



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

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## *A Gaming Assessment*

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## Consortium



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# Outline

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**Objective**

**The assessment's approach**

**Gaming Technique**

**Gaming Sessions**

**Results**

**Conclusions and Research Lines**





## Objective

The assessment's approach

Gaming Technique

Gaming Sessions

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# General Objective

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

Airspace  
Organization  
and  
Management

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



Scenario

Role Name (Ex: AOC)

| General Responsibilities                                                                                               |  |
|------------------------------------------------------------------------------------------------------------------------|--|
| You are in charge of the maintenance of trajectories and they give that consent before any demand adjustment.          |  |
| You will adapt their intentions and trajectories according to their strategies and possible imbalances in the network. |  |

| Personal Game Mission                                                                                                                                                                                     |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Your mission is to provide your preferred trajectories according to the different roles orientations to the Sub-Regional Manager. Your trajectories preference are discussed on the role of your company. |  |

| Personal Game Goal 1                                                                                                                                                               |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Your priorities are: the quality service to passenger is your first priority, but the cost of your operation (jet fuel, flight time and extra fuel consumption) is also important. |  |
| Every time that you are requested to provide your new trajectories you can use a what-if tool that will give you some information which help you to take decisions.                |  |

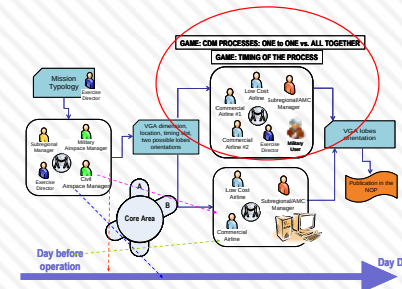
| Available Tools                     | Main Interactions with |
|-------------------------------------|------------------------|
| Trajectories predictor/What-if tool | Sub-Regional Manager   |
| SWIM                                | AOCs                   |
|                                     |                        |

Paper-based

Gaming



Platform-based





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## 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

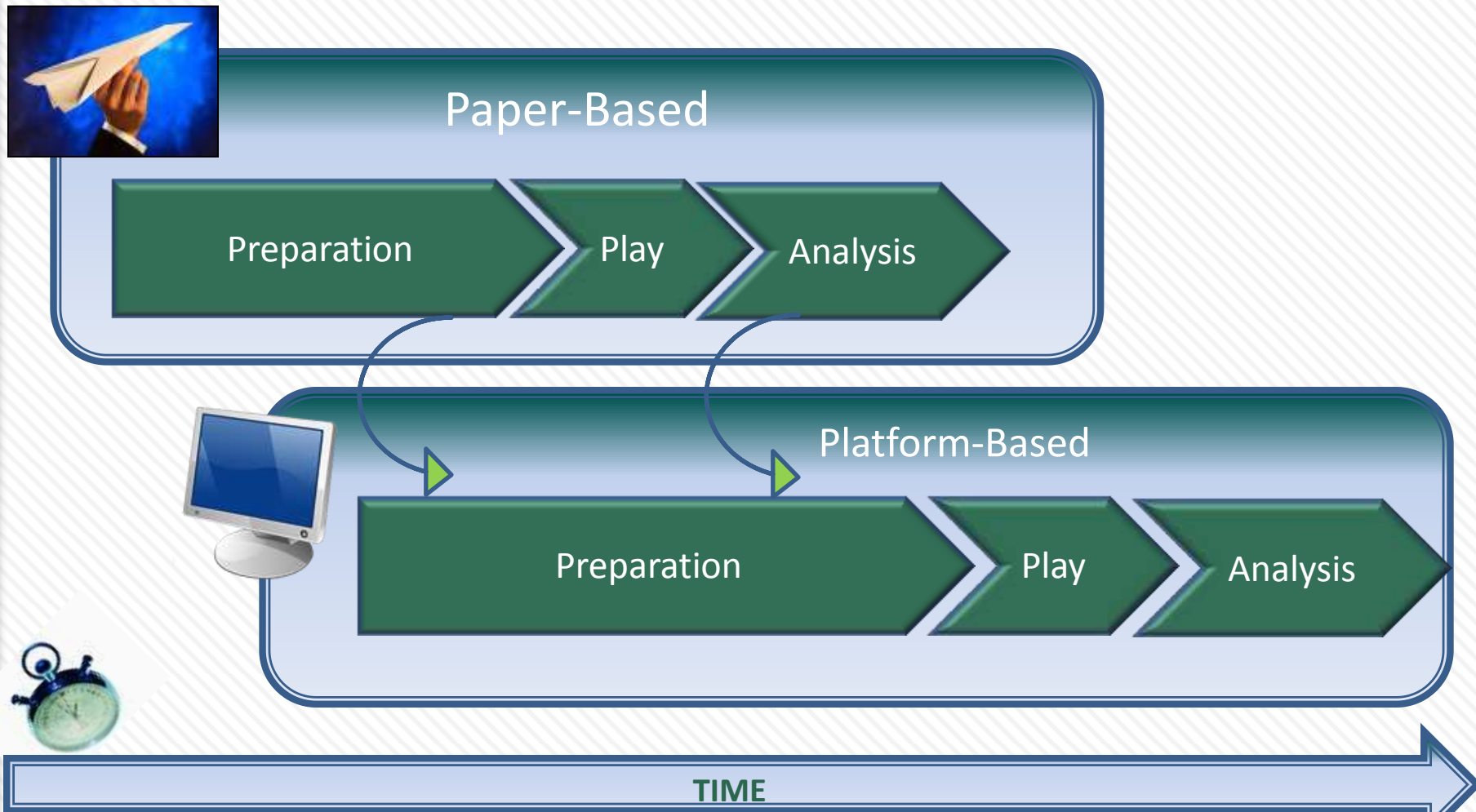
- Relatively easy and low-cost (use of basic office material)
- First assessment
- Support the platform-based games

### Platform-Based

- Use of a platform (more realistic context)
- Close link with different levels of automation
- Complete assessment



## Gaming session activities





## 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

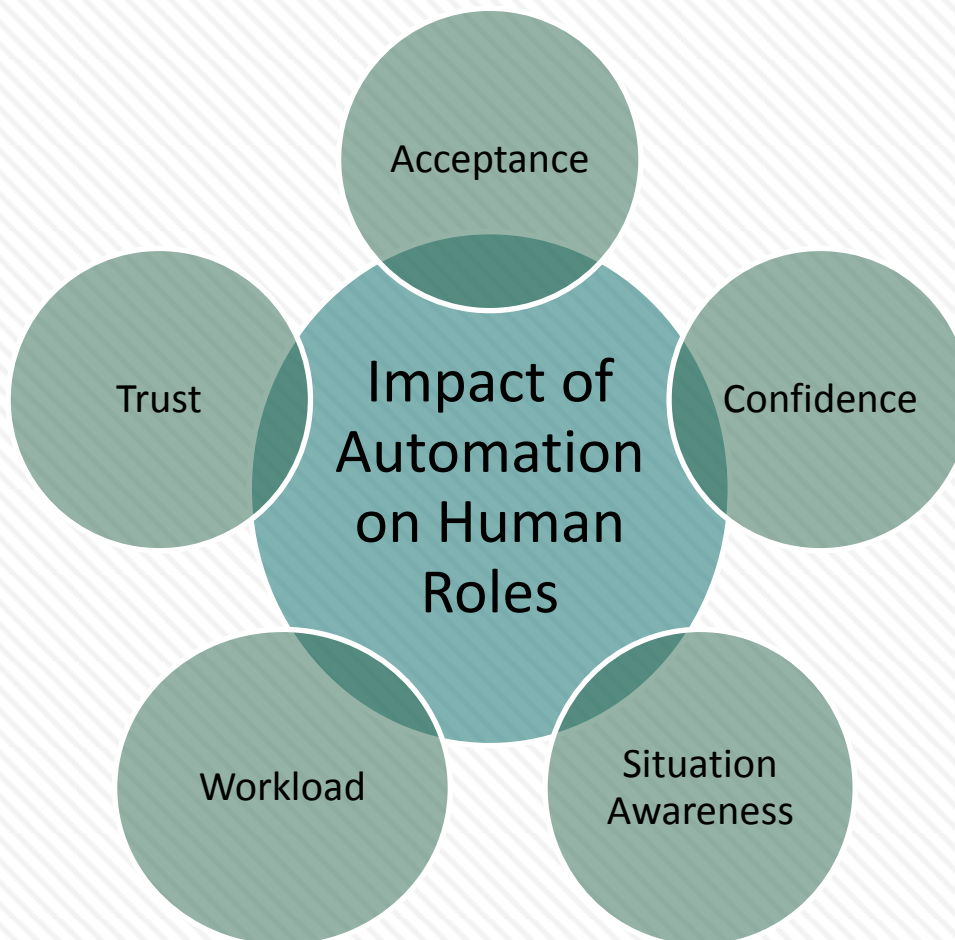
## Platform-Based

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



# Metrics

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## Collection and analysis methods

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### Qualitative Results (mainly):

- Over the shoulder observations
- Questionnaires
- Debriefings
- System Data Collection (only platform-based)



## Scenario – Demand and Capacity Imbalance

Refine/Build Reference Traffic Demand



Detect Airspace Demand and Capacity Imbalance

Select/Refine a demand and capacity imbalance

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

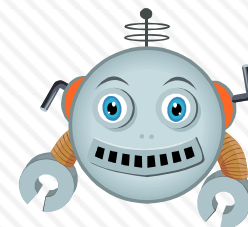
Runs in 2020 time frame  
(Baseline)



Runs in 2035 time frame



Runs in 2050 time frame





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## Paper-based Gaming Results

### Suitability of Levels of Automation

- 2050



2020 and 2035



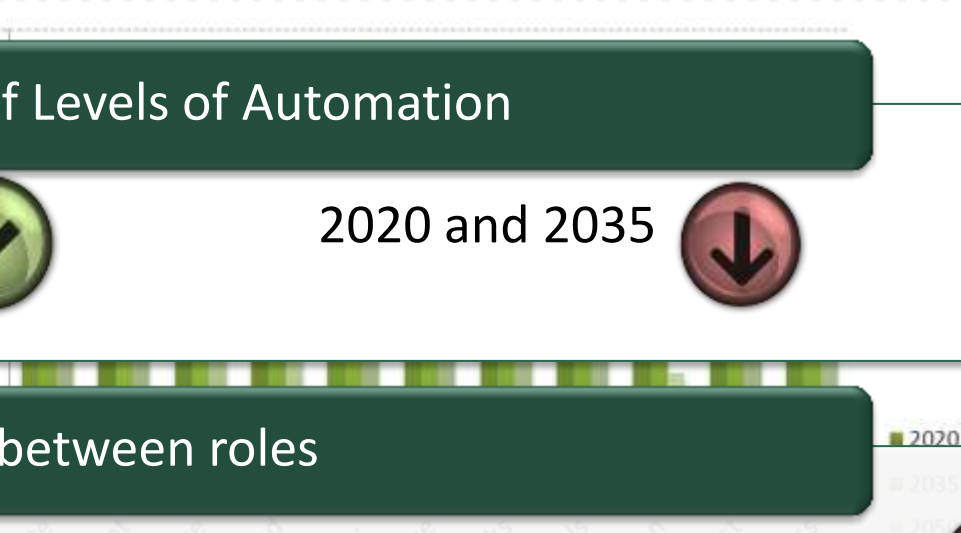
### Interaction between roles

- 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



2035



## 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 → NM

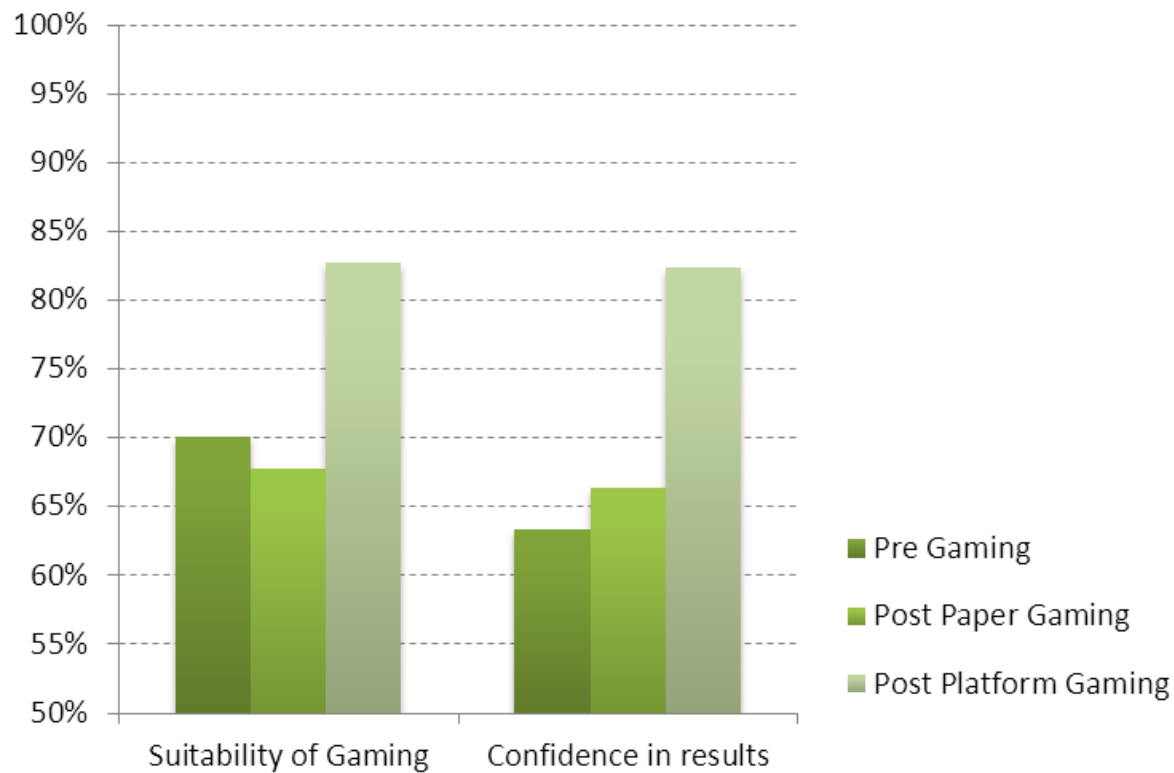


### Needs for additional tools

- Chat was appropriate
- Tool to visualize different solution scenarios



## About Gaming Technique





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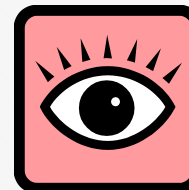


# Conclusions

## 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

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### 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.



## More info

[www.adahr.eu](http://www.adahr.eu)



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More in next Gaming Sessions – Airport Environment



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