Resilience in Air Traffic Management

Alberto Pasquini – Deep Blue

A few words about ATM - I

Assistance for the whole duration of the flight

Tower control A  ACC B  ACC C  Approach control D
A few words about ATM - II

The human role in ATM

Predominant Human Role (and responsibility), supported by well structured rules and procedures, graphic presentation tools, conflict detection tools
Separation between aircraft

Optimisation of the problem
Air Traffic Management (ATM) is a set of services provided by ground-based Air Traffic Controllers to ensure:

- separation between aircrafts, preventing them from coming too close to each other horizontally and vertically
- flow of traffic, providing information to the pilots (routes to waypoints, weather conditions, etc.)

Services based on human activity with central role of the controller, and stringent requirements concerning:

- Reliability
- Safety
- Security
- Availability
Resilience in ATM

- Limited interaction with external world (data provided by radars serving a local community of controllers)
- Human at the centre of the decision process, with limited role of automated system
- Current safety problems mainly due to human errors, air-ground communication problems and degradation of technical and human services combined with adverse atmospheric conditions
- Limited security problems (in ATM only)

Safety performances in ATM - ECAC States - Year 2002

- Number of FATAL ACCIDENTS: 92
- Number of TOTAL fatal injuries: 162
- Number of CREW fatal injuries: 94
- Number of PASSENGERS fatal injuries: 63
- Number of THIRD PARTIES fatal injuries: 3
- Number of FATAL ACCIDENTS where ATM was identified as having DIRECTLY contributed: 0
- Number of FATAL ACCIDENTS where ATM was identified as having INDIRECTLY contributed: 1
### Safety Reporting

![Graph showing severity and number of events]

### Safety reporting in ATM - ECAC States - Year 2002

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Reports</td>
<td>17692</td>
</tr>
<tr>
<td>Total Number of Reports Investigigated</td>
<td>2828</td>
</tr>
<tr>
<td>AIRPROX Report</td>
<td>706</td>
</tr>
<tr>
<td>TCAS Report</td>
<td>992</td>
</tr>
<tr>
<td>TCAS FALSE RAs</td>
<td>107</td>
</tr>
<tr>
<td>Number of FATAL ACCIDENTS where ATM was identified as having DIRECTLY contributed</td>
<td>0</td>
</tr>
<tr>
<td>Number of FATAL ACCIDENTS where ATM was identified as having INDIRECTLY contributed</td>
<td>1</td>
</tr>
</tbody>
</table>
However ...

Two accidents with ATM contribution in recent years (1 direct and 1 indirect)

Milano Linate in 2001

Uberlingen in 2002

ATM as evolving system

Maintenance

Procedures different from practices

Transitions

Evolutions of the environment (e.g. aircraft performances, traffic growth)
However, there is the problem of de-coupling accidents and traffic growth

Challenges of the future – Traffic growth

Challenges of the future – The current system
Challenges of the future – The future system

→ Increase in automation to face growing capacity demand
→ Increase in data exchange between aircraft and ground and between ground centres, due to new systems, equipments and ATM strategies
→ Growing concern for both dependability and security aspects
→ Limited awareness of problem and possible solutions between Providers of Air Traffic Services.
Eurocontrol and EU investments on:

- Safety learning in support of design of new systems
- Target setting and apportionment
- Tolerance of degraded mode operations
- Downlink to controller of TCAS information
- Improvements and further evolution of airborne and ground-based safety nets
- Managing complexity in safety assessment
- Measure and advance safety culture

Case Study

A Case Study

The Short Term Conflict Alert (STCA)
Actions following the Uberlingen accident

As a result from the investigations about the Uberlingen accident a set of initiatives started to improve the features and practice of use of the ground based safety nets and in particular of the STCA

Deep Blue was responsible of a survey about the current adoption and use of the STCA and is participating to the related actions for its improvement

STCA - Functions
Let’s see an example of conflict avoided thanks to the contribution of the STCA.
Is the STCA the silver bullet?

Is the STCA the solution?

STCA could have prevented the Uberlingen accident?

Several limiting factors:

- Controller workload and ability to follow the overall situation
- Technical limitations
- Potential interactions with the TCAS
- Implementation and usage problems

Technical limitations - I

Vertical view

New level assigned by controller

Adequate Separation

Technical limitations - II

Horizontal view

Survey on adoption, implementation and use of STCA

Survey regarding the adoption, implementation and use of STCA in the ECAC states

Survey concluded in 2004

Information from 35 states out of the 44 ECAC members (at that time)

Refined interviews with a representative subset of the respondents

Task force set up as a response to the indication of the survey
Main Results of the Survey

Good level of adoption but unsatisfactory tuning
No standardisation between the systems at the different locations
No coherent view of the STCA aims, between the different involved authorities
Little information to controllers
Reinforcement of already available information

The different views of STCA

Assist in maintaining separation - ICAO
Alert of potential hazardous situations - Eurocontrol Technical Dept.
Collision avoidance - Safety Regulation Commission (SRC) of Eurocontrol
Alert of imminence of collision - International Air Traffic Controller organisation (IFATCA)
Aim of STCA at the national level

- ICAO: 29%
- Eurocontrol: 5%
- SRC: 24%
- IFACTA: 11%
- Other: 31%

Setting of STCA parameters

<table>
<thead>
<tr>
<th>Setting</th>
<th>% Respondents</th>
<th>Nº Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined by Regulator at national level and the same for any control center</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>Defined by ANSP at national level and the same for any control center</td>
<td>50%</td>
<td>8</td>
</tr>
<tr>
<td>Defined independently by each control center</td>
<td>31.2%</td>
<td>5</td>
</tr>
<tr>
<td>Left to the default option of the manufacturer</td>
<td>6.2%</td>
<td>1</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>12.5%</td>
<td>2</td>
</tr>
<tr>
<td>Total respondents</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
### Monitoring of STCA performances

<table>
<thead>
<tr>
<th>Option</th>
<th>% Respondents</th>
<th>Nº Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, performances are monitored with a specific analysis tool</td>
<td>18,8%</td>
<td>3</td>
</tr>
<tr>
<td>Yes, performances are manually monitored</td>
<td>21,2%</td>
<td>5</td>
</tr>
<tr>
<td>Yes, the way in which performances are monitored is defined at a local level</td>
<td>12,5%</td>
<td>2</td>
</tr>
<tr>
<td>No, we do not currently have any monitoring process with respect to STCA performances</td>
<td>25%</td>
<td>4</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>12,5 %</td>
<td>2</td>
</tr>
<tr>
<td>Total respondents</td>
<td></td>
<td>16</td>
</tr>
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</table>

### Instructions for controllers

<table>
<thead>
<tr>
<th>Option</th>
<th>% Respondents</th>
<th>Nº Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, we have written Instructions compliant with ICAO DOC 4444</td>
<td>30,8%</td>
<td>4</td>
</tr>
<tr>
<td>No, our written Instructions are not compliant with ICAO DOC</td>
<td>7,7%</td>
<td>1</td>
</tr>
<tr>
<td>No, we don’t have written Instructions related to the STCA function</td>
<td>61,5%</td>
<td>8</td>
</tr>
<tr>
<td>Total respondents</td>
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<td>13</td>
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Actions suggested and areas of activity of the Safety Nets Task Force

Have a clear management policy
Identify STCA validation criteria and define validation process
Provide local instructions and information for controllers
Study how to improve the STCA algorithm (cleared flight level)
Study possible interactions between STCA and TCAS

STCA as a socio technical system

Environment
Political and social issues, management

Procedural component
Operational procedures
Training procedures
Maintenance proc.
Rules

Human Component
Operative personnel
Maintenance personnel
Engineering personnel

Equipment component
Software
Hardware
Tools

Questions