The Effect of Increasing Levels of Automation in Demand-Capacity Balancing processes on Human Actors and their Roles and Responsibilities

A Gaming Assessment
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Assessment of degree of automation on human roles

Consortium

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Assessment of degree of automation on human roles

Objective

The assessment’s approach

Gaming Technique

Gaming Sessions

Results

Conclusions and Research Lines
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Conclusions and Research Lines
General Objective

Assessment of the behaviour of ATM human roles in a highly automated environment

- Impact of automation on the new roles and responsibilities
- Impact of automation on the interaction between human actors
- Tools that support the ATM actors’ duties
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Approach

Roles & Responsibilities 2020

Roles & Responsibilities 2035, 2050

Gaming

Paper-based

Scenario

Platform-based

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Conclusions and Research Lines
What is Gaming?

- More than pure entertainment
- Low-cost human in the loop activity
- Simulate decision making processes
- Experts are ‘around a table’ playing different roles as they were living real processes
Paper-Based & Platform-Based Gaming

**Paper-Based**
- Relatively easy and low-cost (use of basic office material)
- First assessment
- Support the platform-based games

**Platform-Based**
- Use of a platform (more realistic context)
- Close link with different levels of automation
- Complete assessment
Gaming session activities

Paper-Based

Preparation → Play → Analysis

Platform-Based

Preparation → Play → Analysis

TIME
Platform-based Gaming

CHILL

- Collaborative Human-In-The-Loop Laboratory
- Used in Airspace Organization and Management Gaming (DCB)
- Different categories of actors work together
- Suite of interoperable modelling services and components
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Paper-Based and Platform-Based Gaming Objectives

Paper-Based
- Suitability of the assumed LoA
- Pre-selection of solutions to be assessed
- Preliminary analysis of the impact of automation on human roles

Platform-Based
- Complete assessment of the impact of automation on human roles
- Impact on teamwork
- Needs of possible future support tools
Metrics

Impact of Automation on Human Roles

Acceptance
Confidence
Situation Awareness
Workload
Trust
Collection and analysis methods

Qualitative Results (mainly):

- Over the shoulder observations
- Questionnaires
- Debriefings
- System Data Collection (only platform-based)
Scenario – Demand and Capacity Imbalance

1. Refine/Build Reference Traffic Demand
2. Detect Airspace Demand and Capacity Imbalance
3. Select/Refine a demand and capacity imbalance
4. Assess the impact of the solution at network level

Negative impact

Start UDPP process on SBTs

Local Traffic Manager
Network Manager
Airport CDM/ASM
Airspace User
Games performance - Runs

- Runs in 2020 time frame (Baseline)
- Runs in 2035 time frame
- Runs in 2050 time frame
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Paper-based Gaming Results

Suitability of Levels of Automation
- 2050: Suitable
- 2020 and 2035: Decreases with higher levels of automation

Interaction between roles
- Decreases with higher levels of automation

Substitution of human tasks
- Positively assessed
- Human performance improves with increasing LoA
Paper-based Gaming Results

**Level of frustration**
- 2050, 2020

**Situational Awareness**
- Two of them considered high level of SA with higher LoA
- One of them with low SA with the 2050 scenario

**Other results**
- Flexibility, better managed by the humans
### Platform-based Gaming Results

#### LoA and Trust
- LoA proposed were accepted
- Level of trust is maintained

#### Situational Awareness
- Sufficient with the traffic density and the LoA shown
- Some proposals to improve it

#### Teamwork
- System more helpful when increasing LoA
- The interactions decreases but not missed
Platform-based Gaming Results

Workload

- acceptable

LTM $\rightarrow$ NM

Needs for additional tools

- Chat was appropriate
- Tool to visualize different solution scenarios
About Gaming Technique

- Pre Gaming
- Post Paper Gaming
- Post Platform Gaming

Suitability of Gaming
Confidence in results
Objective

The assessment’s approach

Gaming Technique

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Conclusions and Research Lines
Conclusions

About the impact of automation in roles

- Broadly fully automated environment is well-accepted:
  - Level of trust, acceptance
  - Workload, performance
  - Teamwork decreased
- NM could assume some activities of LTM role
- Flexibility, mainly a human aspect
Conclusions

About the gaming technique

- Gaming sessions met the expectations of the actors
- Combination of the technique was positively assessed
- Include the same actors in both sessions improved their adaptation to the platform environment
Recommendations

About the impact of automation in roles

- Possibility to review and check the final solution
- Assess the workload of the NM in case of assuming LTM activities
- New tools to support:
  - Visualization of multiple scenario data
Research lines

About the impact of automation in roles

- Assess operational procedures in execution phase
- Assess UDPP process
- Assess the impact of increasing LoA when system fails.
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