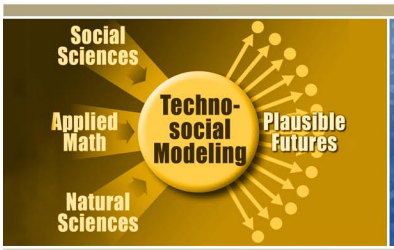

Technosocial Predictive Analytics Initiative

QUARTERLY NEWSLETTER

Spring 2008

Antonio's Notes

We have many exciting things happening inside the initiative this spring. I invite you to take a closer look at two projects that explore technosocial modeling in the domain of global climate change and security. One project focuses on the micro level, examining potential threats to cities and individual buildings that support critical social infrastructures. The other project delves into the macro level, with specific reference to country resilience.

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Leadership Team

Antonio Sanfilippo, Initiative Lead and Knowledge Inputs Area Lead

Jim Thomas, Cognitive Enhancement Area Lead

Steve Unwin, Technosocial Modeling Lead

Operational Team

Fran Stanley, Finance

Tim Strycker, Operations

Gary Morgan, Strategy Advisor

Janine Anderson, Communications

Amanda Cowell, Administrator

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

FOCUS AREAS

The Technosocial Predictive Analytics Initiative (TPAI) focuses on research that targets three application focus areas:

- Effects of Global Climate Change on Homeland Security and Defense
- Counterterrorism
- Nonproliferation

If we are to help our nation meet the challenges that emerge from potential scenarios in these areas, we must develop a new science of predictive analysis that can inform the decision-making processes of government agencies to anticipate and counter strategic surprise.

TPAI supports a multi-perspective approach to predictive analysis through integrated reasoning—drawing knowledge insights from both the natural and social sciences. More specifically, Technosocial Predictive Analytics defines, develops, and evaluates novel modeling algorithms that integrate domain knowledge about interacting physical and human factors. In so doing, Technosocial Predictive Analytics will enable its modeling algorithms with ancillary capabilities aimed at acquiring knowledge inputs and enhancing cognitive access.

PRIMARY R&D AREAS

Getting a start in October 2007, the TPAI is organized into three primary research and development areas. The **Technosocial Modeling** area will develop, implement, and evaluate new mathematical and statistical methods in predictive modeling for real-world scenarios. The **Knowledge Inputs** area will leverage content extraction and analysis for marshaling actionable evidence and use knowledge-representation methods to encapsulate and access expert knowledge and marshaled evidence. The **Cognitive Enhancement** area will exploit visual interactivity and enhanced cognition techniques within a serious gaming paradigm to empower the user in the modeling task.

- Technosocial Modeling
  - Vulnerability of Food Security and Energy Infrastructures to Climate Change and Terrorism
  - Dynamic Scenarios for Organization in Infrastructures
  - Predicting the Impact of Climate Change on U.S. Power Grids and its Wider Implications on National Security
- Knowledge Inputs
  - Knowledge Encapsulation framework: A framework for Knowledge Inputs for Technosocial Predictive Analytics
- Cognitive Enhancement
  - Development of Serious Gaming Technology for Cognitive Enhancement in Predictive Analytics.

Welcome, TPAI Advisory Committee
April 17-18, 2008

Check us out on the Web:
http://predictiveanalytics.pnl.gov

TECHNOSOCIAL PROJECTS SPOTLIGHT

Projects in the Technosocial Modeling area develop, implement, and evaluate new mathematical and statistical methods in predictive modeling for real-world scenarios. This quarter, we focus on two projects looking specifically at vulnerabilities and impacts on people and infrastructures that may emerge from global and regional climate change.

Predicting the Impact of Climate Change on U.S. Power Grids and Its Wider Implications on National Security

Project Team: Pak Chung Wong, Ruby Leung, Ning Lu, Mia Paget

This project addresses both physical and human factors involved in the interplay of energy, security and the environment to help anticipate infrastructure protection challenges which arise from the impact of climate change on power grids.

Using 11 U.S. western-region cities, with current interest in Portland, Oregon, and Phoenix, Arizona, the study focuses on climate change and how environmental variables can affect transmission load and power generation as well as their social impacts. Scenarios are generated based on climate simulation and then examined through two loops, one considering shortages or loss of electricity and the other on the impact to the population through environmental, economic, and reliability-based factors.

We live in a society that is vitally dependent on a network infrastructure of natural, man-made, and human resources to function—from food to water supplies, from electric power to other fuel sources, and from communication and transportation to medical and emergency services. While these resources are seamlessly integrated into the fabric of our society, electric power has the highest "network reachability," and all the other network resources depend on it to operate. Losing electric power inevitably impairs the ability of the other resources to perform, which could cripple society if a widespread outage persisted for prolonged periods.

Building infrastructure that would become impacted would include education (schools), health and medical (hospitals), storage and industrial (refrigerated warehouses), and utility (sewer) to name a few.

The identification of 11 critical infrastructures and national "key assets" of critical infrastructures, as defined in "The report of the President on Critical Infrastructure Protection, October 1997," defines target areas of interest in this study.

SECTOR ASSETS

- Agriculture and Food
- Water
- Public Health
- Emergency Services
- Defense Industrial Base
- Telecommunications
- Energy
- Transportation
- Banking and Finance
- Chemicals and Hazardous Materials
- Poster and Shipping

KEY ASSETS

- National Monuments and Icons (Statue of Liberty)
- Nuclear Power Plants
- Dams
- Government Facilities (Offices and Government Departments)
- Commercial Key Assets (Major Skyscrapers)

Vulnerability of Food Security and Energy Infrastructures to Climate Change and Terrorism

Project Team: Liz Malone, Larry Morgan, Cesar Izaurralde, Sonny Kim, Allison Thomson

Decision-makers and analysts focusing on national security, socioeconomic well-being, or global climate change increasingly recognize that actions in one of these domains will affect the others. This project integrates the broad domains that are crucial to the understanding of global issues involved in climate change and human security.

The initial focus area—India, Pakistan, and Bangladesh—comprises a complex regional context where climate change and terrorism have significant implications for energy and food security. In addition, the area has an energy infrastructure that is still developing—rapidly—with active debates about the sources, including nuclear power.

At least nine elements can contribute to a country's resilience when faced with climate change and threats to food or energy security, alongside potential terrorism or other conflicts.

In this region, food security is a serious issue, with a still-growing population and high population density, and food-productivity/water-resource issues exacerbated by floods, droughts, and monsoonal variations. The political security of the region shows fissures, with wealth and income inequalities contributing to class and ethnic tensions, ongoing disputes over territories and resources (including water), the presence of terrorist organizations, varying religious ideologies, and international negotiations over nuclear weapons.

Our Vulnerability Project builds on the capabilities of three models, all extensively developed and used at the Joint Global Change Research Institute: the MiniCAM, EPIC (Environmental Policy Integrated Model), and VRIM (Vulnerability-Resilience Indicators Model).

Through the TPAI, we are enlarging the domain set to include the important, but rarely modeled, elements of governance and cultural factors to define the relationships among variables and domains.

ELEMENTS

- Food
- Water
- Energy
- Governance
- Health
- Ability to acquire good and services
- Adequate environment
- Human capital
- Social capital/civil society

For additional information on these and other TPAI projects, visit our website at http://predictiveanalytics.pnl.gov

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