

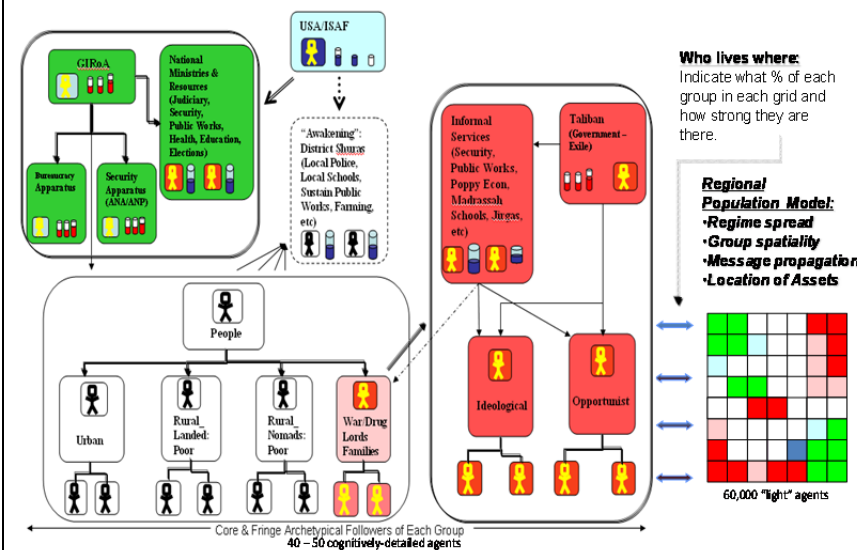
StateSim: Socio-Cognitive Agents in Meta-Networks

The UPenn capability for modeling states, sub-states and sets of states is a toolset we call StateSim. StateSim seeks to recreate a given ethno-political situation and community in an artificial society framework. Doing so permits user-analysts to explore what issues are driving a given community and what might influence it.

A StateSim model has several “moving parts”. It helps the user/analysts to profile the stakeholders and their cognitions (PMFserv), the groups and multiple networks the stakeholders move within and across (FactionSim), the formal and informal State institutions surrounding the stakeholder groups, and a suite of end-to-end lifecycle tools for managing the models and computational studies. More specifically, these include:

- a) **PMFserv** – a model of an agent’s cognitive-affective state and reasoning abilities that is applied to profile the traits, cognitions, and reasoning of individual leaders, followers, and others. It also manages the markups of the objects and artifacts they perceive and reason about. PMFserv is a model of models, a hybrid that integrates a number of scientific theories and models from the literature. It includes a plugin architecture that facilitates turning on and off different models and trying new ones. An intel agency sponsored us (2000-2005) to implement part of their leader profiling methodology inside of PMFserv.
- b) **FactionSim** – a model of the social and organizational roles that exist in an area of operation (eg, multi-state, state, sub-state, or region/village) and that may be played by the PMFserv agents. Developed under a 3 year grant from AFOSR, FactionSim supports collecting and profiling the capabilities, norms, allegiances, enmities, etc. of the formal and informal organizations and networks in the operational environment. PMFserv agents play the leaders, follower-archetypes, and institutional ministers who allocate services to followers or not (based on cultural norms, corruption, and other inefficiencies). PMFserv actually implements FactionSim as a layer or module and thus supports all of the hybrid modeling and plugin capability as it does for the rest of PMFserv.

Figure 1 – Overview of the Components of StateSim



StateSim typically profiles 10s of significant ethno-political groups and a few dozen named leader agents, follower archetypes and institutional actors. These cognitively detailed agents, factions, and institutions may be used alone or atop of another agent model that includes 10,000s of lightly detailed agents in population automata (token nets) that carry out tasks and workflows.

Figure 2: StateSim Stimulates Screens

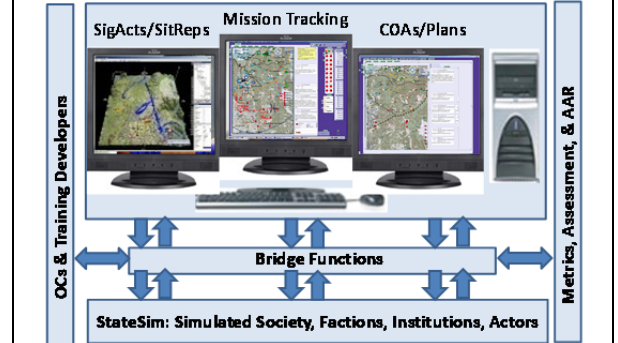
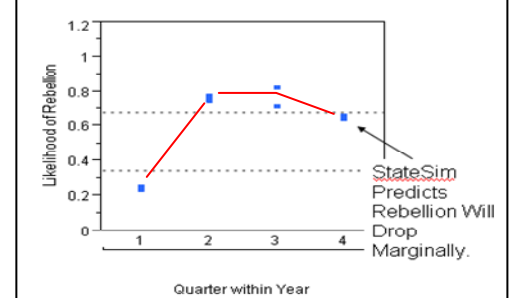
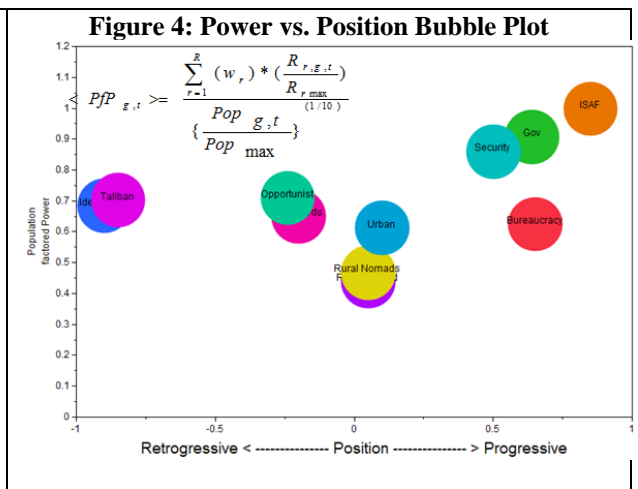
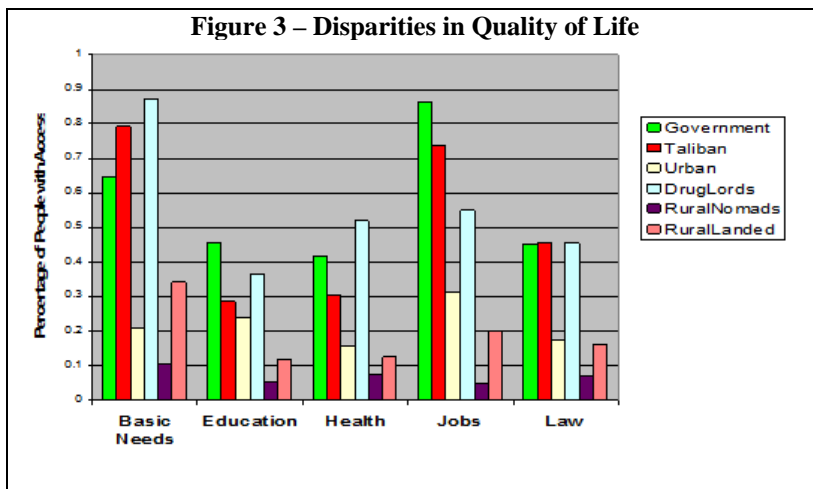


Figure 3: StateSim Projects Effects And Supports Drilldown & Traceback



c) **StateSim** – a model of a state (or cross state or sub-state) region and all the important political groups, their ethnic (and other) conflicts, economic and security conditions, political processes, domestic practices and external influences. StateSim adds plugins and models atop FactionSim including a population model, economic services models, and the actual institutional agencies that allocate public goods and services (or not) to the factions in that region of interest. StateSim was built for three DARPA programs. To date, it has been applied in Afghanistan, Iraq, Palestine, Africa, Sri Lanka, Bangladesh, Thailand, and the Koreas (as well as in UK and USA) to model (forecast) emergence of state instabilities (insurgency, rebellion, domestic political violence, repression, etc.) which are macro-behaviors that emerge from the micro-decisions of all the participants, including the diverse leaders and followers. DARPA indicates it has a record of better than 80% accuracy in over 240 backcast trials they put it through. As the screens in Fig.2 show, one can use this model to experiment on and study operations that might influence a region’s instabilities and to assess the primary, secondary, and tertiary effects (SigActs, SitReps) of different courses of action on the stakeholder groups and actors.

d) **Experiment Support and End to End Data System** – We have been working for the past 2 years to improve the end-to-end system that starts with a web-based instrument for eliciting all our parameter needs from cultural intel SMEs and from various Social Science DBs; that includes data extraction for triangulation of parameter estimates; that then populates and generates a StateSim model of a given region or community; that permits analysts to run it singly or under a Monte Carlo model Controller for design of parameter experiments; that captures model outputs into a data warehouse; that includes viewers to aggregate low level actions into high level metrics; and that permits analysts to drill back down from high level metrics to individual causes including conditions and actors that took actions as well as a dialog engine that permits one to interview the actors about their rationale. For Monte Carlo runs and statistical analysis, one uses external applications (eg, SAS, JMP, etc.) to assess the confidence intervals surrounding the forecasts. Two sample plots from the Afghan Province model are shown below.



Over the past 4 years, StateSim has been developed under DARPA and AFOSR sponsorship. In FY12 it is being adapted to drive the screens of the Battalion Command Training Center for US Army/PEO STRI. StateSim is available to embed in other simulators as well.

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