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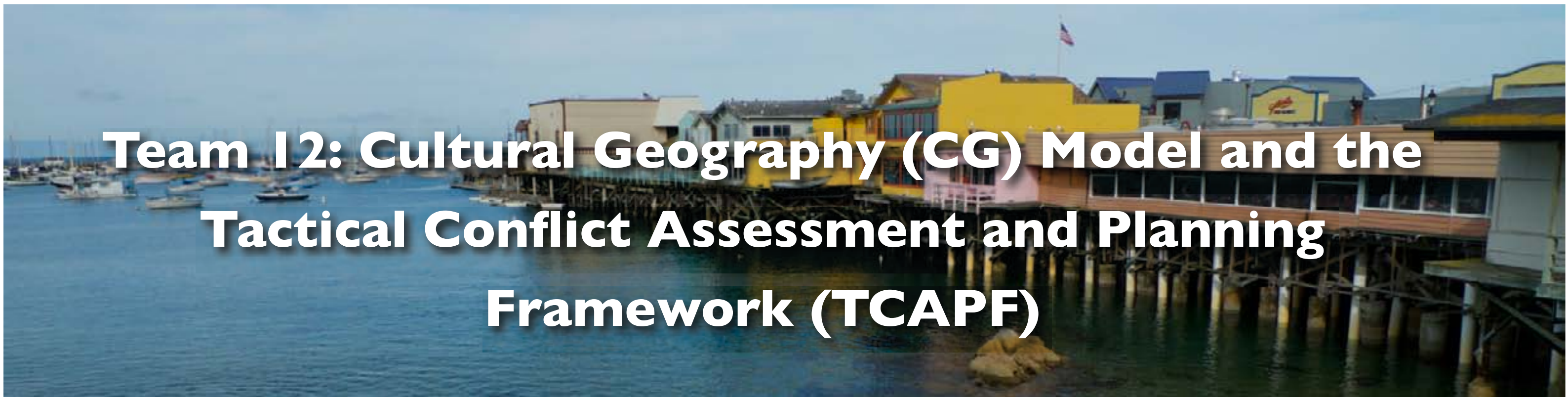

Team 12: Cultural Geography (CG) Model and the Tactical Conflict Assessment and Planning Framework (TCAPF)

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INTRODUCTION

A goal of stability operations is to influence civilian attitudes in favor of the host nation (HN) government and the stabilization forces. To help understand the dynamics of civilian attitudes, the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) developed the Cultural Geography (CG) model to simulate behavioral responses of civilian populations in a conflict eco-system[1].

The CG model is an agent-based model grounded in doctrine and social theory. The model consists of entities (people) interacting with an infrastructure sub-model, interacting with each other through a social network, and responding to specific events. Each entity is defined by a set of demographic dimensions that collectively shape the entity's beliefs, values, interests, stances on issues, and behaviors. Population behaviors are modeled in CG using the Theory of Planned Behavior (TpB) implemented in Bayesian networks[2]. The CG model outputs population stances on critical issues based on various inputs, to include reaction to events, interaction across the social network, and access to essential services.

The CG model is data driven, requiring extensive research and knowledge of the target population's narrative and critical issues. To facilitate the data development process, team 12 tested a proof-of-principle concept for utilizing Tactical Conflict Assessment and Planning Framework (TCAPF) data within the CG model.

The U.S. Agency for International Development (USAID) developed TCAPF in an effort to help civilian and military personnel collect data in unstable areas. The TCAPF questionnaire consists of four open-ended questions[3]:

- Have there been changes in the village population in the last year?
- What are the most important problems facing the village?
- Who do you believe can solve your problems?
- What should be done first to help the village?

TCAPF's straight-forward and effective approach to data collection resulted in acceptance by several U.S. Government organizations in Afghanistan, including the U.S. Army and Marine Corps.

This report describes the team's concept for implementing TCAPF data in the CG model. The team applied the concept using a Pakistan-Afghanistan (PAKAF) case study recently completed by TRAC.

TEAM 12 OBJECTIVE

The primary objective for Team 12 was to explore and implement TCAPF questionnaire data as input to the CG model.

To demonstrate the concept, the team scoped the research to data derived from the second TCAPF question: "What are the most important problems facing the village?" The team selected data from this question because the CG model architecture supports assessment of population stances on critical issues and problems. The benefit of inputting and modeling question #2 data in the CG model is that analysts (and commanders) may gain insights into factors that influence population stances on village problems through experimental designs.

PAKAF CASE STUDY

Team 12 utilized a scenario from the PAKAF Strategic Multi-layered Assessment (SMA) to demonstrate TCAPF data inputted into CG. The PAKAF scenario modeled population stances on three issues from six Helmand province districts in Afghanistan. The three issues under study were security,

[1] Kilkullen, David. Counterinsurgency in Iraq: Theory and Practice. 2007.
[2] Ajzen, Icek. "Constructing a TpB Questionnaire: Conceptual and Methodological Considerations," September, 2002 (Revised January, 2006).
[3] Crnkovich, Mirko. "Tactical Conflict Assessment and Planning Framework (TCAPF) – Stability Operations". USAID presentation dated 26 September 2009.

infrastructure, and governance. For a detailed discussion of the PAKAF scenario, see Hudak et. al, 2010[4].

To support the PAKAF data development process, subject matter experts (SMEs) identified prominent population groups, group beliefs and interests, and events impacting beliefs and interests (such as insurgent attacks or opium eradication operations).

The CG model utilizes Bayesian belief networks to capture the impact of events on beliefs and issue stances. Figure 1 depicts the Bayesian belief network for security implemented in the PAKAF case study. Each entity in the CG model 'possesses' a belief network with unique values in the conditional probability tables that underlie the belief network. Figure 1 depicts beliefs as parent nodes with sample conditional probabilities impacting the population's stance on security.

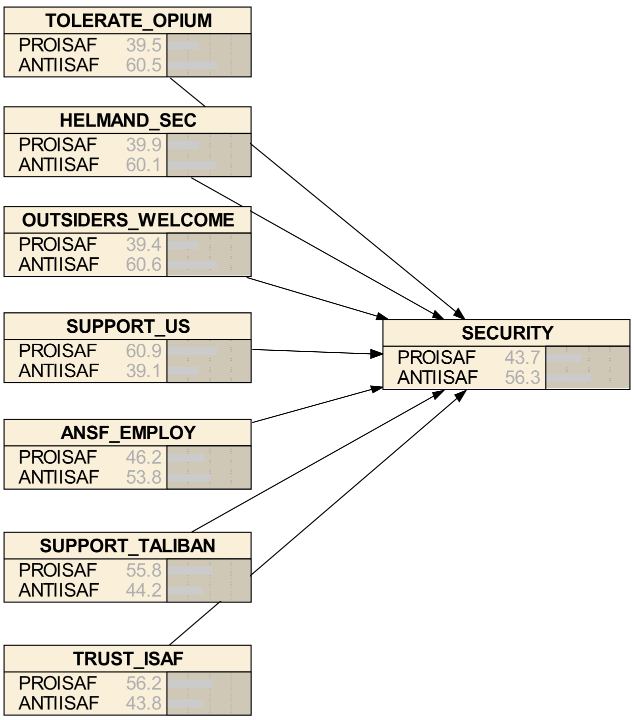

Figure 1. PAKAF Bayesian Belief Network for Security

METHODOLOGY

The team followed the methodology below to input TCAPF data into the CG model:

- Identify and select major problems/issues from TCAPF question #2 for modeling in CG.
- Append selected issues from TCAPF to Bayesian belief networks implemented for the PAKAF case study.
- Map beliefs from the Bayesian belief network to newly appended TCAPF issues/end nodes.
- Develop case files that simulate impact to beliefs (and hence issue stances) resulting from events modeled in the PAKAF case study.

Identify Major Issues from TCAPF Data

The team researched TCAPF data from Helmand province, Afghanistan dated May – September 2009. Respondents to the TCAPF questionnaire resided in multiple districts across Helmand province that generally aligned with the districts modeled in the PAKAF case study.

Results from TCAPF question #2 cited 12 major issues facing the respondents. The team selected four of the 12 problems to model in CG: potable water, irrigation water, education, and health care. Aside from security (which was modeled in the PAKAF study), the four selected issues ranked highest among the respondents.

Append Issues to Bayesian Belief Networks

The team appended the four selected TCAPF issues to Bayesian belief networks developed for the PAKAF case study. The modeling assumption was that beliefs derived from the PAKAF population were sufficiently similar to the beliefs of the TCAPF population. If the beliefs were similar for both populations, then the beliefs utilized for the PAKAF case study could reasonably impact both PAKAF issues and TCAPF issues. Figure 2 illustrates the approach of appending TCAPF issues to the PAKAF Bayesian belief network.

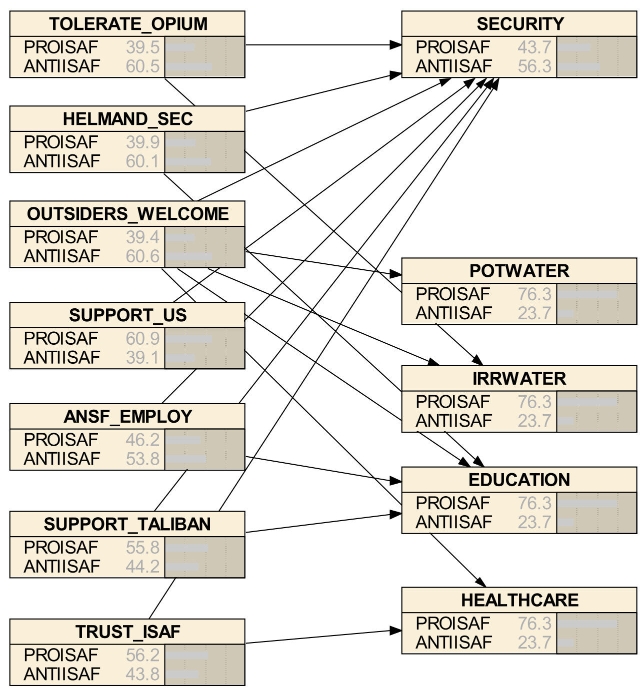

Figure 2. TCAPF Issues Appended to Belief Network

[4] LTC David Hudak, MAJ Francisco Baez, MAJ Steven Jones, Mr Timothy Perkins, Dr Deborah Duong, Mr John Willis, Mr Mark Tanner, Mr Matthew Dearing, Mr Matthew DuPee, Mr Harold Yamauchi, and Mr. Gerald Pearman. "Cultural Modeling Support to Pakistan-Afghanistan (PAKAF) Strategic Multi-layered Assessment (SMA)." Technical Report, 2010.

Map Beliefs to TCAPF Issues

The next step required the team to map beliefs from the PAKAF case study to TCAPF issues appended to the Bayesian belief network. Specifically, the team assessed each belief node to determine whether it would likely impact any of the TCAPF issues. For instance, the belief 'Tolerate Opium' from figure 2 would likely have a relational impact on the population's stance on irrigation water (depicted as 'IRRWATER' in figure 2).

Develop Case Files to Impact Beliefs

The final step in the methodology involved the process of developing case files that impact beliefs in the Bayesian belief network. In the CG model, beliefs may be impacted by events from external actors. For instance, assume the CG model simulates coalition forces conducting opium eradication operations. Following this event, the belief 'Tolerate Opium' would likely be impacted. Assuming 'Tolerate Opium' is mapped to the issue of irrigation water, opium eradication would affect the population's issue stance on irrigation water.

The process of developing case files involved SMEs completing a questionnaire tailored to the events, population groups, beliefs, and issues under study. Specifically, SMEs assessed the impact of each event on each belief from the perspective of each population group. For instance, the PAKAF case study modeled rural and urban population groups. Extending the example above, SMEs might assess that opium eradication impacts the 'Tolerate Opium' belief more for rural dwellers than urban dwellers because rural dwellers are more likely to engage in opium production than urban dwellers. The questionnaire also required SMEs to assess the impact of end node issue stances (to include the four issues from TCAPF) by event and population group.

RESULTS

The team executed an experiment in the CG model involving 14 factors (namely the events modeled in the PAKAF case study) and Bayesian belief networks and case files simulating the TCAPF issues.

The team expects to analyze output from the runs by comparing CG results to TCAPF results with respect to tribal affiliation and occupation. The PAKAF case study modeled population dimensions according to five categories, including tribal affiliation and occupation. TCAPF data also captured respondent demographics by tribal affiliation and occupation. Assuming that TCAPF data is 'ground truth' (or the baseline condition), comparing CG model output against TCAPF output for these demographic groups will provide a measure of validation for the CG model. Results of this analysis will be published in thesis research scheduled for June 2010.

CONCLUSIONS

The team developed and successfully implemented a sound methodology for augmenting a preexisting CG scenario with TCAPF data. Our team's contribution represents a starting point for integrating a popular data collection framework with the CG model.

Recommendations for further research include:

- Improving the CG model to include population migration capability. This capability may enable analysts to model and explore factors impacting TCAPF question #1 data: "Have there been changes in the village population in the last year?"
- Utilizing the CG model to generate simulated TCAPF data. The methodology described in this report facilitates generating TCAPF data from CG. Specifically, the Bayesian belief networks appended with TCAPF issues enable analysts to 'poll' CG entities following model execution to determine issues of greatest interest. This capability would be useful during training exercises and tactical wargames, such as TRAC's 'Irregular Warfare Tactical Wargame.'

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[5] Department of the Army, Headquarters. "FM 3-24, Counterinsurgency." Washington, DC: Department of the Army, Headquarters, December 2006. 1-14..