EUROCONTROL
4th Annual Safety R&D Seminar
Southampton October 2008

Emergencies & Abnormal Situations Training in Air Traffic Control

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Tom Kontogiannis Technical University of Crete
Safety Questions

- Is training for emergencies and abnormal situations sufficient?
- Does it need refocusing?

PhD Research Questions

- Can we develop a reliable Decision Making model for emergencies and abnormal situations?
- Can this model support a reliable Cognitive Analysis method for emergencies and abnormal situations?
- Can we integrate this model into a valid Team Decision Making Performance Metric with practical and research implications?

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The Project

✓ PhD Thesis → ATC Team Decision Making in Emergency Scenarios:
  ✓ PhD study sponsored by EEC
  ✓ Project Manager → Barry Kirwan
  ✓ PhD Supervisor → Tom Kontogiannis
  ✓ PhD Candidate → Stathis Malakis
  ✓ Two years duration.
  ✓ Four deliverables.
    1. Understanding performance issues in emergencies. → Delivered
    2. Decision making methodology in emergencies. → Delivered
    4. Presentation of results. → Completed
PhD Planning

Year 1

- Literature Review
  - Decision Making Models
  - Teamwork
  - Performance Assessment
  - Methods
  - Emergencies & Abnormal Situations
  - Completed

Year 2

- Field Studies
  - IANS: Ab Initio Training in Emergencies & Abnormal situations
  - MUACC: Refresher Training in Emergencies & Abnormal Situations
  - Metrics
  - Completed

Year 3

- Analysis
  - Statistical Analysis
  - Decision Making Model Validation
  - Metrics Calibration
  - Insights
  - Implications
  - Completed
<table>
<thead>
<tr>
<th>Individual Cognitive Strategies</th>
<th>Metrics of Cognitive Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recognition</strong></td>
<td>Noticing “distinguishing” and missing cues</td>
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<td></td>
<td>State projection</td>
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<tr>
<td><strong>Anticipation</strong></td>
<td>Threat acknowledgement</td>
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<tr>
<td></td>
<td>Exploiting less busy periods to perform planning</td>
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<tr>
<td><strong>Uncertainty Management</strong></td>
<td>Critiquing models of situation</td>
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<tr>
<td></td>
<td>Critiquing goals</td>
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<tr>
<td><strong>Planning</strong></td>
<td>Standard planning</td>
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<td>Contingency planning</td>
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<tr>
<td><strong>Workload Management</strong></td>
<td>Prioritizing tasks</td>
</tr>
<tr>
<td></td>
<td>Interruption and distraction management</td>
</tr>
<tr>
<td>Teamwork Cognitive Strategies</td>
<td>Metrics of Cognitive Performance</td>
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<td>-------------------------------</td>
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<tr>
<td><strong>Coordination</strong></td>
<td>Team Coordination</td>
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<td></td>
<td>Shared situation Understanding</td>
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<td>Intent Communication</td>
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<tr>
<td><strong>Information Exchange</strong></td>
<td>Voluntary/ Unsolicited Dissemination of Proactive information</td>
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<td></td>
<td>Provision of Regular Updates on situation status and management</td>
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<td></td>
<td>Ensuring an undisrupted and ungarbled information flow</td>
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<tr>
<td><strong>Error Management</strong></td>
<td>Detection of errors by other team members</td>
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<tr>
<td></td>
<td>Provision of feedback to enable error correction</td>
</tr>
<tr>
<td><strong>Workload Distribution Management</strong></td>
<td>Detection of workload distribution problems</td>
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<tr>
<td></td>
<td>Situation driven reallocation of tasks</td>
</tr>
</tbody>
</table>
The onset of an emergency

Something wrong is happening

???
ACES Model (ATCOs’ Emergency Cognitive Strategies)

- **Managing Uncertainty**
  - What is the cause of vertical deviation?
  - Residual Uncertainty has to be resolved to continue planning

- **Planning**
  - The need for standard and/or contingency planning arise
  - Threats generate uncertainty

- **Anticipation**
  - The need to consider threats arise
  - Additional cues are detected

- **Recognition**
  - Vertical Deviation
  - Flight Crew declares an emergency descent

- **Explosive Decompression**

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Controllers’ Emergency Training

1. IANS:
   i. Part of AB Initio training.
   ii. Briefing sessions.
   iii. Simulator sessions.
   iv. General guidelines on how to handle each occurrence based on ACS Common Core Licensing requirements.

2. MUACC:
   i. Refresher training in emergency procedures / unusual occurrences as part of ATCOs competency scheme.
   ii. Briefing session.
   iii. Simulator sessions.
   iv. General guidance on how to handle each occurrence based on MUACC documents.
Field Settings

1. **IANS:**
   i. AB Initio 42.
   ii. Student Controllers.
   iii. Area Control Surveillance with radar endorsements.
   iv. Unusual occurrences training.

2. **MUACC:**
   i. MUAC operational Controllers.
   ii. Highly experienced.
   iii. Area Control Surveillance with radar endorsements.
   iv. Refresher training in emergency procedures / unusual occurrences.

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# Sample Data

<table>
<thead>
<tr>
<th></th>
<th>Research Data</th>
<th>IANS</th>
<th>MUACC</th>
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<tbody>
<tr>
<td>1.</td>
<td>Unusual Occurrences Observed</td>
<td>113</td>
<td>53</td>
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<td>2.</td>
<td>Controllers</td>
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<td>3.</td>
<td>Teams</td>
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<td>4.</td>
<td>Types of Unusual Occurrences</td>
<td>17</td>
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<table>
<thead>
<tr>
<th>#</th>
<th>Method</th>
<th>Context</th>
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<tbody>
<tr>
<td>1.</td>
<td>Direct observation</td>
<td>Simulator sessions</td>
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<tr>
<td>2</td>
<td>Observations Forms</td>
<td>Paper and electronic format</td>
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<tr>
<td>3.</td>
<td>Interviews</td>
<td>Semi structured &amp; Unstructured</td>
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<td>4.</td>
<td>Incident analysis</td>
<td>MUACC incidents</td>
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<td>5.</td>
<td>Participation</td>
<td>Session briefings, TRM courses</td>
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</table>
Main Statistical Method
Exploratory Factor Analysis

✔ A statistical method for establishing construct validity
✔ A multivariate technique for the identification of the linear components of a given set of variables
✔ Based on the assumption that the existence of clusters of variables in a data set that correlate highly may suggest that those variables could measure elements of the same underlying dimension (known as factor)
## Factor Analysis Mechanism

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
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<td>Factor 2: English</td>
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</tbody>
</table>

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Problems ???

Workload Management

Recognition

Managing Uncertainty

Planning

Anticipation
The Safety Performance Envelope

holdings

rcf

emergency descend

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Safety Questions ➔ Answers

- Is training for emergencies and abnormal situations sufficient?  
  No
- Does it need refocusing?  
  Yes
PhD Research Questions → Answers

- Can we develop a reliable Decision Making model for emergencies and abnormal situations?  
  Yes
- Can this model support a reliable Cognitive Analysis method for emergencies and abnormal situations?  
  Yes
- Can we integrate this model into a valid Team Decision Making Performance Metric with practical and research implications?  
  Yes
Implications

✓ **Training.**
  ✓ The decision making model can be used as a tool for training in emergency and abnormal situations.
  ✓ A cognitive tasks analysis can be based on the Decision Making model.

✓ **Design.**
  ✓ The model can support the needs analysis phase of Ecological Interface Design (EID).

✓ **Research.**
  ✓ Provide a solid foundation for research in decision making.
  ✓ Support a computational model of decision making.
Thank you for your Attention

QUESTIONS?