Results from SESAR Exercise at Hamburg Airport:
Detection of Conflicting ATC Clearances

Karsten Straube
German Aerospace Center
Clarification

DLR (FL) Performer this task as a fully paid sub-contractor for the German Air Navigation Service Provider DFS in the context of SESAR.

Concept and prototypes were developed under the SESAR programme and co-financed by the European Community and EUROCONTROL.

The sole responsibility of this paper lies with the authors.

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Motivation
What is a „Conflicting“ ATC Clearance?

Emirates cleared for take-off runway 33

LH 123 cross runway 33
The Runway Incursion Monitoring System (RIMS)

RIMS alerts when two aircraft are on ONE runway.

Why not EARLIER? During the clearance?!

Source: graphics: BFU; http://avherald.com/h?article=443b5ca2
An additional layer of safety should detect conflicting ATC clearances much earlier.

During the controller inputs the clearances.

The new safety net should performing crosschecks with the clearances and - in most cases - the aircraft position.
Objectives
## Validation Objectives for SESAR Exercise at HAM

<table>
<thead>
<tr>
<th>Feasibility</th>
<th>Fulfillment of operational requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acceptance on the usability of the different alerts</td>
</tr>
</tbody>
</table>

| Safety                                          | All conflicting situations detected? |
|                                                | Allowing the controller to solve the detected situations timely? |
|                                                | False alert rate acceptable for the controller? |
|                                                | Some detections considered as nuisance alerts? |
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Method
What is a „Conflicting“ ATC Clearance?
Shadow mode environment at Hamburg airport

All flight data was copied and re-routed to a separate, temporary control room set up for the duration of the exercise.
Real and additional synthetic traffic
Real and additional synthetic traffic

additional synthetic traffic **only** visible for the controllers in the trial
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„Integrated“ Display of Conflicting ATC Clearances Alerts

PHOENIX
surveillance data processing system

SHOWTIME
flight data processing system including electronic flight strips

Runway Controller
### Tailor made questionnaires

<table>
<thead>
<tr>
<th>ID</th>
<th>Statements</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>Not important</th>
<th>Not affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>When two aircraft receive Line-up and Landing clearances and aircraft receiving the Line-Up clearance is in front of the aircraft when two aircraft receive Line-up and Landing clearances and aircraft receiving clearances are on the opposite ends of the same runway.</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Slightly disagree</td>
<td>Slightly agree</td>
<td>Agree</td>
<td>Strongly agree</td>
<td>Not important</td>
<td>Not affected</td>
</tr>
<tr>
<td>26</td>
<td>The Conflicting ATC Clearance</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Slightly disagree</td>
<td>Slightly agree</td>
<td>Agree</td>
<td>Strongly agree</td>
<td>Not important</td>
<td>Not affected</td>
</tr>
</tbody>
</table>

C2Sa_WP1: (If no, please give proposals how to improve.)

C2Sb_WP1: And what characteristics are relevant for an airport like HAM with crossing runways?
Data Logging

A data logging was recommended by P16.06.01 in order to measure different types of response times to alerts.
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Detection of conflicting situations

Based on observation correct type of alert was triggered in each case.

All controllers emphasized that no alerts were missing.

Multiple alerts with more than two aircraft could be displayed.

<table>
<thead>
<tr>
<th></th>
<th>LND</th>
<th>LUP</th>
<th>TOF</th>
<th>CRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LND</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUP</td>
<td>55</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOF</td>
<td>96</td>
<td>27</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>CRS</td>
<td>25</td>
<td>18</td>
<td>25</td>
<td>4</td>
</tr>
</tbody>
</table>

\[\sum = 379\]
Conflict information appreciated by controllers

Cross vs. Take-off

M = 5.2
SD = 0.7
Validation objective “feasibility”: ATCOs acceptance

<table>
<thead>
<tr>
<th></th>
<th>LND</th>
<th>LUP</th>
<th>TOF</th>
<th>CRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LND</td>
<td>4.9</td>
<td>5.3</td>
<td>5.1</td>
<td>4.7</td>
</tr>
<tr>
<td>LUP</td>
<td>5.3</td>
<td>5.3</td>
<td>4.5</td>
<td>4.7</td>
</tr>
<tr>
<td>TOF</td>
<td>5.1</td>
<td>4.5</td>
<td>4.9</td>
<td>5.2</td>
</tr>
<tr>
<td>CRS</td>
<td>4.7</td>
<td>4.7</td>
<td>5.2</td>
<td>4.8</td>
</tr>
</tbody>
</table>

$\bar{\theta} = 4.9$
Validation Objective: Safety – Timely detection of alerts

<table>
<thead>
<tr>
<th>Controller’s feedback</th>
<th>There was no doubt among the controllers that the alerts are generally displayed in time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M = 5.0, SD = 0.5</td>
</tr>
</tbody>
</table>

- 61.2% of all cases the alert occurred within the same second
- 38.0% of all cases the alert occurred within two seconds
- 0.8% of all cases the alert needed more than two seconds
Validation Objective: Safety – Acceptability of nuisance alert rate

Cross vs. Line up

Crossing D to B East vs. Line up runway 23 via B West

Crossing K to I South vs. Line up runway 33 via I North

Depends on aircraft size
Validation Objective: Safety – Acceptability of nuisance alert rate

Cross vs. Line up

Crossing D to B East vs. Line up runway 23 via B West

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Crossing D to B East vs. Line up runway 23 via B West

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 Depends on aircraft size
Validation Objective: Safety – Acceptability of nuisance alert rate

ATCOs agreed that the number of nuisance alerts was acceptable

Controllers’ feedback

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

M = 4.8
SD = 1.2
Validation Objectives for Shadow Mode Trials

<table>
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<th>Feasibility</th>
<th>Fulfillment of operational requirements mainly by controllers’ feedback on the usability of the different alerts</th>
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<td>Safety</td>
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Next Steps
Next steps

**Interaction of the new safety net and the RIMS has to be studied**
- priority of alerts has to be identified
- clarification which type of alert should be triggered at which time

System should run silently and unattended in shadow mode

Conflicting *taxi clearances* could be tested as well
MANY THANKS

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