SAND2017-11979C

A System-Theoretic Approach to Overcoming Cultural & Organizational Barriers to Nuclear Security Improvement

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DISCLAIMER

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Introduction

- In the words of others:
  - 'An organization may be ***technically competent*** while ***remaining vulnerable*** if it discounts the role of the human factor' (WINS, 2016)
  - Risk-based approaches to nuclear security 'cannot address ***cultural or organizational barriers*** to improved security' (NAS 2010)
  - 'While the IAEA has released methodologies on evaluating vulnerabilities and physical protection, it has not yet introduced guidelines on ***assessing the human factor*** in detection, delay, and response' (Khripunov 2014)
- These quotes suggests a need to better incorporate the ***interaction(s)*** between ***technical & social components*** into nuclear security analysis

Addressing Cultural & Organizational Barriers

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- Traditional approaches to nuclear security analysis:
  - Make assumptions about how the PPS will be used in operation that ignore organizational context
  - Can be challenged by geopolitical disputes, bureaucratic processes, reliance on secrecy
  - Focus on designing to the facility mission (e.g., often profitability) which commonly assumes that current security protocols are 'good enough'
- Yet, there is still the ***EXPECTATION*** for high levels of security personnel vigilance to meet PPS performance goals

Addressing Cultural & Organizational Barriers

- Recent approaches to address cultural & organizational barriers to security performance are exemplified in the IAEA's Nuclear Security Culture Model
  - Built on Schein's theoretical model of organizational culture
    - Basic assumptions→Espoused values→Artefacts
  - Offers descriptive characteristics of
    - Individual (leadership [8] & personnel [5]) behaviors to 'foster more effective nuclear security'
    - Management systems (17) that 'prioritize security'
- Seems to assume that once these characteristics are established, they will be steady over time

Addressing Cultural & Organizational Barriers

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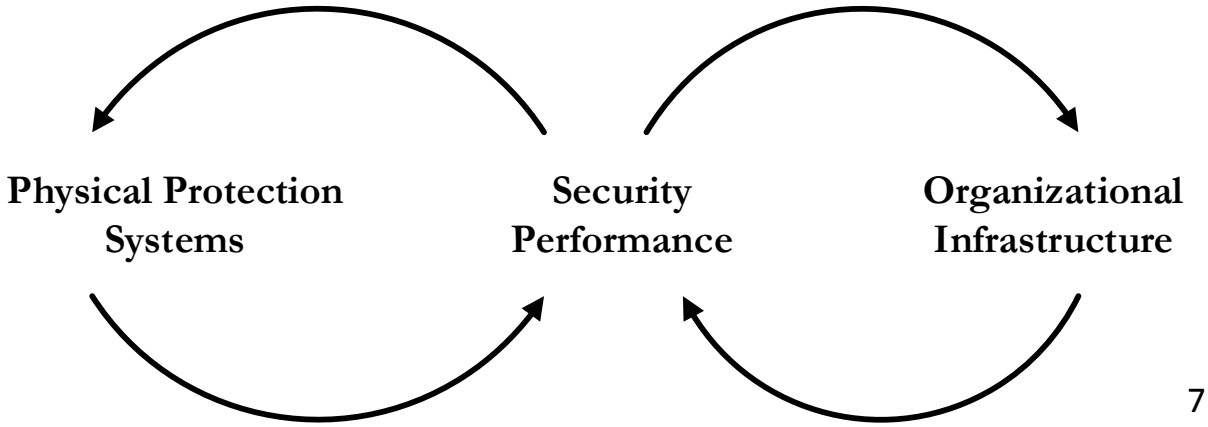
- Though a widely used & useful framework for addressing some of these barriers, this underlying assumption struggles to account for how
  - Challenges to securing nuclear materials and facilities are
    - Varied (e.g., outside, insider, cyber)
    - Ever present (e.g., rise of new terrorist or criminal groups)
    - Do not only stem from adversary action (e.g., performance can be diminished without presence of an adversary)
  - Human & organizational influences (& their interactions) impact security often acting as barriers to desired performance levels

A New Approach

- Based on evaluating how system-level interactions between ***PPS*** & ***organizational infrastructure influences***

- Incorporates tenets of systems theory & organization science
  - Human behavior is required to enact the PPS to achieve desired performance
  - The PPS is necessary to guide human behavior to achieve desired performance

- Argues that security performance ***emerges*** from interactions among ***PPS components*** & ***human behaviors*** within organizational infrastructures



A New Approach

- Therefore, security performance can be described in terms of how these interactions accomplish high-level ***detection, delay*** & ***response*** security functions
  - These functions are often captured in security performance specifications
- Yet, there are a few ***key assumptions*** underlying performance specifications
  - (1) the required task is identified & assigned
  - (2) the standard for task completion is met
  - (3) completion of the required task supports high level security functions
- Here, desired levels of security performance require ***BOTH***
  - An adequately designed PPS be able to achieve the performance specifications
  - The validation of these 3 assumptions on PPS use

A New Approach

- As such, this approach argues that to achieve desired levels of security performance
  - The PPS is necessary to guide human behaviour, ***AND***
  - Human behaviour (assumptions on PPS use) is required to enact the PPS

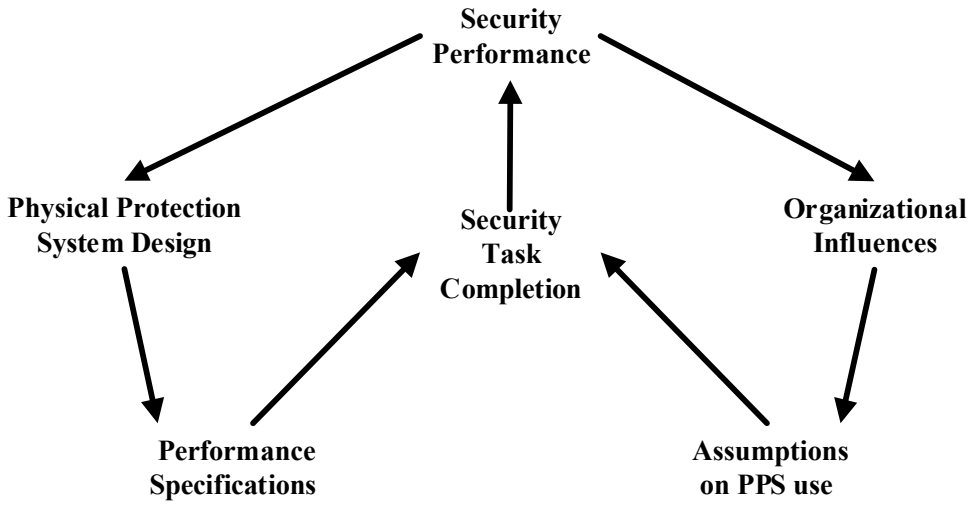
- Desired security performance, then, occurs when
  - Security task completion accomplishes security functions
  - Performance specifications align with assumptions on PPS use ***AND***
  - Organizational influences support the validity of these assumptions

- Organizational influences can ***support*** or ***oppose*** these assumptions on PPS use

A New Approach

- Assuming a fully functional PPS with clear performance specifications, a ***security task completion approach*** provides
  - An explanation for how non-technical influences can cause sub-optimal security performance
  - A mechanism for addressing the gap between the IAEA nuclear security culture model & detection, delay & response performance measures

- The analytical focus ***shifts*** from identifying individual behaviours to assessing how organizational influences impact assumptions on PPS use



Lessons from SNF Transportation

- Consider a hypothetical case of international transportation of spent nuclear fuel (SNF) from Country A to Country C
  - Country A (stable government & strong transportation infrastructure)
    - Generates the SNF
    - Hosts a port capable of loading/unloading SNF shipments via barge
  - Country B (quasi-stable government & weak transportation infrastructure)
    - Geographically located between Country A & Country C
    - Hosts a port capable of loading/unloading SNF shipments via barge
  - Country C (stable government & strong transportation infrastructure)
    - Hosts SNF disposal site
    - Does not host a port capable of loading/unloading SNF shipments via barge

- The ***security task completion approach*** provides a rigorous, objective method for evaluating (potential) incongruities in security performance
  - By related various entities
  - Along an international transportation route

Lessons from SNF Transportation

- This ***security task completion approach*** explicitly includes operational context as a causal factor in security performance
  - A potential improvement over traditional approaches that struggle to account for the expanding complexities of securing SNF during global transit

SNF Transportation Security Implementation Decision *(related security task)*	**Organizational Influences[a]**	**Impact on Assumptions on PPS Use**	**Effect on Security Performance[b]**
Not agreeing on clear security responsibility transition protocols at a land border crossing *(assess/reconcile intrusion detection sensor)*	• Unclearly communicated security expectations • Lack of feedback channels	• The required task(s) not identified & assigned • The standard for task completion cannot be met	Detection-related security tasks not completed → decreased P_D → decreased security performance

[a]Described in terms of those offered in Williams (2017)

[b]In terms of traditional security performance measures: probability of detection (P_D), delay time (t_D) & response force time (RFT)

Lessons from SNF Transportation

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- Cultural & organizational barriers can materialize into increasingly complex risks against achieving desired levels of security performance

- The ***security task completion approach*** offers one option for identifying organizational influences to help overcome these risks

- For SNF transportation, specifically, the ***security task completion approach*** better addresses the challenges of this transborder, multi-modal distributed process
  - Can help design more robust PPS
  - Can identify misalignment in organizational influences on security

Conclusions

- The ***security task completion approach*** argues that interactions between social & technological components better explains 'non-traditional' challenges to security performance
  - E.g., the security impact of an increasing number of SNF cask transfers between transportation modes (e.g., road to rail to water)

- Forthcoming research results introduce how this **security task completion approach** is incorporated into a system-theoretic analysis framework
  - Which offers potential benefits for PPS designers, security operations assessors (or managers) & security performance oversight entities

- Overall, the ***security task completion approach*** shows promise for overcoming cultural & organizational barriers to improving performance in our increasingly dynamic security environment