Detection of Nuclear Proliferation: Network Science Idea Challenge $2,000 Prize

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US Department of Energy
Defense Nuclear Nonproliferation Research & Development

Nuclear nonproliferation encompasses many networks: power-generation reactors to mining, transport, conversion, enrichment, and storage networks. Financial, industrial, communications, sensor, knowledge, and accountancy networks all tie in. So do political, social, and professional networks. Multiple networks with multiple interdependencies.

The idea challenge is to formulate a problem in nonproliferation, proliferation detection, or treaty monitoring and verification that could (possibly) be solved with a network science approach. The problem should be one that would be otherwise difficult to approach.

This is an unusual challenge. You're being asked to both formulate a question as well as propose an approach or method to find an answer. Most challenges define the question, and often provide the relevant data as well. This is more like your future professional life, if you choose a career in research: skill at imagining and then constructing questions is central.

You don't have to be a nonproliferation expert to have good ideas. For many nonproliferation-relevant activities, your common sense is a decent guide. For instance, for a clandestine underground test, there needs to be a location, a deep hole in the ground, equipment for emplacement, sensors for measurement, personnel, electrical generators, and so on.

Some candidate areas include detecting clandestine underground tests, theft or diversion of relevant materials, groups of centrifuges for enrichment, clandestine movement of nuclear materials, or discovery of unusual activity around a storage site. You're not restricted to these topics, though.

Network science is only beginning to be systematically applied to proliferation detection. Your ideas could help.

Challenge:	*Ideas for applications of network science to nuclear nonproliferation*
Submittal:	A three-to-five page white paper describing the idea
Format:	The [Heimeier Catechism](#)is a good guideline; you do not need to estimate cost.
Submit to:	James Kornell, korneljm@nv.doe.gov
Open:	01 June 2015
Close:	15 July 2015
Announcement:	15 August 2015

Scoring Judging will be based on three criteria:

- Interestingness (60 points). Your idea should be something that would be very hard to do without a network science approach. Nonlinearities, cascades across interdependent networks, use of essential network characteristics, predictive power, all of these contribute.
- Plausibility (20 points). A plausible route forward must be outlined. The Heilmeier questions will help. If you assume access to a particular category of data, you're stronger if you show the data exists. ('Exists,' not 'should exist.')
- Testability (20 points). This includes not only confirmation testing but tests for hypothesis violation. Is there a null hypothesis to test against? Is there a baseline? Could you run a sensitivity analysis against your key variables? How would you estimate false positives and false negatives?

Clarity of exposition is not an explicit scoring criteria, but if the judges can't tell what you're talking about, that will not help your score.

Qualifications for entry Undergraduates, graduate students, and post-docs are eligible. You must be affiliated with UCSB, UC Davis, or UC Berkeley, and by extension, any of the universities in the UC Berkeley-centered [Nuclear Science and Security Consortium](#). There are no restrictions on country of origin or citizenship.

- Multiple ideas from one person (or team) are fine; teaming is encouraged, particularly across departments/majors. One idea per white paper, though.
- Ideas become unrestricted property of the US Government. 'Unrestricted' means you can still do things with your ideas if you like.
- PDF of your white paper is the preferred submittal format
- One award, $2,000 to the winning individual or team.
- Judges' decision is final

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