Introduction of a More Automated Environment in En-Route ATC

Evaluation of impact generated on the operator by mental workload assessment
SESAR PROJET AND THE STUDY PRESENTED

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**Conclusion**
Final objective:

- Development of an operational concept in the 4DTRAD environment
- Environment including CPDLC for 4D clearances
- To resume: Introduction of a partial automation of the ATC task
  - Resolution of a part of conflicts by automation

Concept of SESAR W.P. 4.7.2:

- Including two complementary services in ATC working situation:
  - The TC-SA service: De-conflicting service
  - The CD aid service: Conflict identification
- Make easier the detection and resolution of conflicts for controllers

How to assess the impact of this modification on controllers?
INTRODUCTION

Pre-requisites:

1. Define the way to integrate these “solutions” to the ATC working environment:
   - Integrate conflict aid services to the working situation
   - Define the HMI (Human Machine Interface) that could be used

2. Determine which parameters make possible the evaluation of the impact generated on the controllers:
   - The level of Mental Workload
CONTENTS OF THE TALK

Presentation of the experiment carried out and first results deducted:

Air Traffic Control situation built: working position and air traffic samples used

Experiment conditions evaluated

Participants

Experiment principle

Data recorded and analyzed

First results achieved

Objective: Assess mental workload felt by ATCo when working with conflict aid services
Including conflict aid services in the working position:

- **Dedicated study**
- **Solutions chosen:**
  1. TC-SA: Conflicts automatically resolved => A green clock on the label of aircraft constrained by speed adjustment
  2. CD aid: Residual conflicts detected appear in a timetable
AIR TRAFFIC CONTROL SITUATION
BUILT FOR THE EXPERIMENT

Air Traffic sector

- Reflecting a futuristic air traffic control situation
- Use of a generic sector
- Futuristic rules and procedures applied (business trajectories)
EXPERIMENTATION CONDITIONS EVALUATED

4 experiment conditions:

- Assess the impact of each service aid, independently and coupled
- Conditions and air traffic samples order crossed between participants
- Played with “equivalent” air traffic samples
PARTICIPANTS OF THE EXPERIMENT

12 European and qualified Air Traffic Controllers:

- 8 French ATCo coming from different French control centers
- 2 ATCo from MUAC, Maastricht
- 2 ATCo from Skyguide, Switzerland

All participants previously had a significant training (2 weeks) on HMI used, air traffic sector and ATC simulations.
EXPERIMENT PRINCIPLE

For each experiment conditions

Manage a two-hours air traffic sample:

- Binomial of Air Traffic Controllers: TC & PC
- After one hour, role switching: TC ⇔ PC
DATA RECORDED AND ANALYSIS CARRIED OUT

Three kinds of parameters have been recorded to assess mental workload felt by participants

- Performance assessment: Radio frequency data
  - Number of clearances and radio occupancy

- Subjective assessment: ISA assessment scale and AIM questionnaire
  - Evaluation of mental workload felt (from 1 to 4), each 5 minutes periods
  - Questionnaire to assess the impact of automation on mental workload

- Objective assessment: Eye-tracker data
  - Number and duration of eye fixations
  - Pupil diameter data
FIRST RESULTS ACHIEVED

Three consistent mental workload evaluations:

- The average number of eye fixations on conflict aircraft according to experimental condition
- The average duration of eye fixations on conflict aircraft according to experimental condition
- The average maximum value of pupil diameter during eye fixations according to experimental condition
- The score of AIM questionnaire defined for each experimental condition
- The average value of ISA scale for each experimental condition
CONCLUSION

Mental workload felt by Air traffic Controllers is lower with the use of conflict aid services:

- Especially for the TC-SA and TC-SA + CD aid services
- Consistent results have been obtained with several approaches

Perspective of this project:
- Proposing a new version of the CD aid service
Thank you for your attention!

Your questions?
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