Transportation Security Administration (TSA)

Requirements and Capabilities Analysis (RCA)

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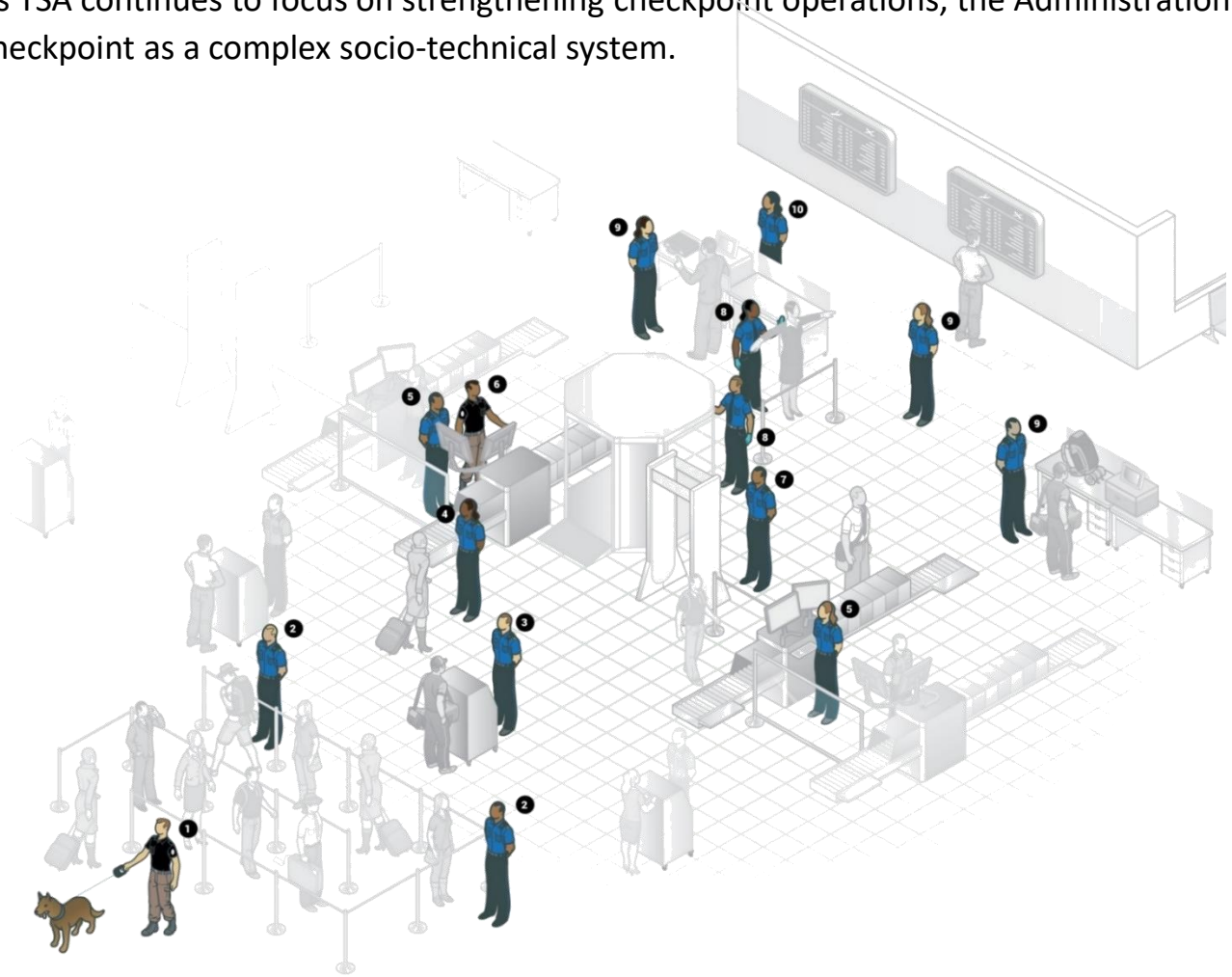
Transportation Security Administration

Human Performance and Checkpoint Operations

As TSA continues to focus on strengthening checkpoint operations, the Administration examines the checkpoint as a complex socio-technical system.



A Checkpoint Team

1. Passenger Screening Canine Team
Specially trained canines can detect explosives odors in bags or on people.

2. Behavior Detection
Actively engages passengers and observes for indicators of an imminent attack.

3. Travel Document Check
Verifies boarding passes and identification documents.

4. Divest
Prepares the passenger for the screening process.

5. X-ray
Identifies potential explosives and other prohibited items.

6. Explosives Specialist
Responds to suspicious X-ray images. Trains officers on explosives recognition.

7. Walk Through Metal Detector
Screens for hidden guns, knives, and explosives components.

8. Advanced Imaging Technology
Screens for prohibited items hidden on the body.

9. Explosives Trace Detection
Detects the minutest particles of explosives residue.

10. Supervisor
Coordinates the team and provides first-line oversight.

Checkpoint Operations as a Complex Socio-Technical System

Summary

As the operational arm of TSA, Transportation Security Officers (TSOs) represent the front line of physical security screening operations for all commercial airline passengers, baggage, and cargo. ***Characterizing the checkpoint as a complex socio-technical system allows for a macro-ergonomic approach*** that takes into consideration both the ***human*** element involved in checkpoint operations, as well as the human-machine interactions with the automated tools and technologies that facilitate screening.

Challenges

One of TSA's primary challenges is to optimize human performance of screening tasks across the Administration in order to enhance security effectiveness and efficiency. This involves ***ensuring that officers are equipped with the training, tools, processes, procedures they need*** to effectively and efficiently perform screening tasks at security checkpoints.

Focus Areas

Operator Cognitive Load

Function Allocation

Automation

Operator Cognitive Load

Description: Over the course of a shift, TSOs rotate through several screening positions, each of which has a unique set of cognitive, behavioral and physical requirements. By focusing on the cognitive demands required of TSOs for each position and for checkpoint screening as a whole, TSA can optimize officer performance to further enhance security effectiveness.

Operational Challenges

- Understanding the ***cognitive demands*** required of each officer screening position
- Designing officer tasks that mitigate performance decrement effects and enable ***sustained, optimal performance***
- Developing ***systems, tools, technology, and processes*** that align with the cognitive requirements of each position

Research and Solutions

- ***Cognitive Task Analyses*** (CTAs) provide a baseline understanding of each position's unique requirements
- ***Assessing system integration*** evaluating the tasks assigned to the human and those assigned to the system
- Evaluation of ***alternative task groupings*** that mitigate cognitive load and enhance officer performance

Function Allocation

Description: Function Allocation refers to the assignment of specific tasks to either the system or a human operator. Proper function allocation helps optimize overall system performance.

Operational Challenges

- Understanding factors affecting officer ***trust in automation***, including ***automation complacency***
- Enabling efficient and effective ***human-machine interactions*** during live checkpoint screening operations
- Ensuring ***proper function allocation*** that optimizes both checkpoint screening effectiveness and efficiency

Research and Solutions

- Research to understand baseline levels of officers' ***Trust in Automation***
- Development of ***optimal presentation of system alarms*** for officer resolution
- Evaluation of ***bounding box accuracy***, and impacts of inaccurate automation on operator performance
- ***TSO Aptitude Alignment*** (TAA) effort that will assess TSO selection criteria, and may consider aptitudes related to trust in automation, human-machine interactions, etc.

Types of Automation

Description: Two types of automation include **-adaptive automation** (where the automated system flexibly allocates tasks between human and machine) with **adaptable automation** (where the human allocates the tasks).

Operational Challenges

- Enhancing security effectiveness by transitioning from "auto-assist" to ***"auto-detect" capabilities***.
- Enhancing the accuracy and presentation of ***auto-generated system alarms*** to ensure optimal human performance of resolution tasks.
- Understanding the impacts of ***increased levels of automation*** on officer performance
- Developing ***tools and processes*** to ensure automation complements and enhances operator performance

Research and Solutions

- Development of ***automated threat detection algorithms***
- ***Evaluation of current TSA technologies and SOPs*** with respect to automation level, type, and mode to optimize human performance
- ***Opacity and Complexity Assessment Software Tool*** (OCAST) to facilitate adaptive automation based on image complexity

Mitigating Challenges

Evolving capabilities stand to benefit several areas of checkpoint screening operations, with benefits for security effectiveness, security efficiency, and overall human performance.

Opportunities to Enhance Checkpoint Operations

Automated Threat Recognition
Automated threat recognition driven by deep learning algorithms will help reduce the cognitive burden associated with performing visual search tasks.

Improved Human-Machine Interactions
Optimizing the ways in which human operators interact with automated technology and systems will ensure a more efficient and seamless security screening process.

Enhanced Trust in Automation
Automakion can enhance the reliability of systems, with benefits for officer trust in and usage of technological capabilties.

Optimized Presentation of Threats
Identifying the ideal threat presentation parameters for individual TSOs would enhance both officer trust and detection levels.

Officer Aptitude Alignment
Assessing the feasibility of workforce specialization, would allow TSA to evaluate the critical tasks performed by each role at the checkpoint and improve the cognitive burden on TSOs.