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EVALUATION OF HUMAN INTERACTION WITH AUTOMATION:

EXPLORING POTENTIAL IMPLICATION TO SECURITY OF RADIOACTIVE SOURCES

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Human tasks are continuously being replaced with automated systems.

- The human element is a crucial component of radiological security systems, but it can also become the point at which systems fail

- Technological advancements have made it possible to replace human tasks with automated systems
  - Algorithm-driven financial trading
  - Advanced Driver Assistance Systems (ADAS) such as adaptive cruise control

Benefits

- Reduces the rate of human error in day-to-day operations
- free personnel from repetitive and mundane tasks

Challenges

- How humans interact with automation introduces an additional set of challenges and associated risks.

Automated systems possess a degree of authority in terms of decision making.

Autonomy

systems, or processes within systems, having the capability and authority to make decisions and carry out actions with varying levels of human supervision or control

Human In-The-Loop (HITL)

- human operator is informed by a system and would ultimately be responsible for making the final decision

Human On-The-Loop (HOTL)

- human operator oversees actions carried out by a system with the ability to intervene

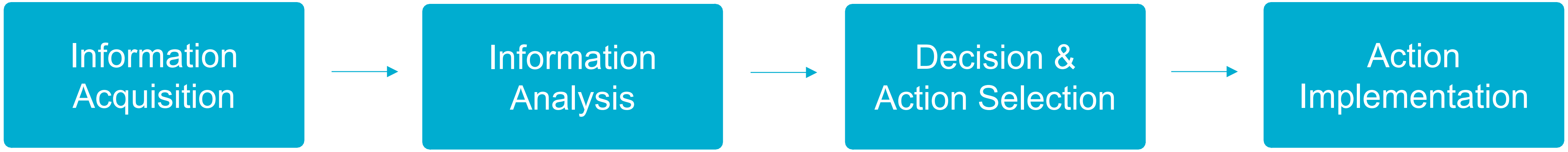
Human Out-Of-The-Loop (HOOTL)

- the system operates in a fully autonomous manner performing functions without operator ability to intervene

Information processing and decision making tasks are ideal candidates for automation.

- Radiological security tasks with the most potential for automation
  - anomaly detection,
  - central alarm station (CAS) monitoring
  - alarm adjudication

- Information processing can be split into four functions



- The complexity of automated systems and autonomous decision making depends on many factors including:
  - the task performed by the system,
  - the operator interacting with the system, and
  - consequence of failure

Human-machine interactions should be considered from a cognitive/behavioral perspective.

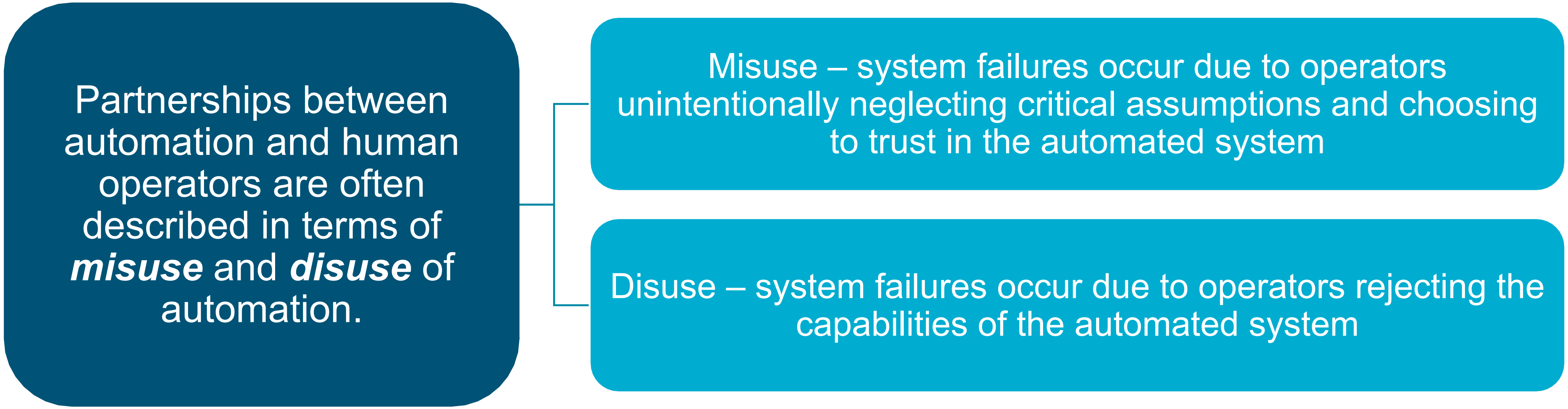
Cognitive science is the study of the mind and its processes examines the nature, tasks, and functions of cognition (e.g., thinking, reasoning, remembering)

- An important behavioral consideration when evaluating the effectiveness of automated systems is *trust in automation*

- Trust in automation is very complex, but can be understood by analogy to interpersonal trust

- Trust in automation depends on factors relevant to interpersonal trust (ex. perceived competence and understandability), in addition to technology specific factors (ex. reliability and robustness).

Trust in automation may not be easily measurable as a performance metric.



Partnerships between automation and human operators are often described in terms of ***misuse*** and ***disuse*** of automation.

Misuse – system failures occur due to operators unintentionally neglecting critical assumptions and choosing to trust in the automated system

Disuse – system failures occur due to operators rejecting the capabilities of the automated system

- Examples:
  - human operators may not be willing to put sufficient trust in the automated system if they have some preservations regarding to its robustness ultimately defeating the purpose of its implementation
  - human operators that do not adequality understand the inner workings of an automated system may choose to blindly trust its results.

Cognitive science offers opportunities to assess the impact of automation on radiological security.

Research

- Develop understanding of the optimal role of technology
- Demystify the obscurity of automated processes

Design

- Collect best practices on ways of improving human-technology collaboration
- Introduce these best practices into future security system designs

Training

- The outcomes of the research and best practices from other industries should be effectively integrated into training

This scoping study identified specific areas for further investigation.

- The utilization of technology in security is growing rapidly and additional research is needed, from the cognitive and behavioral perspective, to
  - better understand the roles of technology and humans,
  - the most effective and balanced approaches to introducing technologies, and
  - the appropriate levels of trust that should be placed in these technologies

- Unlike transportation security and cybersecurity, radiological security has received very little attention within this space
  - Existing work can be adapted to radiological security, but the differences between such security domains must be taken into consideration

- Future consideration for research within this space should aim to fill the current gaps and address topics such as
  - determining the optimal role for automation with the radiological security space, and
  - demystifying the obscurity of automated processes to an adequate level of understanding.

Questions?