

Examination of the Current Approaches to State-Level Nuclear Security Evaluation

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1. Introduction

With increasing threat of terrorism, yet no truly global regime formed for nuclear security, approaches to nuclear security vary widely among states.

An effective global nuclear materials security system will cover all materials, employ international standards and best practices, and reduce risks by reducing weapons-usable nuclear material stocks and the number of locations where they are found. Such a system must also encourage states to accept peer reviews by outside experts in order to demonstrate that effective security is in place [1]. It is thus critically important to create an integrative framework of state-level evaluation of nuclear security as a basis for measuring the level and progress of international effort to secure and control all nuclear materials.

There have been studies to represent state-level nuclear security with a quantitative metric. A prime example is the Nuclear Materials Security Index (NMSI) by the Nuclear Threat Initiative (NTI). Another comprehensive study is the State Level Risk Metric by Texas A&M University (TAMU).

This paper examines the current methods with respect to their strengths and weaknesses and identifies the directions for future research to improve upon the existing approaches.

2. Current Methods of State-Level Nuclear Security Evaluation

The NMSI by NTI is the first-of-its kind tool for public assessment of state-level nuclear materials security conditions. It ranks countries on the degree of nuclear security by covering various indicators that reflect a state's international status and societal conditions mainly related to the management of nuclear materials, with the goal of guiding government policies to set priorities for nuclear security risk reduction measures. This index is quite simple to use for policy applications and comprehensive in its scope of countries covered in the measurement.

Nonetheless, the NTI index fail to address several important issues for nuclear security such as proliferation risks, disarmament, the threat of

sabotage of nuclear facilities, and the assessment for low-enriched uranium or radiological materials that can be used for building a "dirty bomb" [1]. Besides, certain categories are dubious as they are more or less subjectively determined by expert panels (and furthermore, not fully open to the public).

The NTI index also relies on expert judgment for the weighting of individual indicators, which invites questions about its transparency and subjectivity. In addition, on the rankings of countries on certain indicators, external and internal views diverge, raising questions about the objectivity and the sensitivity of the NTI results.

While most results of NTI NMSI seem reasonable, some outstanding cases invite questions about weighting, sub-indicator construction and scoring methods, all of which deserve closer examination. For example, as shown in Table 1, South Korea scored very low for certain sub-indicators.

Table 1: NTI NMSI Scoring for S. Korea

	Weight	Score Range	South Korea
5.1) Political Stability	24%	0-20	9
5.1.1) Social Unrest		0-4	2
5.1.2) Orderly Transfers of Power		0-4	3
5.1.3) International Disputes/Tensions		0-4	1
5.1.4) Armed Conflict		0-4	1
5.1.5) Violent demonstrations or violent civil/labor unrest		0-4	2

This is the subcategory of 5) Risk Environment; 5.1) Political Stability. This subcategory is again composed of five sub-indicators; 5.1.1) Social unrest, 5.1.2) Orderly transfers of power, 5.1.3) International disputes/tensions, 5.1.4) Armed conflict, and 5.1.5) Violent demonstrations or violent civil/labor unrest. The definitions of these sub-indicators and the explanation of their range of scores are referred to the source of the Economist Intelligence Unit (EIU)'s Risk Briefing, which is not publicly available. For political stability South Korea ranks 88th among 151

countries, which is on par with Kenya, Mali, Rwanda, and Uganda. Even casual observation can detect this is quite odd a result; on the Freedom House Index, South Korea ranks far better in its two indicators – political rights and civil liberties – than those countries.

Another example showing pitfalls of NTI NMSI is be the category called 1) Quantities & Sites. This category is based on a statistically reasonable assumption that more material and sites raise risk. Yet it inherently biases the category against closed fuel cycles, nuclear propulsion, and accession to the fissile material cutoff treaty [4].

Some of the sub-indicator definitions tell that the larger the quantity of nuclear material held, the greater the materials management requirements and potential risk that materials could be stolen. Also the sub-indicator 1.2) Sites and Transportation is based on the logic that the greater the number of sites with nuclear materials and the frequency of transport of those materials, the greater the potential risk of security breaches. This logic of more-is-worse is fallible to the point of arguing that everyone who drinks is an alcoholic. The peculiarities of each national nuclear program should be considered and evaluated in a more sophisticated fashion [4].

The State Level Risk Metric by TAMU provides a state's risk profile by considering threat, vulnerability and consequence space of nuclear security risk so as to assist national decision-makers in optimizing resource allocation for nuclear security risk minimization. TAMU's State-level Nuclear Security Measures covers a wide range of issues to assess the risk, such as threats of sabotage, theft of spent nuclear material, radiation material leading to the production of weapon-usable devices, which were not addressed in the NTI NMSI. This risk-based methodology employs a combination of pathways analysis, game theory, multiple-attribute utility analysis, decision theory and risk analysis. It also models the adversary's strategic decision making while accounting for the capabilities, motivations, and disincentives that may influence a terrorist's choice of the target [2,3]. In short TAMU's assessment method deals with more complex issues that were not considered in the NTI method.

Unfortunately, however, TAMU's research is currently under an embargo due to the confidentiality of its data sources. Openness and transparency, which is one of the important goals of establishing a state-level nuclear security framework, will be suspended because of this kind of an issue.

While the aforementioned studies by NTI and TAMU are quite comprehensive in the scope of indicators and the coverage of nations, they are relatively underdeveloped with regard to cultural

dimensions underpinning nuclear security. Also the notion of nuclear security is somewhat narrowly applied throughout the entire framework.

3. Directions for Future Work

The current review of two frameworks of modeling state-level nuclear security by NTI and TAMU groups suggests at least two directions for further work. First, given that nuclear security is narrowly conceived in both frameworks, a better evaluation framework for state-level nuclear security will have to incorporate deeper dimensions of societal conditions that influence nuclear security such as cultural perceptions of the general public and key nuclear decision-makers. Second, in light of the inherently subjective nature of expert judgment, more work needs to be done to increase the cross-expert and intertemporal reliability of the nuclear security evaluation schemes.

4. Summary

The objective of this research was to obtain a better, broader view on state-level nuclear security by re-examining the current assessment frameworks for nuclear security. This study also aims to fill the gap of underdeveloped parts of the current assessment methods by refining the indicators for nuclear security culture with large-scale international survey data – the *World Values Survey* and the *Pew Global Attitudes Survey*. From specific survey questions as to nuclear safety and security as well as more generic attitudes towards risk, we create a variable representing national levels of nuclear security culture. Our comparison of state rankings on the risk metrics with and without the refined index for nuclear security culture reveals that the latter metric correlates far better with publicly perceived national nuclear security profiles.

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