Feasibility Study of Flight Centric Mode of Operations

A Human Performance Approach

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This work is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734143 under European Union’s Horizon 2020 research and innovation programme.
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FCA concept

Conventional

Planning Controllers and Executive Controllers
Geographical sectors, Free Route Airspace
Legacy system used

Flight Centric ATC

Single-person operations (FCA PECs)
Monitoring, CD&R, teamwork
System support is imperative

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System support

TrafficSim

Dynamic, automated, complexity-based ALLOCATION

Less-impacted flight algorithm (LIFA)

CD&R tools with advisory

Filtering

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System support
System support

**Allocation**

Assigned aircraft
- blue label with white callsign

Assumed aircraft
- blue label with blue callsign

**Filtering**

Amount of information about surrounding aircraft is filtered by relevance

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System support

**Less-impacted flight algorithm (LIFA)**

- **orange** MTC indicates an acting role
- **yellow** MTC indicates an observing role
Key validation objectives

**Suitability of set-up of roles, responsibilities and tasks allocation**

**Automated allocation of aircraft to controllers within an FCA**

**Display design** for presenting FCA on the CWP

**Concept for conflict management between controllers, both internal of the FCA and to adjacent sectors**

**Coordination** between controllers both internal of the FCA and to adjacent sectors

**Impact of FCA on safety and human performance including controller workload and situational awareness measurements**
Validation design

- V2 Real-Time Simulation in January, 2019
- Budapest ACC, FL325+
- 2 days simulation, 8 runs
- 11 ATCOs ($M_{age}=36.2$, $SD_{age}=10.9$)

<table>
<thead>
<tr>
<th></th>
<th>Medium Complexity</th>
<th>High Complexity</th>
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<tbody>
<tr>
<td></td>
<td>Reference Scenario</td>
<td>Solution Scenario</td>
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<tr>
<td>Number of Sectors</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>ATCO per Sector</td>
<td>1 EC + 1 PC</td>
<td>10 Flight Centric PECs</td>
</tr>
<tr>
<td>Number of Aircraft per Sector per minute</td>
<td>10-12</td>
<td><strong>50-57</strong></td>
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HF Assessment

Questionnaires:

• Workload (Bedford Workload Scale, Assessing the impact of automation on mental workload, Instantaneous Self Assessment)

• Situational awareness (SASHA-Q)

• Simulation Specific Questionnaires (Tools and Operating method)

Debriefing sessions
Results
Tasks and operating procedures

- Conflict detection deemed OK
- Conflict resolution advisories not very realistic
- Conflicts involving more than 2 controllers need to be further addressed
- Allocation acceptable, but further improvement would be appreciated
Results
Situational awareness

• Lack of full mental picture of the AoR
  • Filtering was not efficient for evolving flights and irrelevant flights
  • Difficulty in planning ahead (e.g. before entering, vertical movements)
  • The logic behind CR suggestions was not transparent

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Results
Workload

- Low workload in medium complexity
- Acceptable workload in high complexity

Contributors:
- Coordination/Communication
- Management of new tools and HMI

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Results
HMI

Assigning altitude, heading and speed was quick and efficient...

I had quick access to essential information (…)

It was clear which ATCO should solve the conflict (…)

The aircraft under my responsibility were clearly marked (…)

The HMI gives me the information needed to provide separation between aircraft...

The HMI gives me the information needed to solve the conflicts...

Warnings (MTCD, STCA) were correctly activated and terminated (…)

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Conclusions

• Changes in task allocation: conflict detection and resolution
  • LIFA: unambiguity as to who should act
• Situational awareness became fragmented
• Workload contributors identified
• HMI strengths and weaknesses analysed

Situational awareness must increase!

Transparent, explainable AI
IMPROVEMENTS FOR WAVE 2
Dynamic filtering (including Probe)
Advanced CR advisories and improved HMI
More realistic operational scenarios (e.g. adverse weather, TRA avoidance, FIR exiting conflicts)
Iterative validation (small and large-scale RTS)

Improved situational awareness and trust
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