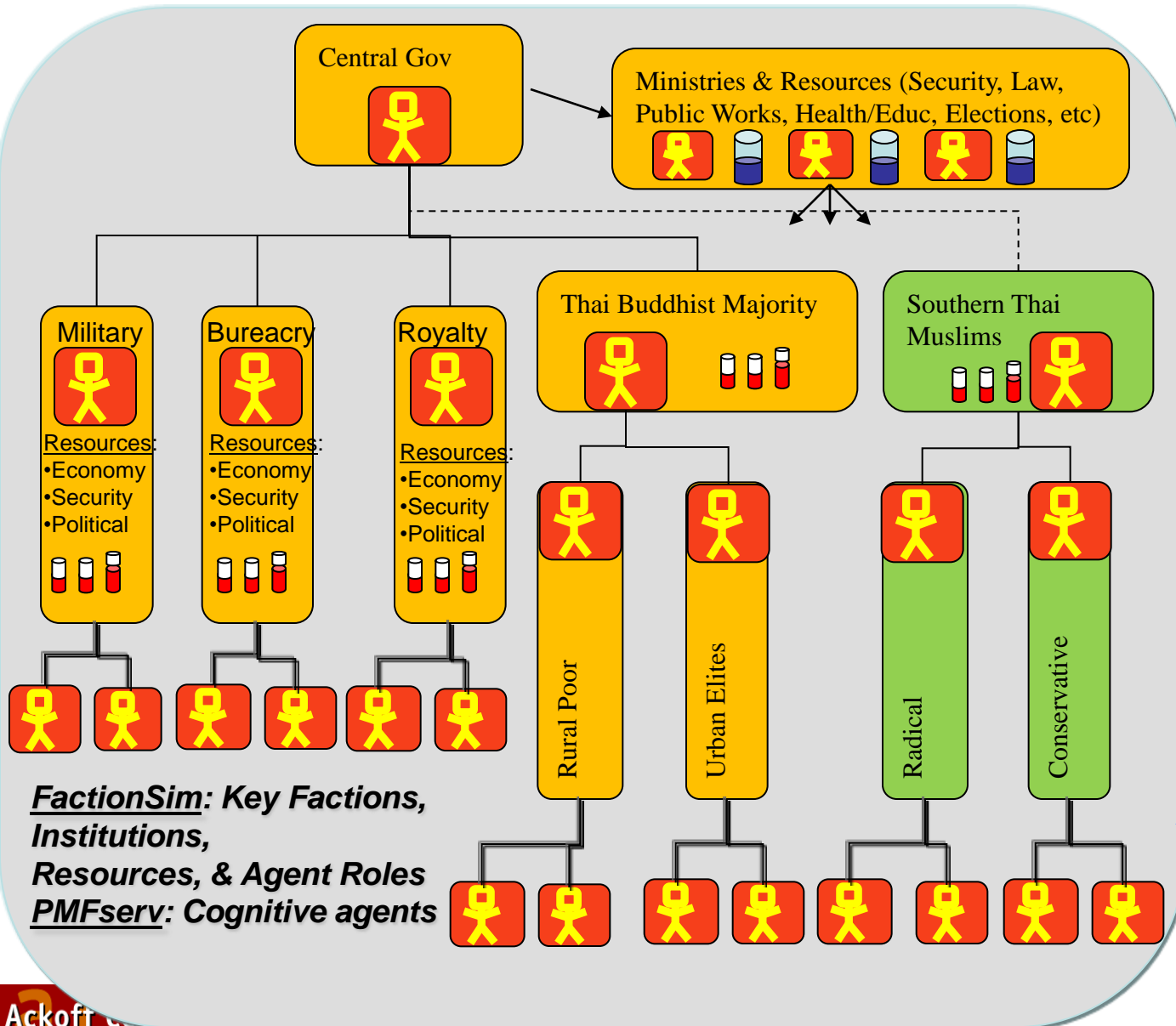


Afghan Stakeholders – Generic District



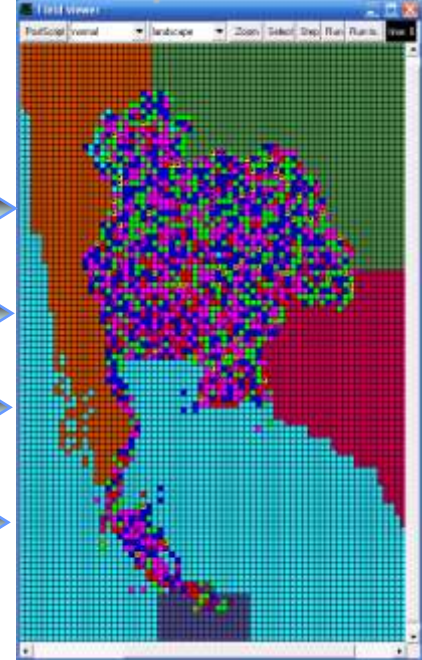
PMFserv-FactionSim Meso Models Exhibit a Network Organization

- Politically salient groups, institutions, and agents identified and profiled with the help of SMEs



Small World Social Network Theory:
Influential people in the country affect simple agents (followers)

PSI: Population Model



2006 Validation: Real vs. Sim Thai Leader

Real vs. Sim Muslim Population

Sim vs. Real Thai Leader's actions Against the Muslim Rebellion (separatists) In the South

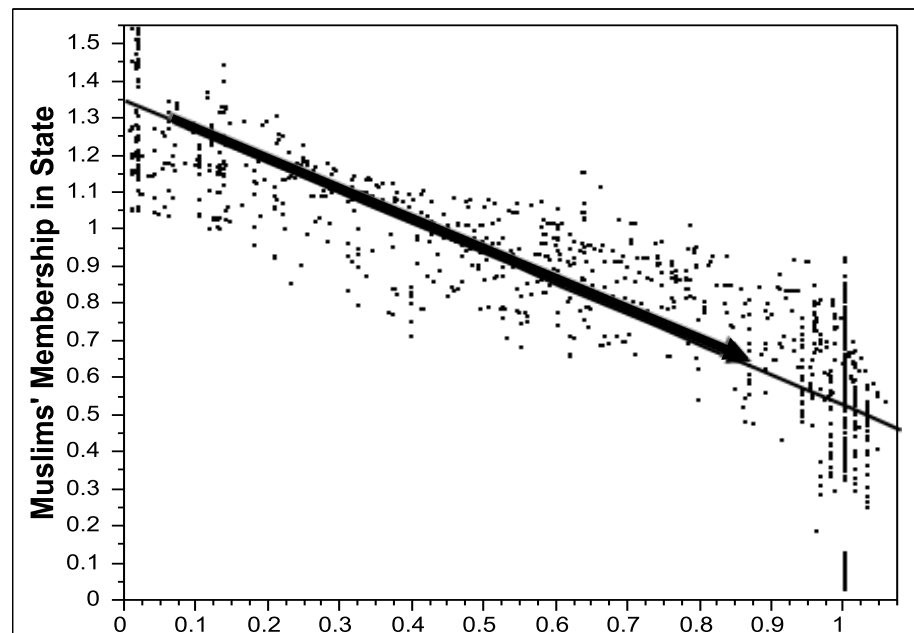


% of Population Leaving Lawful Muslim Villager Group, as function of Abusive Security Forces (and Civilian Injuries)

Figure 11.13: Validation of Simulated Leader vs. Real Action Decisions

Comparison of distributions to see Mutual Entropy (M), Reject H0 & Accept H1 if $M < 0.1$

	PMF _{sim} - Simulated Prime Minister's Actions	Real Leader's Chosen Actions			
Distributions					
Decision Action Counts	Real Decisions				
	Count	Negative	Neutral	Positive	Col. Total
	Negative	16	0	5	21
	Neutral	1	0	0	1
	Positive	7	1	3	11
Simulated Decisions	Row Total	24	1	8	33
Mutual Entropy Calculations	Joint Entropy of Sim & Real	1.396	$H(\text{SIM}, \text{REAL}) = - \sum p(\text{sim}, \text{real}) \log p(\text{sim}, \text{real})$		
	Entropy of Sim	0.681	$H(\text{SIM}) = - \sum p(\text{sim}) \log p(\text{sim})$		
	Entropy of Real	0.760	$H(\text{REAL}) = - \sum p(\text{real}) \log p(\text{real})$		
	Mutual Entropy of Sim & Real	0.045	$M(\text{SIM}; \text{REAL}) = H(\text{SIM}) - H(\text{SIM} \text{REAL})$		
Legend of Leader Actions					
Negative Actions:		Neutral Actions:		Positive Actions:	
Discriminate		Perceive (Observe Events)		Give Culturally Sensitive Assistance	
Suppress - Increase Number of Cops				Give Essential Assistance	
Suppress - Increase Violence of Cops				Reduce Suppress by Number	
				Reduce Suppress by Violence	



Extent of Police State and Collateral Damages





DARPA/ICEWS 2008 Validity Assessment - Forecasting Events Of Interest (EOIs) for CountrySim Models:

- Rebellion/Separatism
- Insurgency/Coup
- Domestic Political Violence
- Inter-Group Violence
- State Repression

A country model contains about
 30-40 PMFserv agents in ~10
 factions. It is projected forward in
 time for 12 Quarters (2004-2006)
 x 5 EOIs x 4 Countries
 = 240 backcasts

(mean of ~12 Monte Carlo runs
 for each backcast)



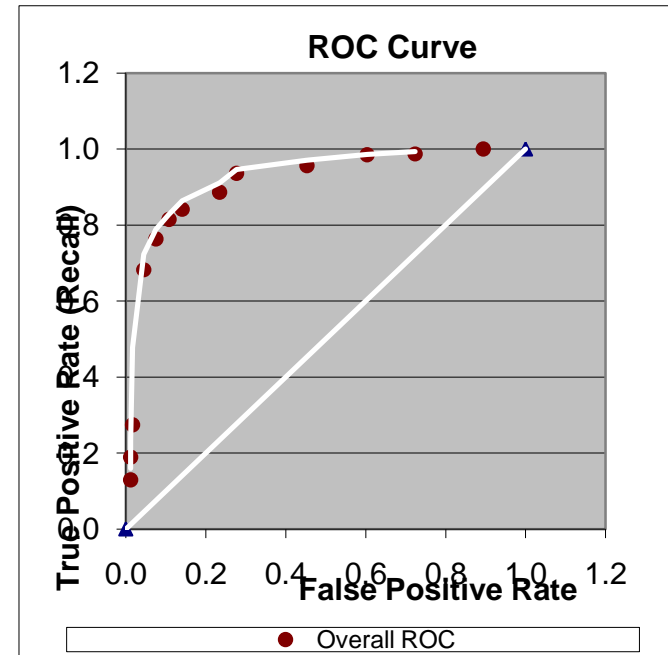
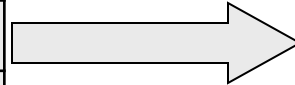
Across Country Summary Metrics with StateSim

(240 Backcasts for 4 Asian Countries in 2005-2006)

With varying Likelihood Thresholds, we have ROC Curves:

With Likelihood of 0.5 as Threshold

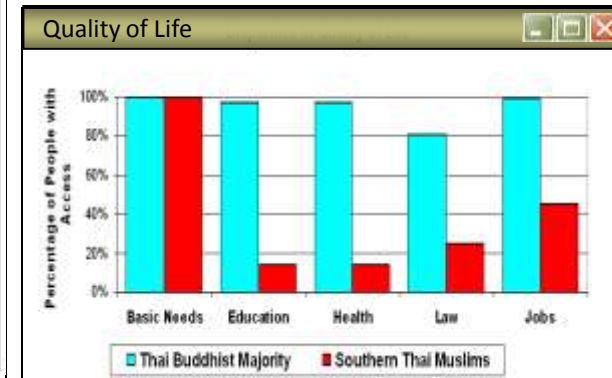
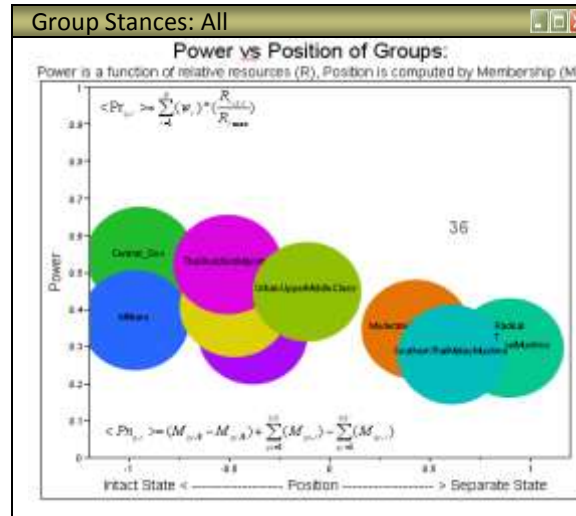
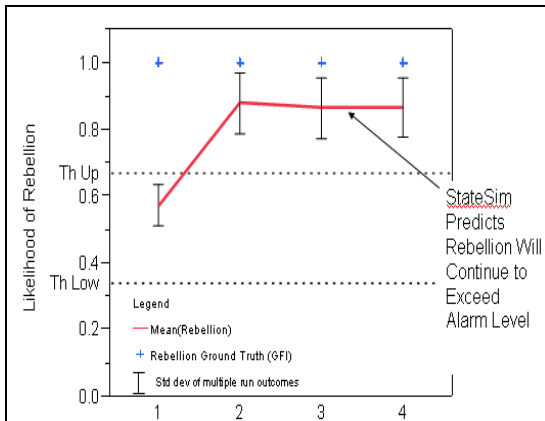
Accuracy	0.88
Precision	0.68
Recall	0.84



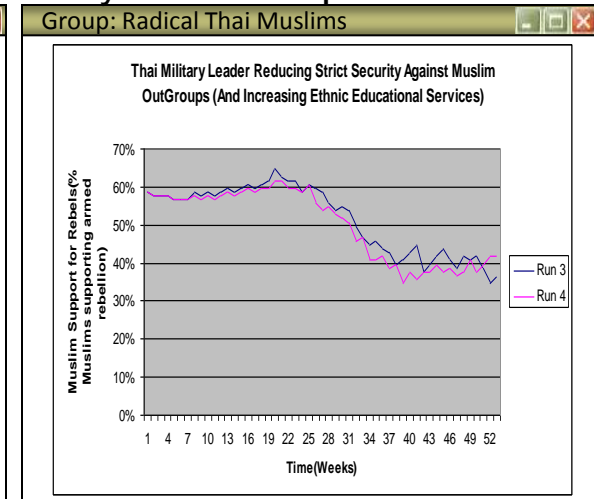
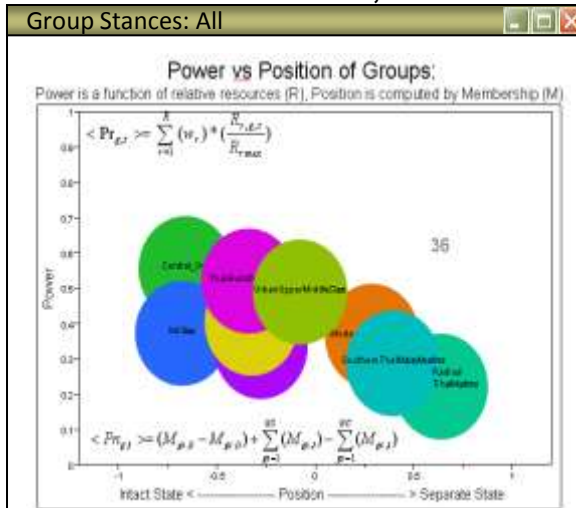
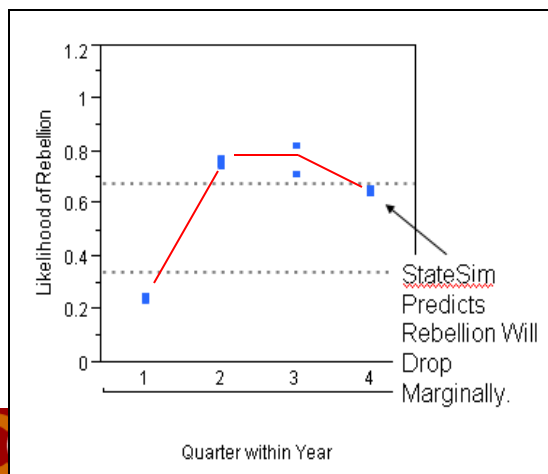
- What metrics will best help military analysts?
- What metrics insulate analyst from model bias?
- What about comparing ground truth to the model-computed PDF?
- Ensembles across multiple forecasting models?
- Drill down with a causal agent model? It's the minorities that are interesting.
- What measurement methods will help models to advance the science?

Sensitivity of Outcomes to Shifts in Profiled Values

Status: Thai Military Leader Is 'Exclusive of OutGroups' (Police Repression, Abuse of Rights)
 Outcome: Rebellion Occurs, Stances Are Polarized, No Services for Muslims



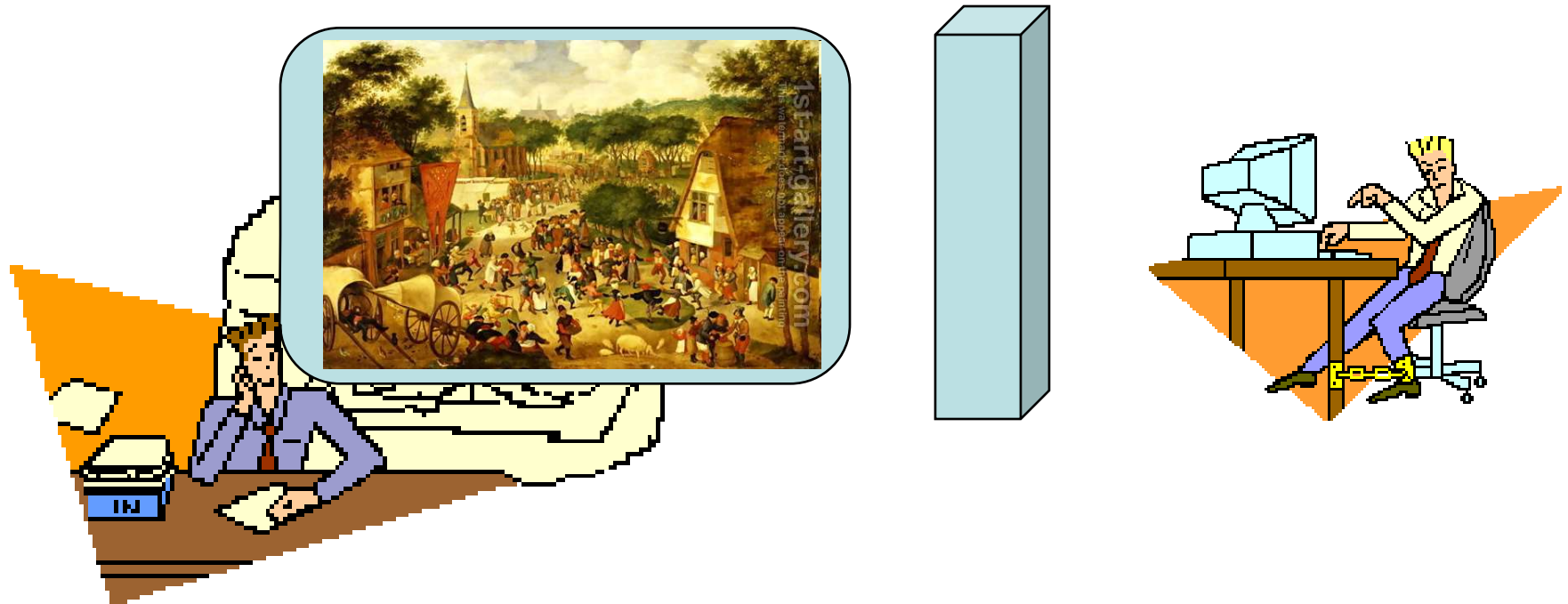
What-If: Thai Military Leader Improves 'Inclusiveness of OutGroups' (Less Abuse of Rights)
 Outcome: Rebellion Lowers, Stances Grow Closer, Radical Security Force Drops



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Domain Specialist's Dilemma



- I have to go through the Programmers/Modelers ☹
- They don't even agree which approach to use:

Bottom Up/Micro

Cognitive Agents

Agent Swarms

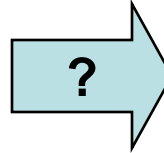
Top Down/Macro

Macro-System
Equations

Other
Camps

- Most of what they show me doesn't work!!

Modeler's Dilemma



Given:

- Gameworld (terrain, buildings)
- Finite State Machines (scriptable)
- FSM (a-life, do paths, obey physics)
- Agent Scripting Language

Desired:

- Cognitive agents fulfilling social roles
- Economic, socio-political institutions
- Conversational agents with depth
- Emergent macro-behaviors

3rd Generation Agents Facilitate Analysis & Training

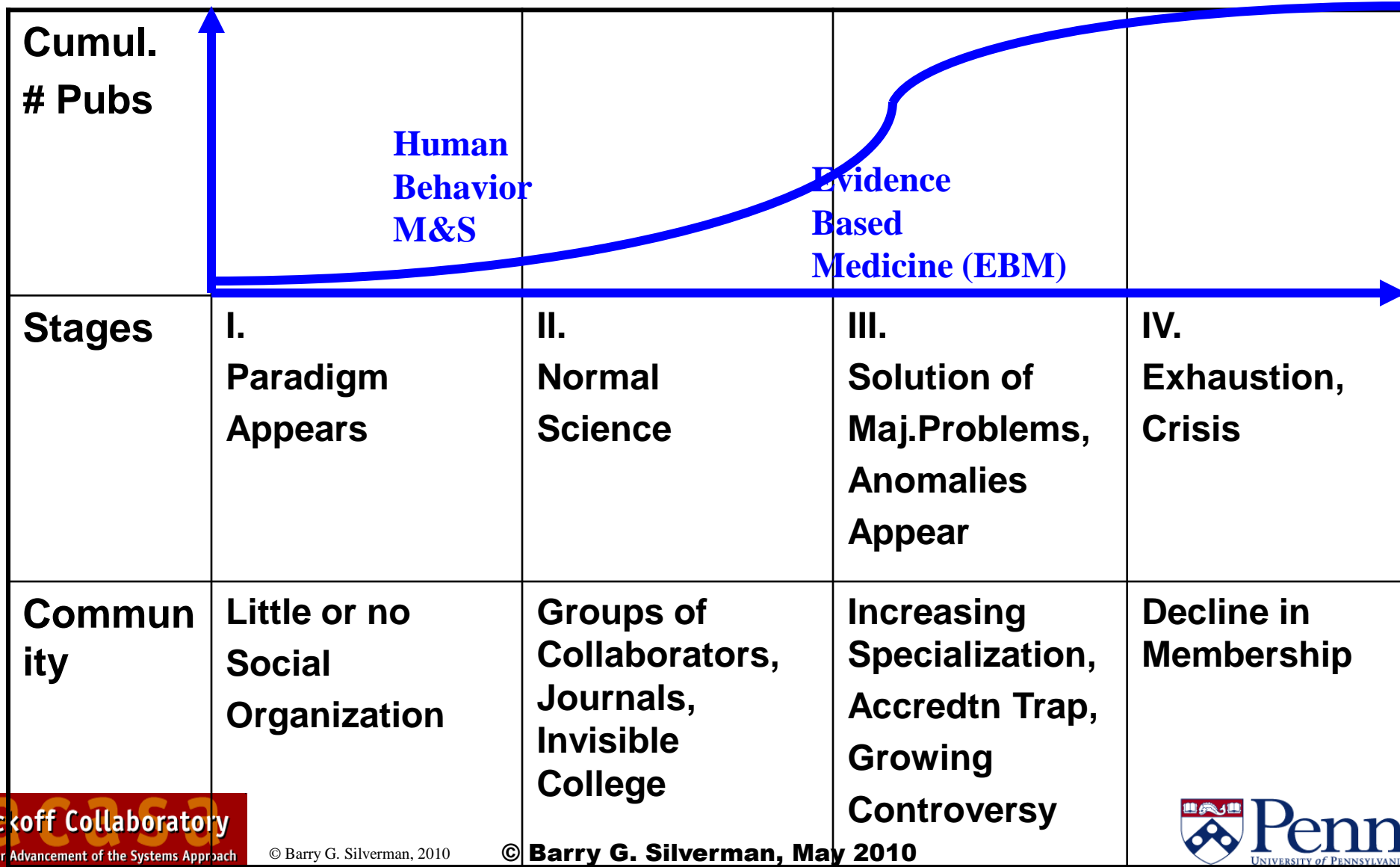
Increasing Agent Understanding in Social Terrains

Decreasing Reliance on Training Developers	<u>1st Generation:</u> Finite State Machines (and scripted actions)	<u>2nd Generation</u> Uni-Paradigm (eg, Cognitive-Affective Agents)	<u>3rd generation:</u> Multi-Paradigm: Socio- Cognitive Agent Theories & Models w/ Emergent Behaviors	
	Humans play roles, supply dialogs (numerous players needed each session)	<div style="background-color: black; color: white; padding: 20px; border-radius: 15px; display: inline-block;"> \$100s/y* </div>		
	Scripted branching dialogs (many 100s of trainer hours required to author each case)			
	Humans profile social science model parameters & ethno- poli-cultural situation (a few hours to produce each case)			<div style="background-color: yellow; color: black; padding: 2px; border: 1px solid black; border-radius: 5px; display: inline-block;"> \$1s </div>

* - millions of \$US

Social Scientist's Dilemma

Development of a Scientific Discipline (Kuhn, Carnap, Popper, Others)



What are the Social Sciences?

- Separate Fields (Silos) such as in Univ. Depts
 - Psychology
 - Sociology
 - Political Science
 - Structure/Institutions
 - Rational Actors
 - Philosophy
 - Electoral Processes
 - Anthropology
 - Economics
- Hypothetico-Reductive Thinking: Scientific Method
 - Fields get narrower and deeper
 - Best-of-Breed Theories & Models == **fertile, minable model base!**

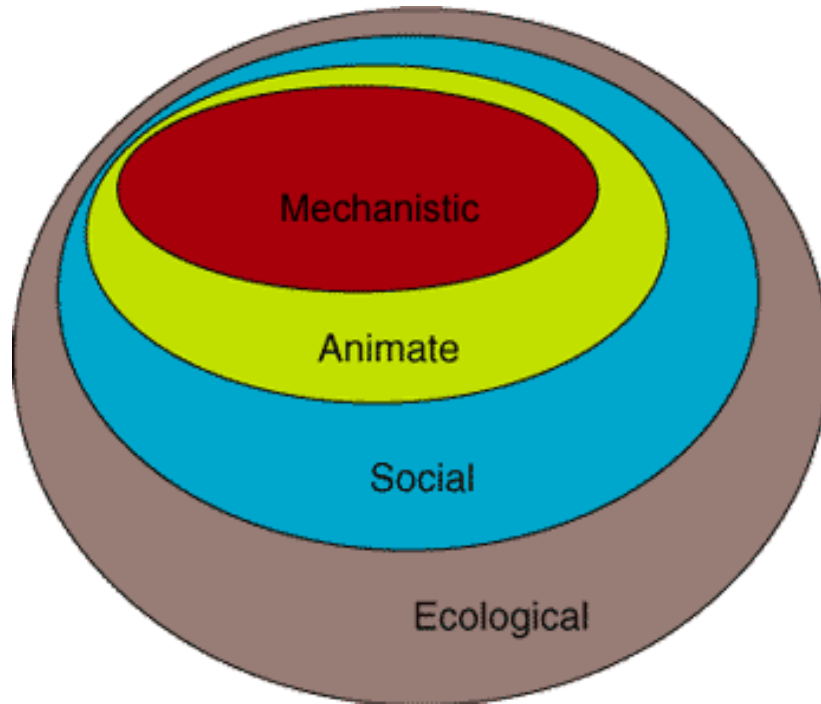
For a discipline to become a Normal Science:

- Need “1st principles” with replicatable results in each of many hypothetico-reductive ‘silos’ (scientific method, positivism, reduction)
 - Pragmatism, “best” theories/models
 - Post-positivism, modernity, descriptive “realism”
 - Keep it Descriptive, Stupid (KIDS)
- Also, need wholistic synthesis across silos (systems approach) including real world and M&S implementational tests of the collection.
 - Synthesis requires SME mental models (Exoteric)
- Synthesis and reduction should work in spirals that identify (and fill) gaps in the science.

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Types of Systems



Purposeful:

A system that can make its own choices,
Not the choices that a designer gave it.

<u>Type of System Model</u>	<u>Parts</u>	<u>Whole</u>	<u>Example</u>
Mechanistic	No choice	No choice	Machines
Animate	No choice	Choice	Persons
Social	Choice	Choice	Corporations
Ecological	Choice	No Choice	Nature

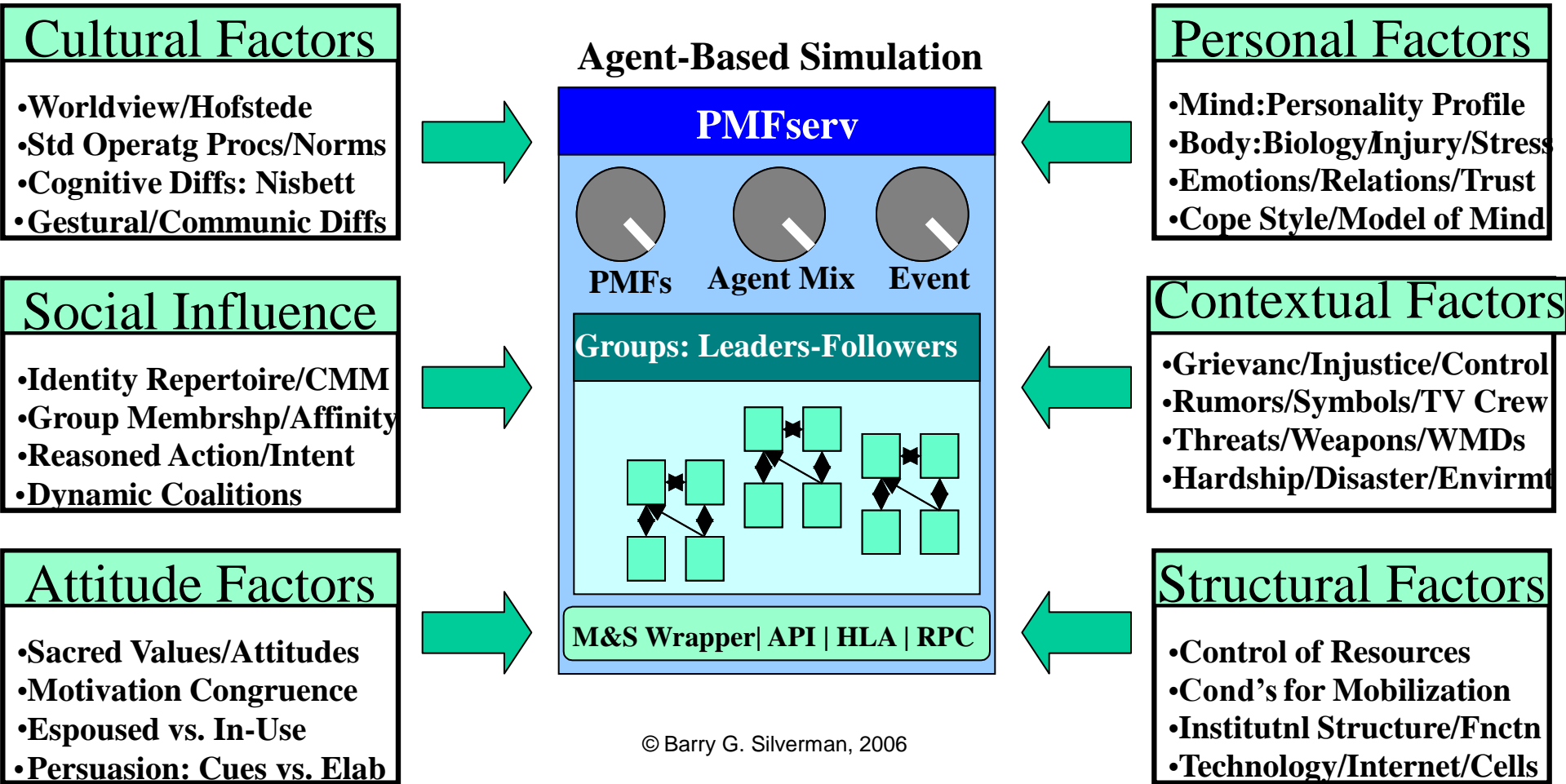
What is a model of a social system?

- *A representation containing the essential features (purposeful persons, purposeful organizations) of some social setting in the real world.*
- The “design” of the social setting including all its stakeholders’ purposes, values, desires, grievances
 - Mental model = non-computational
 - Computational

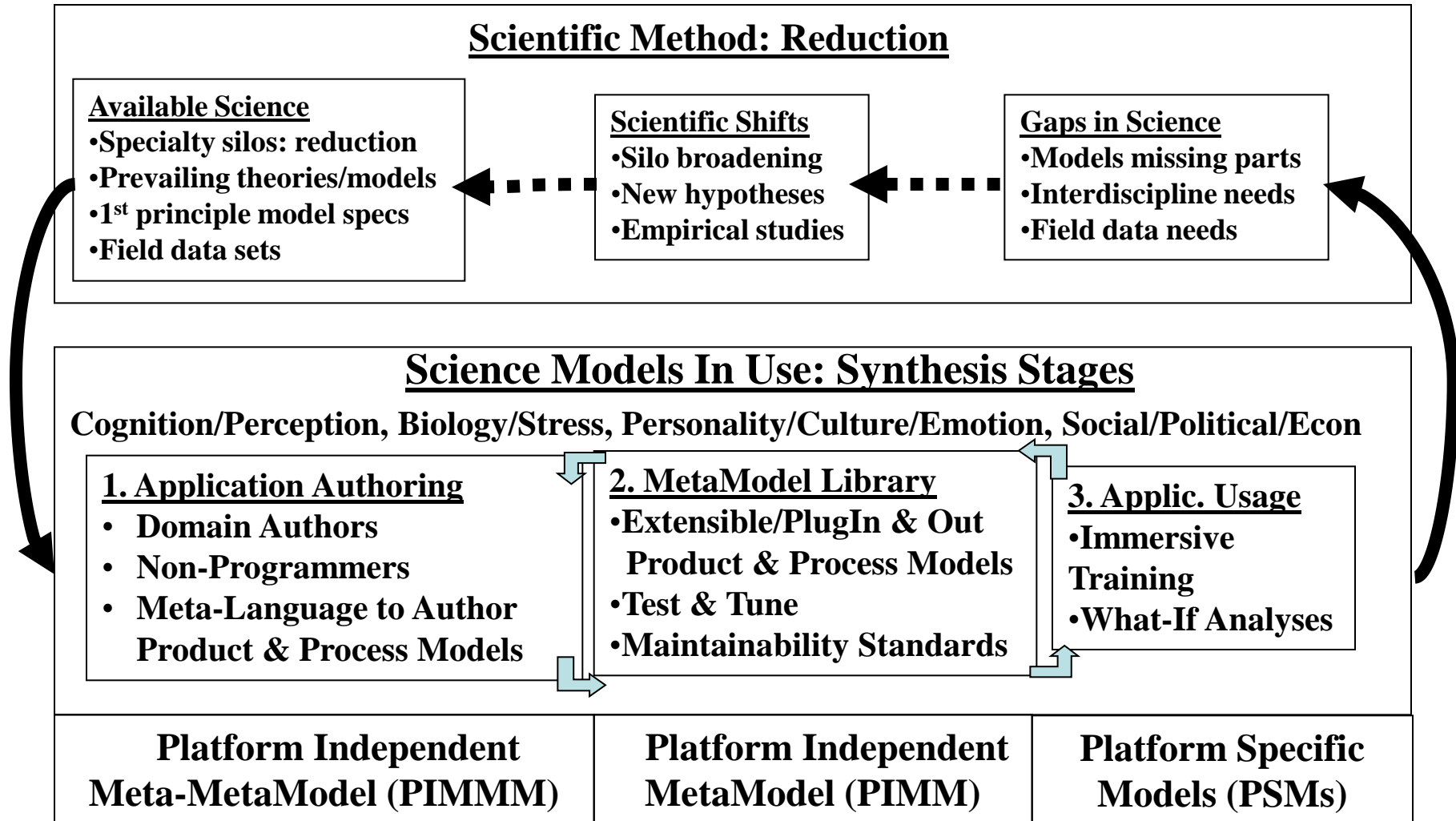
Social Problems Don't Look Silo-ed:

Wicked or Ill-Structured" Problems – Each is evolving and unique.

Keep It Descriptive, Stupid (KIDS) - There are always more factors to add for agent models. Unlike econometrics, there is no curse of dimensionality for agents.



Interaction of Synthetic and Reductive Paradigms



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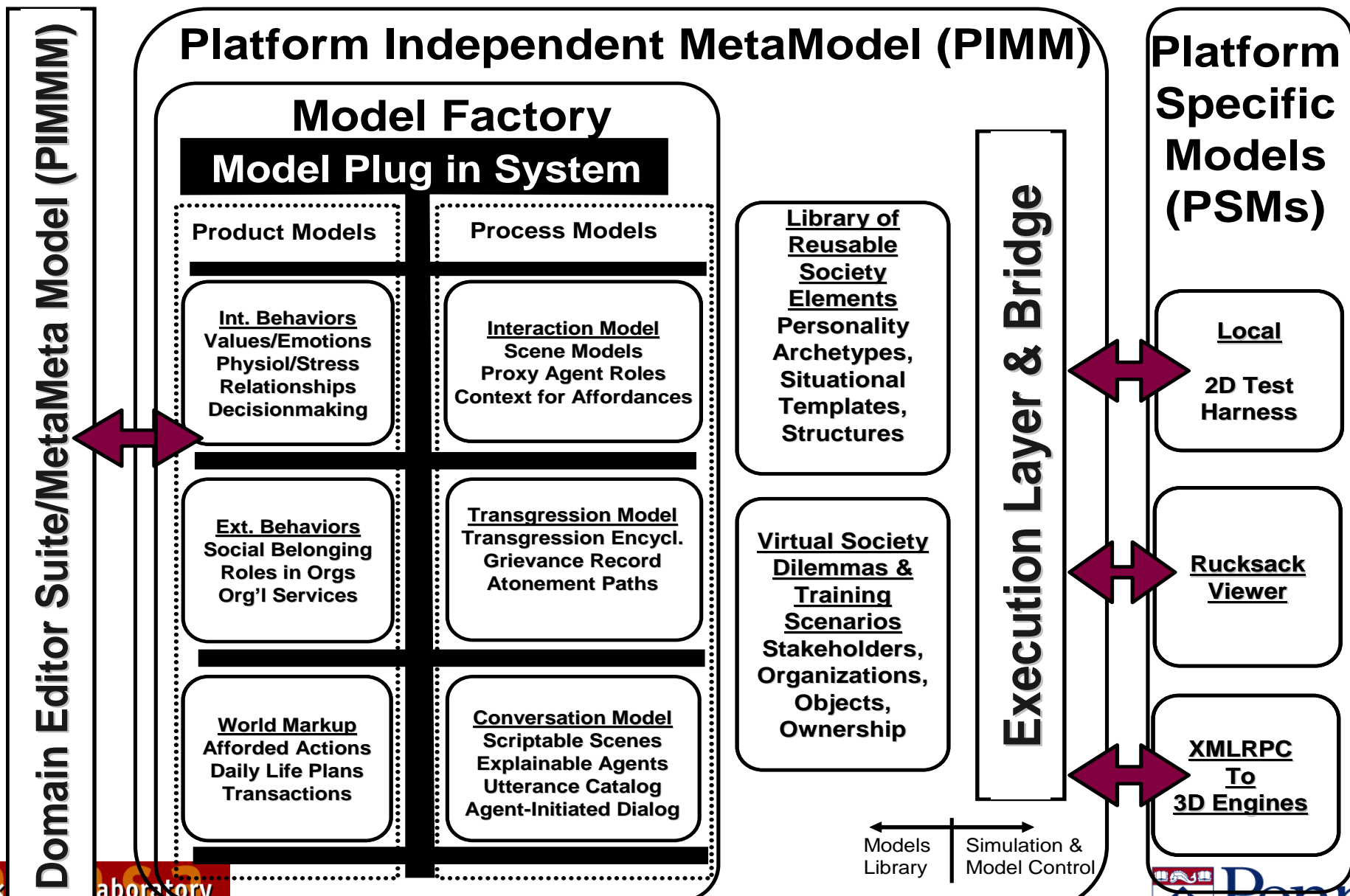
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Mismatch of Agent Generation and Social Systems Modeling

- 1st gen Agents: Scripted
 - Hard to make them purposeful
- 2nd gen Agents: Uni-Paradigm
 - Hard to introduce synthesis, purposeful parts & wholes
- 3rd gen Agents: Purposeful Parts & Wholes
 - Multi-Paradigm
 - Hard to manage the resulting library of models
 - Keep it Descriptive, Stupid (KIDS)

Model Factory PlugIn (PlugOut) Pattern:

Manage model library as a Meta-Model or generator of instantiations.



PMFserv is a Multi-Resolution 'Model of Models'

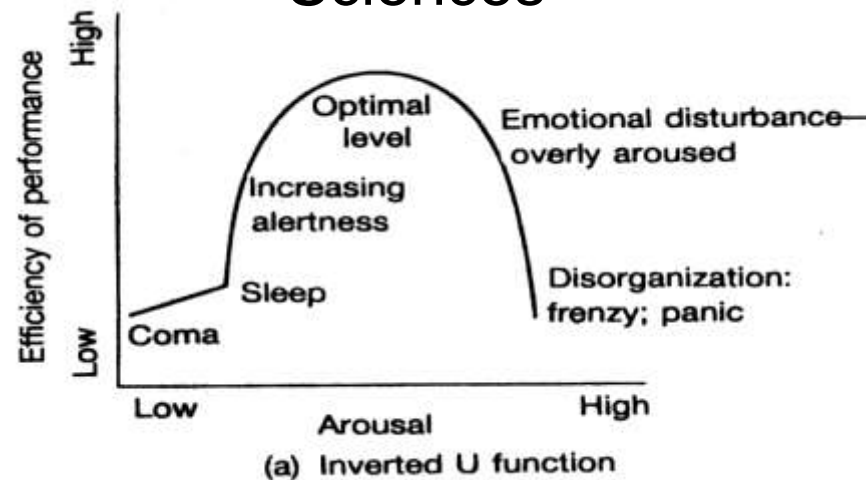
(Many best-of-breed models/theories have no math in them)

Layer	Functionality	Best of Breed Theories (Not home-grown)
Cognitive Agent	<ul style="list-style-type: none"> •Leader Personalities •Follower Archetypes/Norms •Agency Ministers (Corruptible) •External Actors 	<ul style="list-style-type: none"> •OODA Loop (Boyd), Sense/Think/Act (Newell & Simon) •Perception, Focus of Attention (Gibson, Hammond) •Stress/Coping Styles (Janis-Mann), Bounded Rationality (Simon) •Personality Traits, Cultural Values, Religious Values, Tribal Norms (Hermann, Hofstede, House:UN Globe Study) •Affective Reasoning and Relationship Management (Ortony) •SEU, Multiattribute Utility Functions (Kahneman, Keeney & Raiffa)
Socio Political Group	<ul style="list-style-type: none"> •Factions, Factional Roles •Government, Bureaucracy •Institutional Agencies (Security, Utilities, Elections, etc.) •Resources & Economy •Alliances, Coalitions, Votes •Battle Simulator 	<ul style="list-style-type: none"> •InGroup Membership, Loyalty, OutGroup Bias (Eidelson, Hirshman) •Motivational Congruence, Mobilization, Greivance (Wohl, Collier) •Actual vs. Perceived Group Power/Vulnerability (Machiavelli, Eidelson) •Institutions, Greed, Public Goods (Rotberg, Collier, Fearon/Laithon) •Developmental Econ (Lewis/LRF, Solow, Harrod-Domar) •Poltical/Democratic Transitions (Haggard & Kaufman, Geddes) •Instability Theories (Religious Fundamentalist, Ethnic Cleansing, Anarchy, Anti-Imperialist, Gangs/Warlordism, Crime/Corruption)
Geogr Grid	<ul style="list-style-type: none"> •Spatial layout: groups& regime •Perception Constraints •Terrain & land 	<ul style="list-style-type: none"> •Territorial ownership, acquisition, maintenance •Maps, spatial distribution, segmentation, infrastructure, roads/ports •Line of sight and hearing, spread of news (spin) •Maneuver, navigation, waypoints •Temporality – real time vs. faster than realtime

Overview

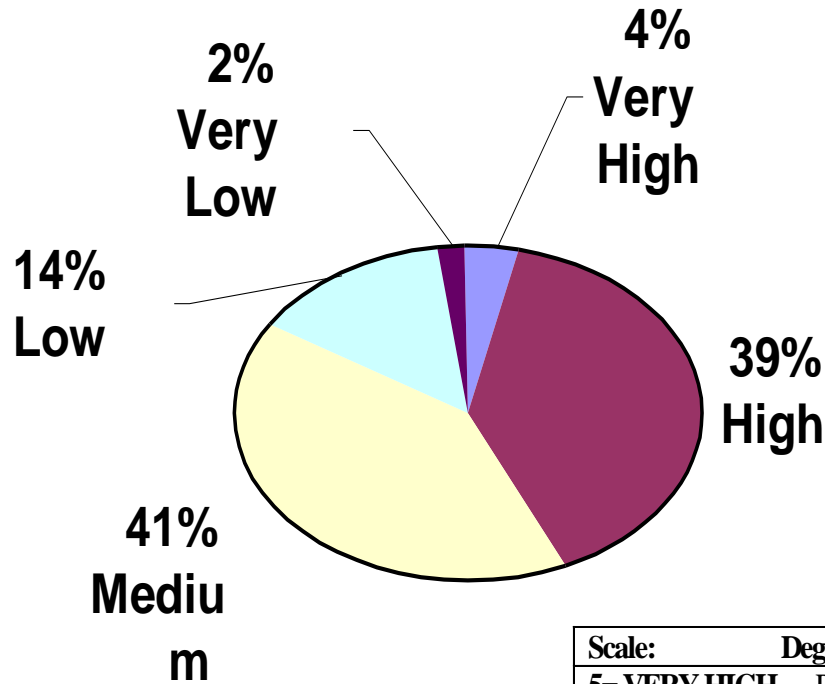
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Best-of-Breed Performance Moderator Functions (PMFs) may be to Socio-Cognitive Processes, what 1st Principles are to Physical Sciences



- External Stress
 - Fatigue
 - Heat
 - Noise
 - Vibration
 - Time Pressure
 - Sleep Loss
 - Workload
 - Drug, Alcohol
- Internal Stress
 - Anxiety & Emotion
 - Stamina
 - Morale & Motivation
 - Experience
 - Way of thinkg/Ideology (Positive/Negative)
 - Uncertainty
 - Personality (Big 5)
- Social Relations
 - Perceptions about Groups
 - Relationship strengths
 - Mobilization
 - Social Trust/Distrust
 - InGroup Bias
 - Values congruence
 - Herd conformance
 - Cultural Norms
 - Compliance

Percent of Human Behavior Literature in Each Validity Category (based on a sample of 48 abstracts in booklet -- 461 PMFs)



Average Validity: 3.5

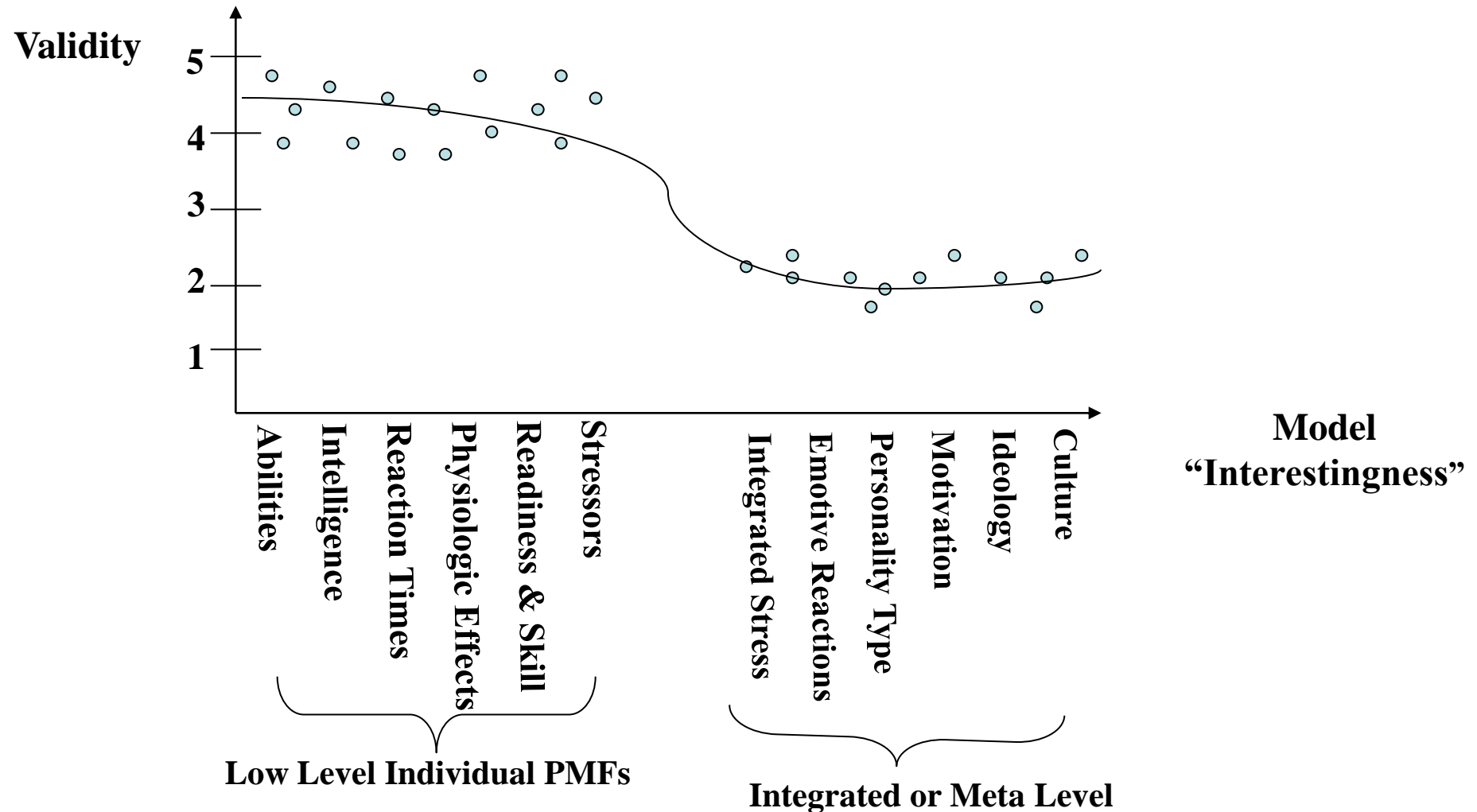
Scale:	Degree of Value of Literature Item for Constructing PMFs
5= VERY HIGH	PMFs provided with backup data sets
4= HIGH	Could make PMFs directly from the data in this study
3= MEDIUM	Some preliminary data for initial PMF construction, but more data needed
2= LOW	Theoretical model suggested from which an ungrounded PMF could be derived.
1= VERY LOW	No valid data in this report for PMF construction
0= NONE	Irrelevant to the PMF construction process.

www.seas.upenn.edu/~barryg/PMFset.zip

www.seas.upenn.edu/~barryg/PMF_Addendum1.doc

The Inverse Relationship Between HBM/PMF

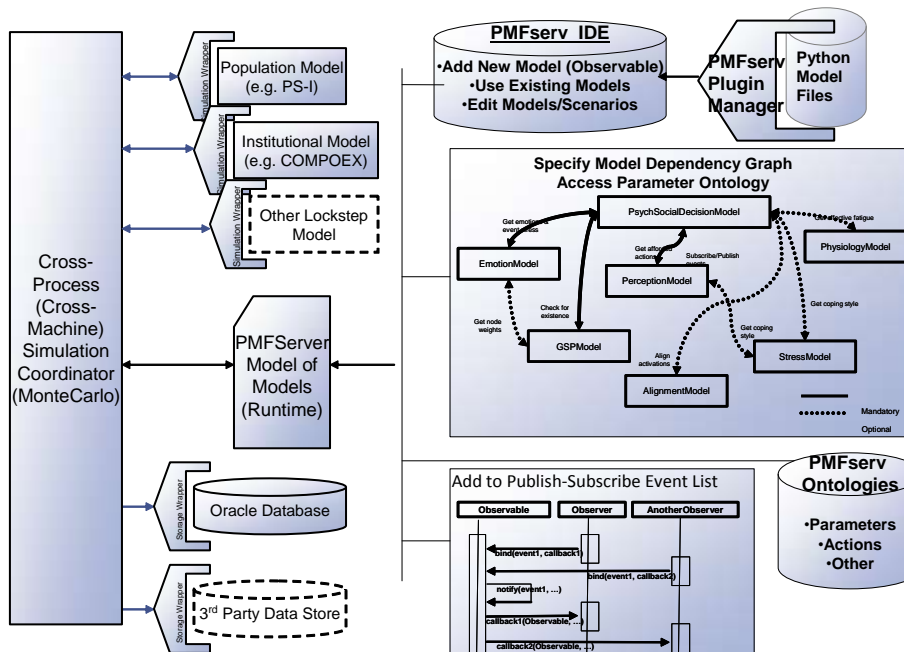
“Interestingness” And Its Scientific Validity (Data Grounding)



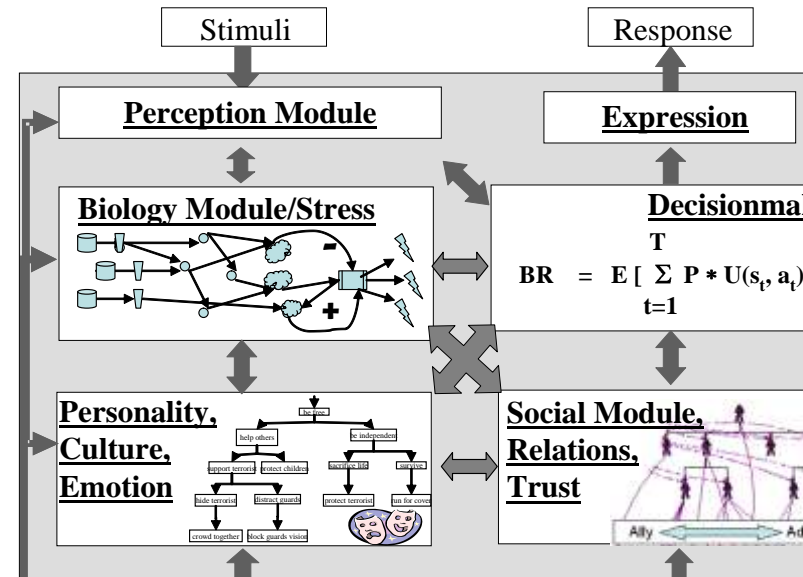
PMFserv's Unified Architecture for Cognition

(Breaking Stovepipes Between Sub-Fields – Assemble model of models)

Plugin Framework

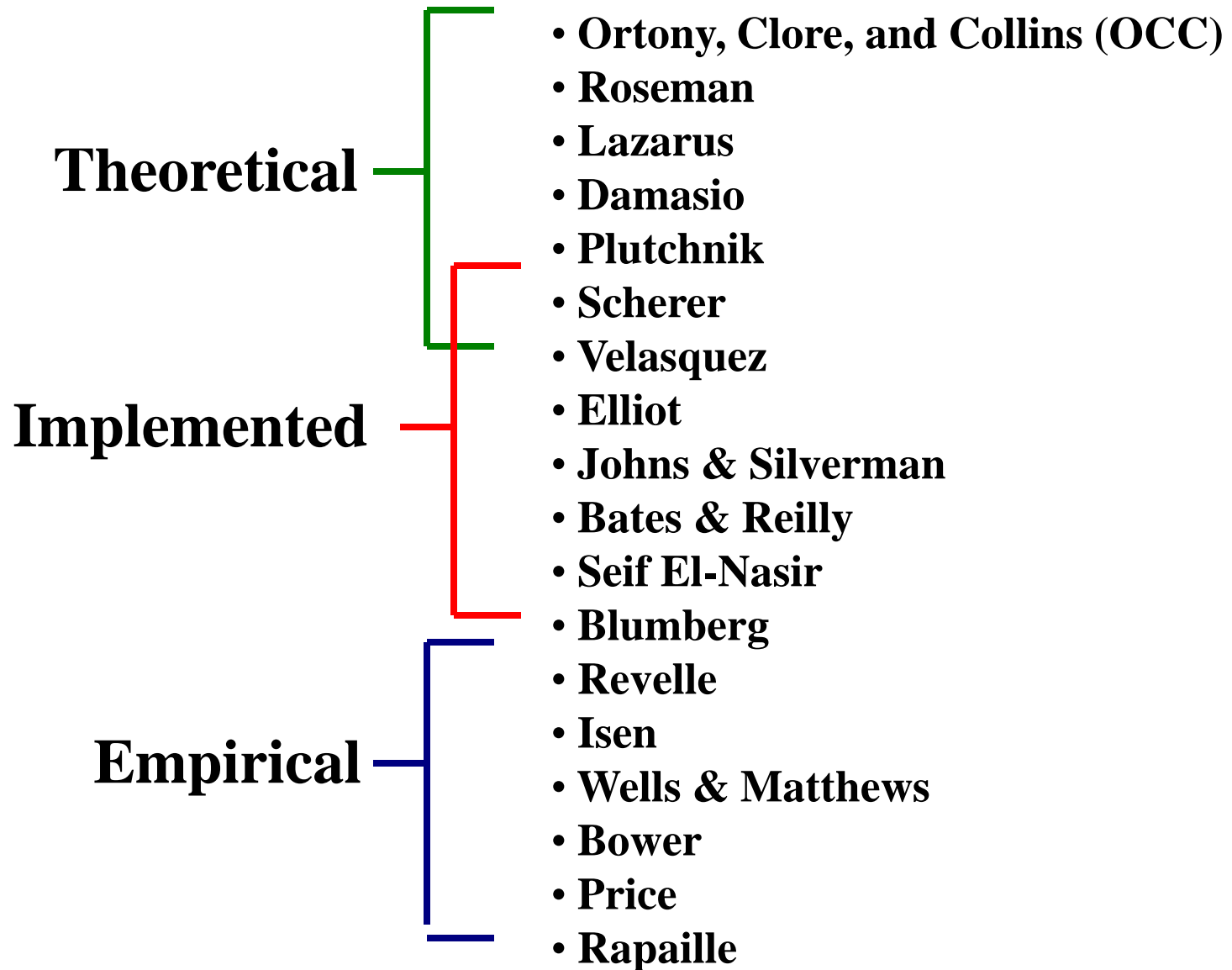


OODA Loop



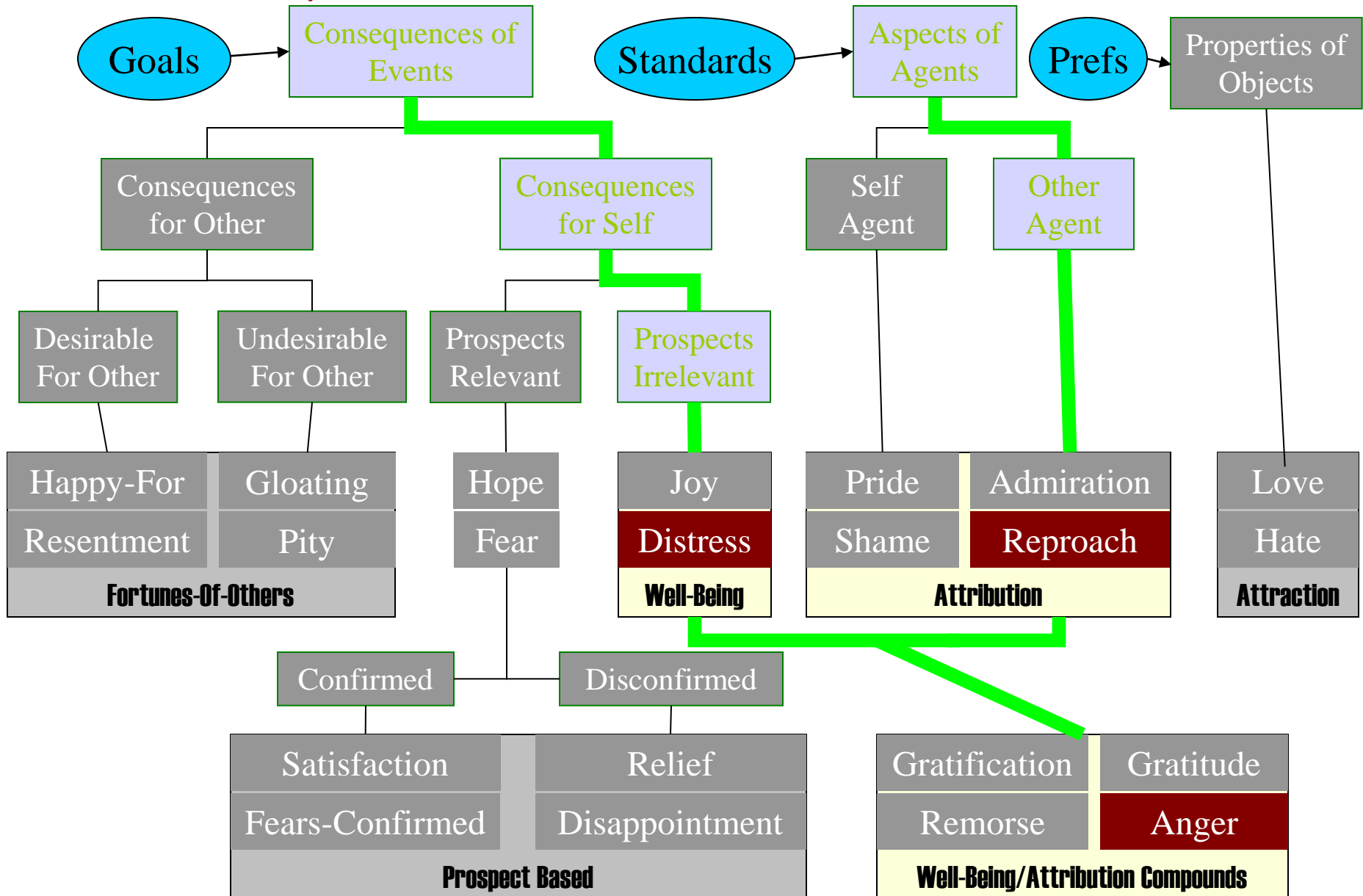
- Find best-of-breed PMFs
- Synthesize (math implementation, parametric unification)
- Expose gaps between fields, identify research needs
- Assess validity (5 levels of analysis)

Emotion Literature Currently Studied:



The Ortony, Clore, & Collins (OCC) Emotion Model – Cognitive Appraisal

Security beats crowd member



Using the OCC Model to Generate the Crowd's Emotions

Upon receipt of news that his buddy was beat by security:

$$\left\{ \begin{array}{l} \text{Distress} \\ \text{(failure of goal to} \\ \text{have healthy friends)} \end{array} \right\} + \left\{ \begin{array}{l} \text{Reproach} \\ \text{(failure of standard} \\ \text{that people should} \\ \text{not harm those I} \\ \text{care about)} \end{array} \right\} = \text{Anger}$$

Both of these are extremely important motives, and consequently the anger will be intense. But how intense? And how long will it last?

Gaps with Any Cognitive Appraisal Model

- What are the Values: OCC calls them Goals, Standards, & Preferences (GSPs)?
 - Value tree attributes
 - Tree branch importance weights (for differing individuals: personality, culture)
- What are the leaf node activation & decay rates?
 - As contexts shift (adapting)
 - Under differing world views (learning)

Somatic-Based Concerns ...

- Somatic models should produce evocations for *each* of the values they consider distinct

$$U_{COA} = \sum_{i \in \text{Values}} [e_i * \rho(e_i) * w_e]$$

Where,

e_i = the intensity of an evocation caused by a single concern

$P(e_i)$ = the probability of e_i occurring

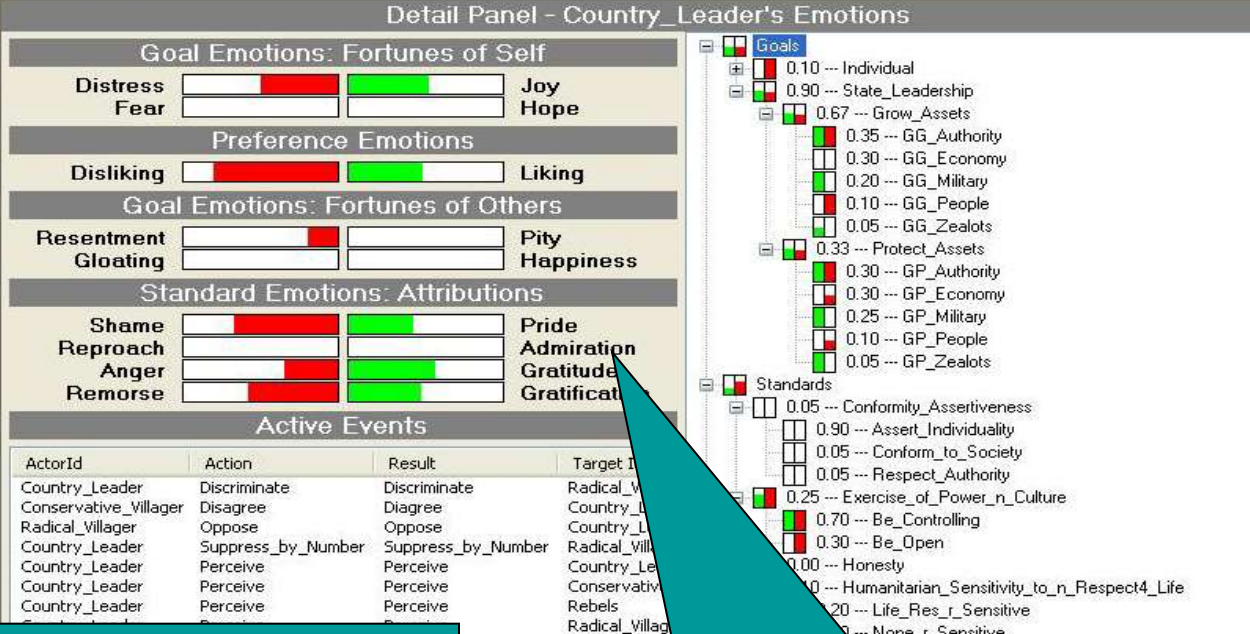
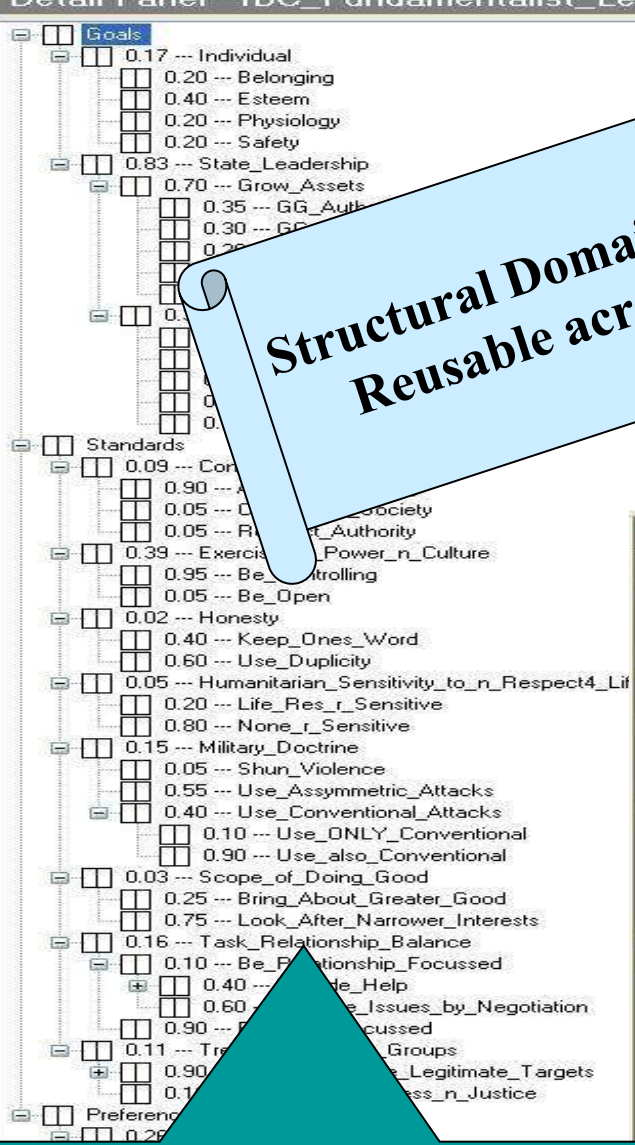
w_e = the weight of importance of this value

- Utility functions are expected to return a single number
- Culture & Personality theory can be applied to derive i & w_e
- Social fMRI studies needed to derive e and $\rho(e)$

Best of Breed Leader Models

Structural Domain Knowledge
Reusable across datasets

- GSP Trees, structured with:
 - Hermann Personality Profile Tool
 - Hofstede Cultural Factor Set
 - UN Globe Cultural Traits
 - Bounded Rationality (Prospects, EU)
 - Affective (OCC) – emotional utility
- Estimating Weights
 - Evidence Tables, ACHs, AHPs
 - Bayesian Priors



GSP Trees (Bayesian-weighted)

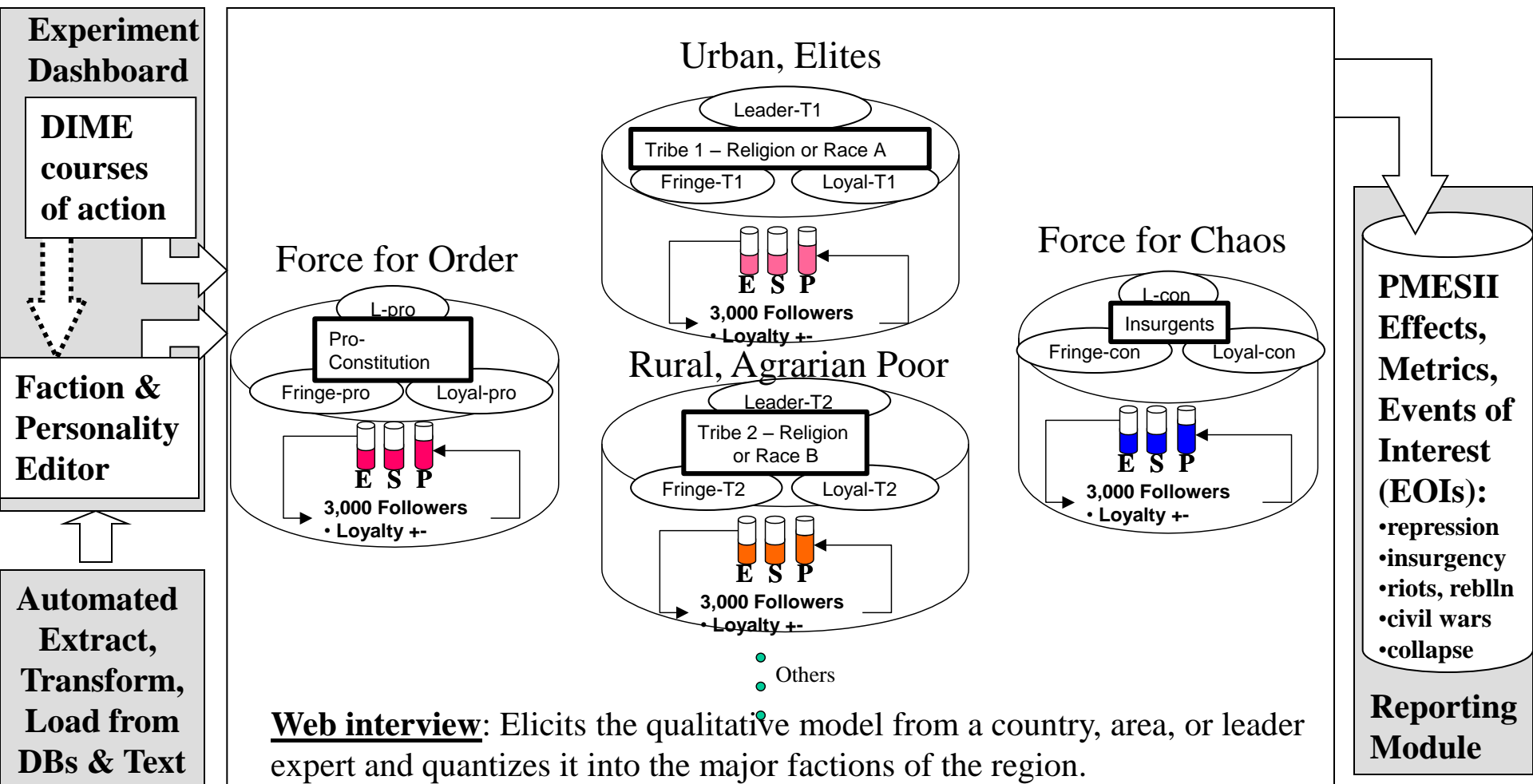
- **Preferences** - longer term hopes
- **Standards** - means acceptable in self and others
- **Goals** - short term needs and actions to reach Prefs

11 pairs of emotions internally-derived utility

$$U = \sum_{\xi} I_{\xi}(s_k)/11$$

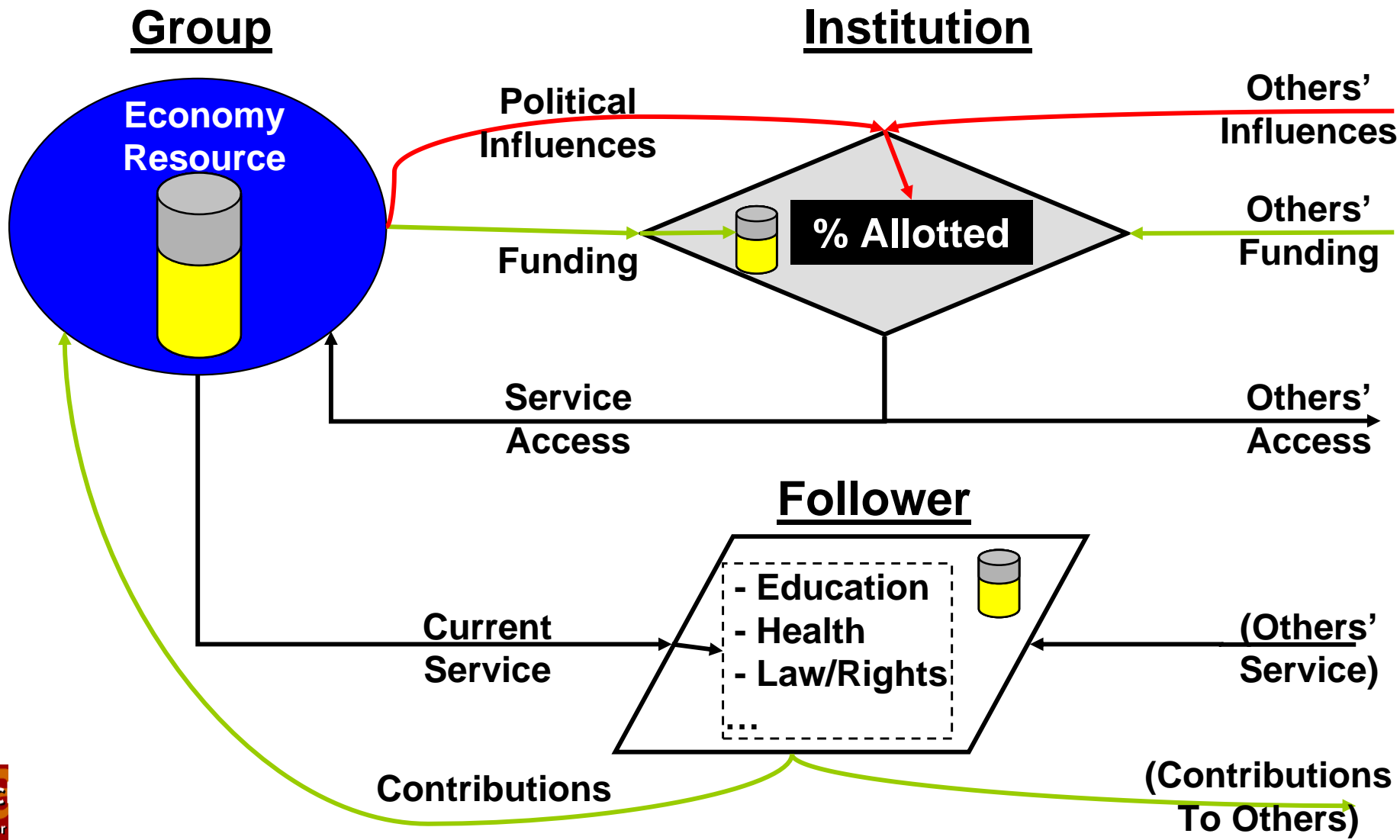
FactionSim Template for Inter/Intra-State Actor Modeling

(Potentially Conflicting Group Leaders, Followers, Ministers Are Profiled)

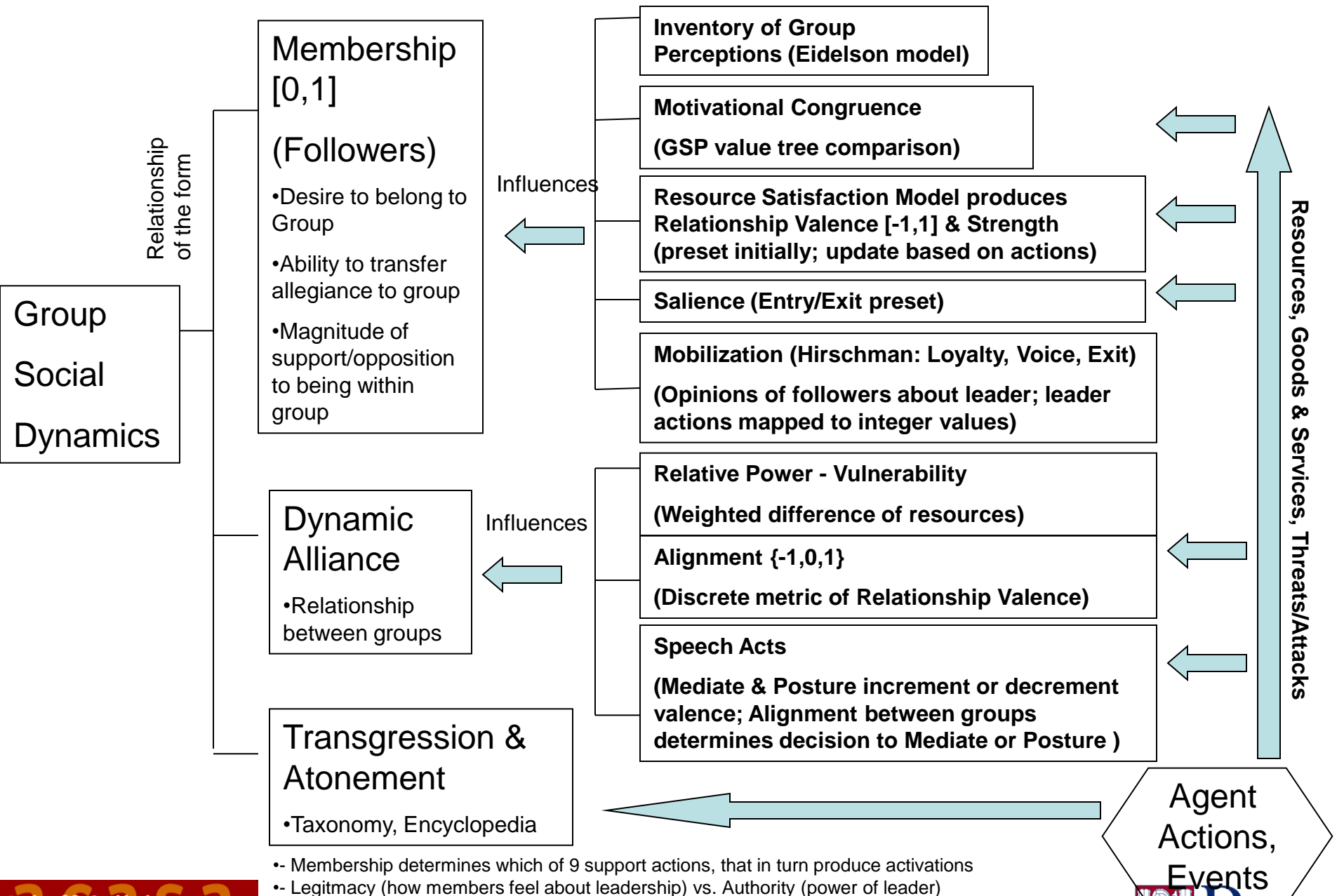


Public Institutions Provide Goods and Services

(Health/Educ, Security/Courts, Public Works, Elections)



Illustrative Inputs and Outputs for a Model of Social Science Models (CountrySim)



- Membership determines which of 9 support actions, that in turn produce activations
- Legitimacy (how members feel about leadership) vs. Authority (power of leader)

Research Frontiers in Social Science: Followers

Topic	Theories	1 st Approx. Model	Gaps/Needs
Perception of Group	Inventory of Beliefs (VID)	<ul style="list-style-type: none"> •Violate GSPs •Relative Power •Simple Corruption 	<ul style="list-style-type: none"> •Encyclopedias for all groups (crowdsourced)
Motivational Congruence	Value System Similarity	<ul style="list-style-type: none"> •GSP (group avg, leader GSPs, between groups) 	<ul style="list-style-type: none"> •Behavioral Voting •Non-Voting •Corruption
Resource Satisfaction	Cogn Appr Thry (objectification removes emotion)	<ul style="list-style-type: none"> •Modified OCC (permit objectification, but also material emotions) 	<ul style="list-style-type: none"> •Who to credit for gifts? •How much credit? •How long (decay)?
Mobilization	Hirschman (Loyalty, Voice, Exit)	<ul style="list-style-type: none"> •9 discrete levels (for/against each group) •Drawn from OCC params 	<ul style="list-style-type: none"> •Many Competing theories to try
Memetics	Shannon Info Thry Bandura Soc.Lrng	<ul style="list-style-type: none"> •Metrics built from OCC and other params 	<ul style="list-style-type: none"> •Weak theoretical base

Research Frontiers in Social Science: Leaders

Topic	Theories	1 st Approx. Model	Gaps/Needs
Leadership	Wholistic	<ul style="list-style-type: none"> •Cognition-affect/Utility •Pers.Traits/Group Norms •Social/Ego/Econ. Nets 	<ul style="list-style-type: none"> •Double Loop Learning •Smart Search of Intractible Sim Space
Internal Power	Muddlin/Reactive Coalitional Strat.Planner	<ul style="list-style-type: none"> •Leader's Own GSPs •Utility of Role to Self •Corruption/Payoffs 	<ul style="list-style-type: none"> •Multi-step reasoning •Model of Other •Corruption Nuances
External Power	Power vs. Vulnerability Dynamics	<ul style="list-style-type: none"> •Relative resource strength •Cross-Group Alignment 	<ul style="list-style-type: none"> •War of Attrition 'Game' •Bluffing Strength/Will •Actual data
Alliance Formation	<ul style="list-style-type: none"> •Enemy of my Enemy •Pacts 	<ul style="list-style-type: none"> •Drawn from OCC valence & strength •Pact violation penalties 	<ul style="list-style-type: none"> •Coalition dynamics •Perception vs. reality
Speech Acts	Attributional Theory	<ul style="list-style-type: none"> •Utility to listener filtered by group alignment & GSPs 	<ul style="list-style-type: none"> •Weak theoretical basis

Overview

- Gallery of Past Projects
- Challenge: 3 Universal Dilemmas (in Human Socio-Cultural Behavior M&S)
- Response: Systems Social Science Defined
- Software Design Patterns To Think About
- Example Model of Models Library
- Case Studies: Training & Analysis
- Conclusions, Lessons Learned, Next Steps

FactionSim Permits One to Study Many Theories of Instability (Insurgency, Rebellion, Repression, etc.)

- Ethnic Cleansing (One Faction Aims to Eliminate Another)
- Religious Extremism/Many Jihadists Modeled (Atran Absolutists)
- Isolationism, Separatism & Mobilization Movements
- Alienation/Politicized Religion (Sageman)
- Economic Deprivation Theory -- Lewis (and LRF) – 2 sectors (1979):
 - Small modern core – prohibitive to join, elitists
 - Large agrarian, tribal – poverty stricken, alienated
- Informal Economy Theory (non-declared income, crime, black market, insurgent econ, smuggling, etc.) -- Hart, then de Soto (1989)



- 3 Phases of Insurgency (Mao) -- COIN 'Doctrine',
- Overthrowing Authoritarians -- Haggard & Kaufman (Democratic Transitions)
- Preventing Terrorism – DIME/PMESII Studies, COIN, EBO

Overview

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Summary of PMF Approach

- PMF Agents – Compose leaders and followers. Open the agenda to research on parameters across many human behavior disciplines (biology/stress, perception values/personality/emotion, culture/groups, trust/reputation, decisions/gaming, social/political, economics)
- Emergent Human Behavior – Agent approach lets you rapidly mockup realworld factions and scenarios and study how action choices lead to alternative effects and ways to influence groups and individuals
- Sensitivity Studies – Find principled ways to explore the space of possible outcomes, to avoid conflict states, and to understand the elasticities of behavior parameters as interventions are attempted

Shifting HBM To Normal Science Systems Social Science

- Social Science and Computational Science are necessary, but not sufficient
- SSS is a new paradigm. –
 - shift of social science from theoretic reductionism to pragmatic synthesisism
 - descriptive (KIDS) modeling inside humanistic- and ethically-guided inquirer organizations.

For a Discipline to become a Normal Science, One Must Conduct Multiple Levels of Validitation

1. **Internal validity assessment.** For any given theory or model we try to implement, is it complete, clear, coherent, and robust? What are the situations it fails to address? What needs to be added to make it better? (5 sub-levels of validity assessment:

Scale:	Degree of Value of Literature Item for Constructing PMFs
5= VERY HIGH	PMFs provided with backup data sets
4= HIGH	Could make PMFs directly from the data in this study
3= MEDIUM	Some preliminary data for initial PMF construction, but more data needed
2= LOW	Theoretical model suggested from which an ungrounded PMF could be derived.
1= VERY LOW	No valid data in this report for PMF construction
0= NONE	Irrelevant to the PMF construction process.

2. **Ontological adequacy.** Do the combined set of theories and models implemented work well together? What are the gaps that need to be filled in? What further research and studies does this suggest?

3. **Analytical adequacy.** Can the collection of models assembled and implemented thus far satisfy various types of correspondence tests and historic recreation tests? What about SME sniff tests and Turing assessments?

4. **Mechanism assessment.** If we have gained some trust in the first three levels of testing, are the socio-cognitive agent collections able to explain the underlying mechanisms guiding situations? Can we use them going forward to explain anything? Are the possibility spaces that they enumerate worth knowing about?

5. **Cross-sample testing.** To avoid the problem of over-fitting to a single test sample, we always need to examine if the models work across samples. Here we propose to apply them to many States, Groups, People.

* -See references for a number of papers publishing each type of assessment

Future Research

- Bottom up modeling to produce macro-behaviors (economics, political processes) has not been done -- agent approach looks promising
- Complex social system phase shifts and robustness studies
 - Intelligent model controller
- Improvements to the PMF approach (help tradecraft):
 - Automated extraction and generation of agent scenarios
 - Better predict leaders' next action tendencies.
 - New types of agent planning and look-ahead.
 - Statistical techniques for practitioners to run policy experiments
 - Interpretability of output (eg, mining a warehouse of output parameter streams for patterns)
 - Automated comparison of descriptive to normative behavior
 - More validation studies

Selected Publications

- Silverman, BG, Bharathy, GK, Johns, M, Nye, B, Eidelson, R., Smith, T, “Socio-Cultural Games for Training and Analysis”, IEEE Trans. On SMC, Nov. 2007, 37: 6, pp. 1113-1130
- Silverman, BG, Bharathy, GK, Nye, B, Eidelson, “Modeling Factions for ‘Effects Based Operations’: Part I – Leader and Follower Behaviors”, J. Computational & Mathematical Organization Theory, Dec 2007, 13:4, pp. 379 – 406.
- Silverman, BG, Bharathy, GK, Nye, B, Eidelson, “Modeling Factions for ‘Effects Based Operations’: Part II – Behavioral Game Theory”, J. Computational & Mathematical Organization Theory, Jun 2008, 14:2, pp. 120-155.
- Silverman, BG, Bharathy, G, Pourdehnad, J, et al., “Individual Consumer Differences and Design Implications for Web-Based Decision Support”, (subm to J of Behavior and Info Technology).
- Silverman, BG, Normoyle, A, Chandrasekaran, D, Bharathy, G, “An Embeddable Testbed for Insurgent and Terrorist Agent Theories: InsurgiSim”, J. Intelligent Decision Technologies, IOS Press, v.2, 2008
- Silverman, BG, “Systems Social Science,” invited paper for special issue on Knowledge Management, J. Intelligent Decision Technologies, IOS Press, (accepted).
- Silverman, BG, Bharathy, G., Nye, B, “Gaming and Simulating EthnoPolitical Conflicts” in Proc. Descartes Conf on Mathematical Modeling for Counter-Terrorism (DCMMC), NYC: Springer, 2007 (under revision for J. of Cognitive Science Research).
- Silverman, BG, Bharathy, G., Nye, B, “Personality Profiling is Politically Correct” Proc. IITSEC Orlando: Dec. 2007 (Honorable Mention – Best Paper Award).
- Silverman, BG, “Human Terrain Data – What Should We Do With It”, invited paper for Winter Simulation Conf, Washington: WSC Foundation/INFORMS/ACM, Nov’07, pp. 260-265.
- Silverman, BG, Bharathy, G, Kim, GJ, “A New Kind of Political Science” 66th Annual National Conference of the Midwest Political Science Assoc: April 3-6, Chicago.
- Silverman, BG, Bharathy, G, Kim, GJ, “A Synthetic Systems Approach to Building Virtual Countries”, 66th Annual National Conf of the Midwest Political Science Assoc: April 3-6, Chicago.
- Silverman, BG, Bharathy, G, Kim, GJ, “The New Frontier of Agent-Based Modeling and Simulation of Social Systems with Country Databases, Newsfeeds, and Expert Surveys”, in AM Uhrmacher & D Wrens (ed), Agents, Simulation, and Applications, Taylor & Francis, (2008 accepted).
- Silverman, BG, Bharathy, G, Nye, B, et al., “State and Sub-State Actors: Synthesizing Theories Across the Social Sciences”, in A. Kott, G. Citrenbaum, (eds), Handbook of Estimating Impacts of Interventions, Springer Press, (2008 accepted).
- Silverman, BG, Bharathy, G., Kim, J, Nye, B, “Gaming and Simulating Adversaries in EthnoPolitical Conflicts,” in S. Argamon (ed), Computational Methods for Counterterrorism, Springer (accepted)