SmartNodes - Towards supporting time-critical decision-making in Aviation Security

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What is Aviation Security?

ICAO Annex 17 Definition

Aviation Security: “A combination of measures and human and material resources intended to safeguard civil aviation against acts of unlawful interference”
The nature of the beast

- Aircraft complexity
- Traffic growth / number
- Evolving threats
- Devastating impact but…
- Rare events
  - Hard to identify
  - Hard to predict

http://radar.zhaw.ch
A day-to-day scenario

The preceding scenario is relatively simple and a day-to-day scenario ...

- French Aircraft
- Italian Airline
- London – Cyprus
- German pilots
- Trouble over Greek/Albanian border
Its decision time

- **Naturalistic Decision Making**
  - J. Boyd, M. Endsley, G. Klein

- **Information Centric**
  - Right info -> right person -> right time

- Who is that?
Hurdles & obstacles

1. Scale & Complexity
2. Diversity of sources
3. Diversity of users
4. Unguaranteed availability

- We need:
  - Shared awareness
  - Collaboration
  - Network of dispersed entities
Conceptual Approach

- Sense & Measure
- Create meaning

Information Fusion

- Work flows
- Socio-technical systems

Cognitive System Engineering

- Replicated Assets
- Work collaboratively

Multi-Agent Systems
ERRIDS – European Regional Renegade Information Dissemination System

- EUROCONTROL & NATO Exercise
  - renegade aircraft
  - cross borders

- Analytically created an ontology to describe situations

- Identify triggers

![Ontology Diagram]

- Flight Deck Integrity
- Crew State
- Cabin State
- Aircraft Situation
- Aircraft Health State
- Pilot State
- Co-Pilot State

Experiments
Breaking down, building up

Is the pilot in control?

Is the pilot alive?

Is the pilot stressed?

Is the auto pilot on?

Does he sound panicked?

Is he a new pilot?

Is the pilot in the cockpit?

Who else is in the cockpit?

What is his heart rate?

Is the door locked?

What is his blood pressure?

What is the cockpit temperature?

The cockpit temperature is normal

His blood pressure is normal

His heart rate is accelerated

The cabin door is open

The pilot is in his seat

There are non-flight crew on the deck

His voice is strained

He's an experienced pilot

The pilot is alive

The pilot seems stressed

The autopilot is off

The pilot is not absolutely in control

Ontology

Data

Situational Awareness

Approach
Fuzzy Assistance

Approach
SmartNodes & State Space Models

Experiments
Flight Profiles & Early warnings

- Build a system of SmartNodes
  - onboard security threat
  - flight path
- Create a profile over time
  - deviation tracker
- Early warning
  - Nudges not shoves
- Each user builds their own
  - Air marshal
  - Pilot
  - Air defense commander
EU Exercise
- 2 major European Airports
- Hijack & deviation to 2\textsuperscript{nd} Airport
- Ground negotiations

Focus of experiment
- Cabin and flight deck situation
Maximising Communications

- Decision makers & assets at disparate locations
- Differentiated comms channels
  - Transponders
  - Onboard
  - Satellite
- Prioritize to meet the objectives
  - Cognitive Systems Engineering

Conclusions
SWIM & TCDM

- Information Management Architecture
- Aircraft - mobile nodes
- Connect the sources to the destinations
- Share the wealth
  - Push/Pull
  - External Agreements
  - Reliance
  - Cross-border
- Demand surge
NextGen/SESAR - Dual Use

Conclusions
Conclusions

- **TCDM**
  - increase decision making time, decrease SA creation time

- **Situational Awareness**
  - Fuzzy logic provide the puzzle pieces
  - SmartNodes can provide the picture

- **Communication**
  - SA is useless until given to decision makers
  - Can meet some objectives now
    - More granularity of airborne emergencies

- **SWIM style approach needed for**
  - more subtle assessments
Further questions?

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