

# Technosocial Predictive Analytics Initiative

QUARTERLY NEWSLETTER



Winter 2008

## Antonio's Notes



Welcome to the Technosocial Predictive Analytics Initiative and our first newsletter. Each quarter, we will bring you the highlights and progress of our research. This month, we invite you to check out our new internal website. Stay tuned ... this spring, a new external site is coming that will provide additional information for your interested clients.

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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

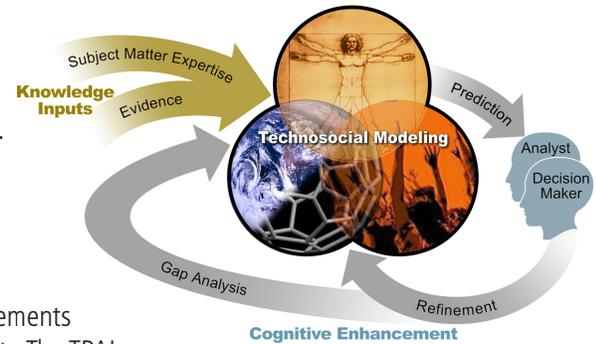
**Gary Morgan**, Strategy Advisor

**Amanda Cowell**, Administrator

## TECHNOSOCIAL MODELING TO EXPLORE PLAUSIBLE FUTURES

The Technosocial Predictive Analytics Initiative, launched by Pacific Northwest National Laboratory in October 2007, employs integrated and innovative computational models to estimate plausible futures in real-world scenarios.

Strategically, TPAI addresses specific concerns in the areas of global climate change and its effects on homeland security and defense, counterterrorism, and nuclear nonproliferation. Each area contains both human and physical elements that co-exist in a fluid and dynamic environment. The TPAI supports a multi-perspective approach to integrate reasoning—drawing data from both the natural and social sciences to better understand this environment. You can learn more about our processes by visiting the Technosocial Predictive Analytics Initiative on the Web.



TPAI is organized into three Research and Development areas:

**Technosocial Modeling** to develop, implement, and evaluate new mathematical and statistical methods in predictive modeling for real-world scenarios

**Knowledge Inputs** Research to leverage computer aided content/signal extraction and analysis for marshaling actionable evidence and knowledge-representation methods

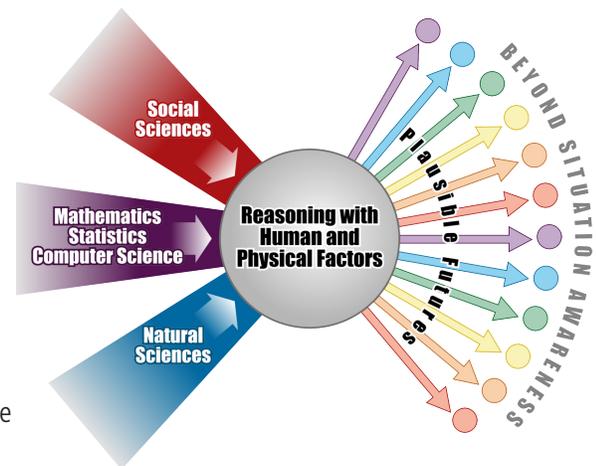
**Cognitive Enhancement Projects** that exploit visual interactivity and enhanced cognition techniques within a serious gaming paradigm to empower the user in the modeling task.

## WHAT'S IN A NAME

Technosocial Predictive Analytics, (tĕk-nō-sō-shəl) adj. 1) The ability to forecast/project potential future outcomes of societal systems, including institutions and technologies, using computer-based tools to assist in identifying, assessing, and integrating relevant disparate data in a broad knowledge domain. 2) The application of modeling methodologies from physical and behavioral sciences, merged to predict not only physically measurable phenomena, but also the human perceptions of, and reactions to, those phenomena, along with any accompanying feedback relationship.

To gain a better understanding of what Technosocial Predictive Analytics can mean to you and your clients, please contact our Initiative Lead—Antonio Sanfilippo.

PNNL internal website address: <http://tpai.pnl.gov/>



Reasoning with Human and Physical Factors

## PROJECT STATUS REPORTS

Encompassing the individual projects within this initiative, the Technosocial Predictive Analytics Team is collaborating to develop a conceptual scheme that will provide common communication and exchange protocols that will enable the integration of the individual project capabilities.

### Knowledge Encapsulation Framework: A Framework for Knowledge Inputs for Technosocial Predictive Analytics

**Project Lead:** Andrew Cowell

**Team:** Michelle Gregory, Patrick Paulson

Subject-matter-expert knowledge and relevant trusted data sources in the area of climate change and security create the foundation from which users can actively work with data-in-hand, appending annotations and opinion pieces to their existing information and finding new facts to support their research.

Through textual temporal analysis and knowledge vetting, the user can validate that their material is time-relevant, applicable to the domain, and holds sufficient credibility to be used in analysis. This approach can be translated to other domains—including nuclear nonproliferation and counterterrorism.

**1<sup>st</sup> Qtr ✓:** The development of a strategy for capturing scenario evidence on climate change and security, articulated across three activities: 1) data harvesting, 2) dataset creation, and 3) repository design.

### Development of Serious Gaming Technology for Cognitive Enhancement in Predictive Analytics

**Project Lead:** Rick Riensche

**Team:** Gary Danielson, Patrick Paulson

Going beyond traditional gaming technology and methodologies, this project will endeavor to produce novel methods and tools for participant interaction and immersion into the modeling and simulation process. Beginning with fairly general techniques, we will then build topic-specific extensions to target areas such as climate change and counter-terrorism.

Using a game-engine, reusable abstractions and interfaces will connect the logical environment and field of information used by a model with a physical environment. These techniques are relevant for both climate change and counterterrorism.

**1<sup>st</sup> Qtr ✓:** The initial definition of a gaming environment through the inclusion of a catalog of basic modeling “objects,” in addition to a preliminary literature review and evaluation of current serious gaming engines.

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

**Project Lead:** Liz Malone

**Team:** Larry Morgan, Cesar Izaurralde, Sonny Kim, Allison Thomson

Food Security and Energy Infrastructures builds upon a new modeling approach to integrate the broad domains that provide a critical understanding of global issues when examining climate change and human security. Ecological, energy/economics, agricultural and social factors are represented at appropriate spatial and temporal scales to gain a holistic understanding of the technosocial components and their respective connections to climate change and security.

**1<sup>st</sup> Qtr ✓:** A high-level draft design diagram focused on integrating governance aspects with energy, economic, and ecological aspects to help model vulnerability of food security and energy infrastructures to climate change and terrorism.

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

**Project Lead:** Pak Chung Wong

**Team:** Ruby Leung, Ning Lu, Mia Paget

Through cutting-edge modeling theories derived from climate, energy, and national security domains, this system creates viable future scenarios to address the involved physical and human factors. Developed scenarios can then suggest confidence levels to enable policy-makers to reach coherent strategies that are based on predictions for the impact that climate change can have on U.S. power grids.

**1<sup>st</sup> Qtr ✓:** An initial concept definition for scenario analysis to help predict the impact of climate change on U.S. power grids and its wider implications on national security.

### Dynamic Scenarios for Organizations in Infrastructures

**Project Lead:** Paul Whitney

**Team:** Sandy Thompson, Garill Coles, Cindy Henderson, Katherine E Wolf, Alan Brothers, Jon Young

Technical advances on this project focus are the integration of the information from two modeling approaches: “Judgmental Bootstrapping” forecasts (statistical summaries of well-structured expert elicitation) and mathematically complex dynamic Bayesian network models.

This project will deliver a mathematical modeling methodology that demonstrates technical and social linkages, unique combinations of information, and diagnostics that will enable confidence.

**1<sup>st</sup> Qtr ✓:** The establishment of scenario settings and data for nonproliferation and counterterrorism scenarios, and a draft survey of judgmental bootstrapping methods.