



Research by HungaroControl and PildoLabs

Outcomes & Outlook



GreAT Final Meeting, 24.05.2023, Amsterdam

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Project manager



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Content

- ✈ Validation exercises in the simulator
- ✈ Validation exercise in the OPS room
- ✈ Other R&D projects of HungaroControl

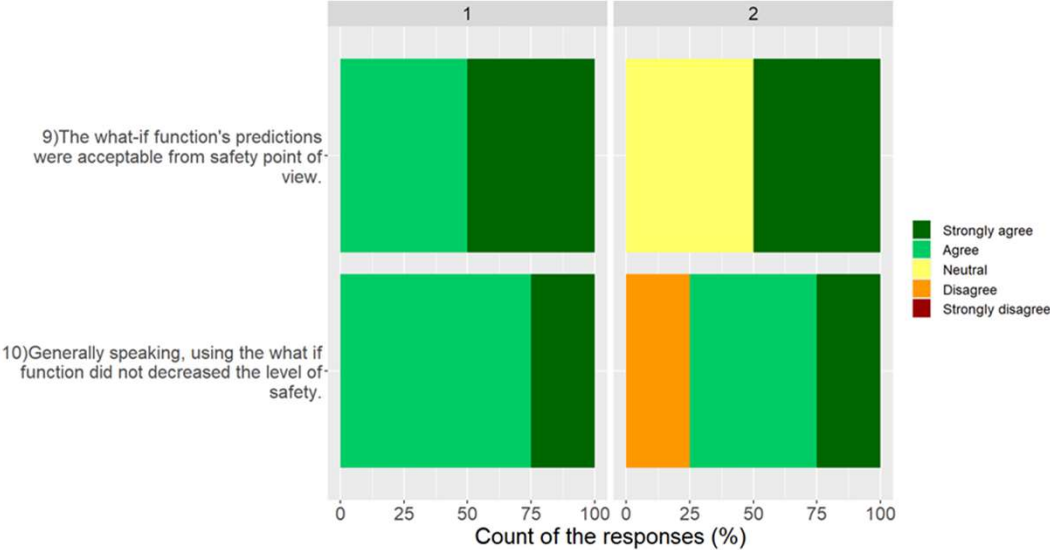


What-if validation in MATIAS – BEST simulator

- Two simulation sessions
- 20-21 September 2022
 - 4 scenarios in 2 circuits
 - Base/Ref (1.0) vs Sol (3.0)
 - 4 ATCOs
- 7-8 November 2022
 - 8 scenarios in 2 circuits
 - Sol (3.0) only
 - 8 ATCOs
 - The traffic load (medium vs. high) was only manipulated in the second iteration.
 - Scenarios with runway change were considered medium density traffic, whereas the simple runway direction scenarios were more difficult.



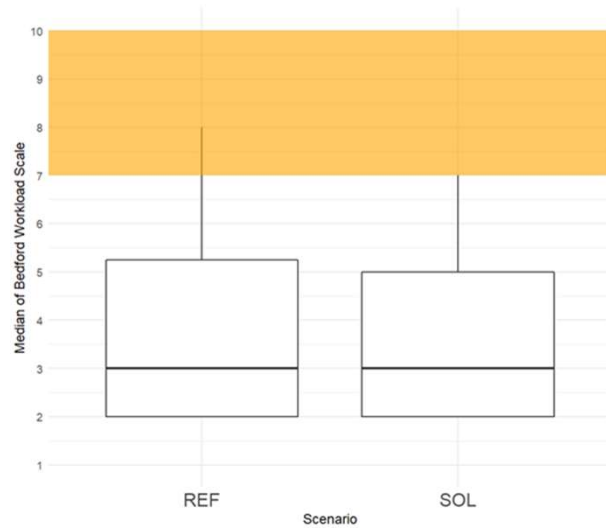
Results - SAFETY PERFORMANCE



Safety related question results from the post-simulation questionnaire

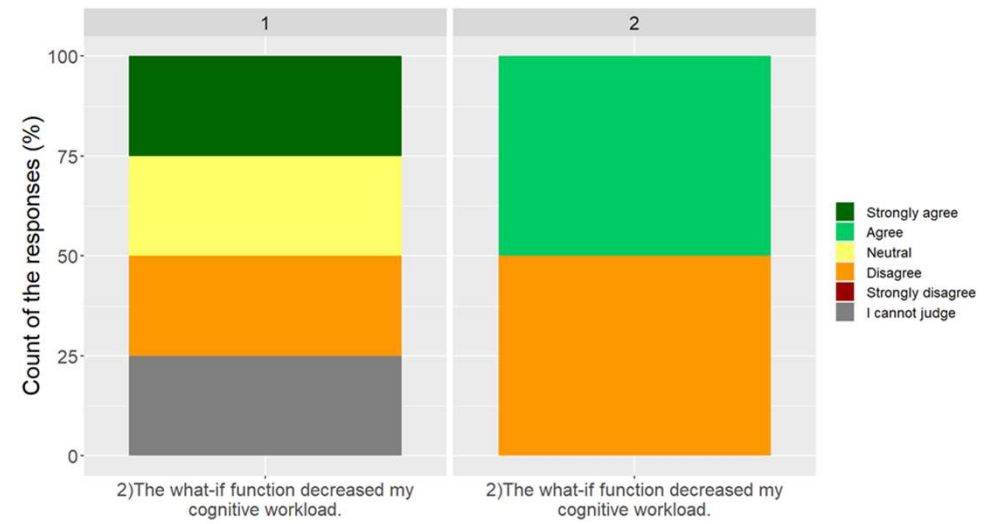
Results - WORKLOAD

BEDFORD



Median values of the Bedford Workload Scale, separated into the reference scenario (current MergeStrip) and the solution scenario (new MergeStrip, what-if function)

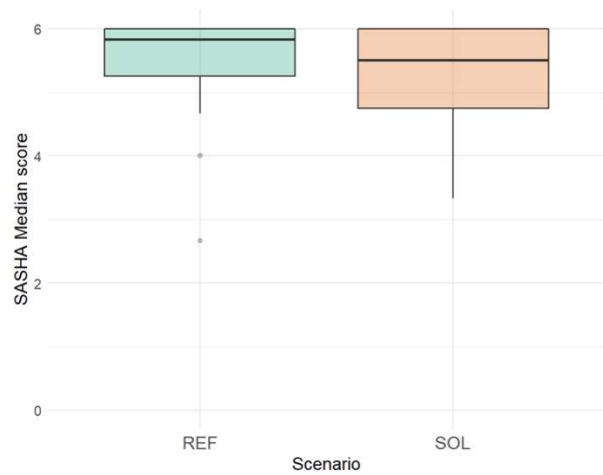
POST SIM QUESTIONS



Post-simulation question on cognitive workload in the first and second iteration.

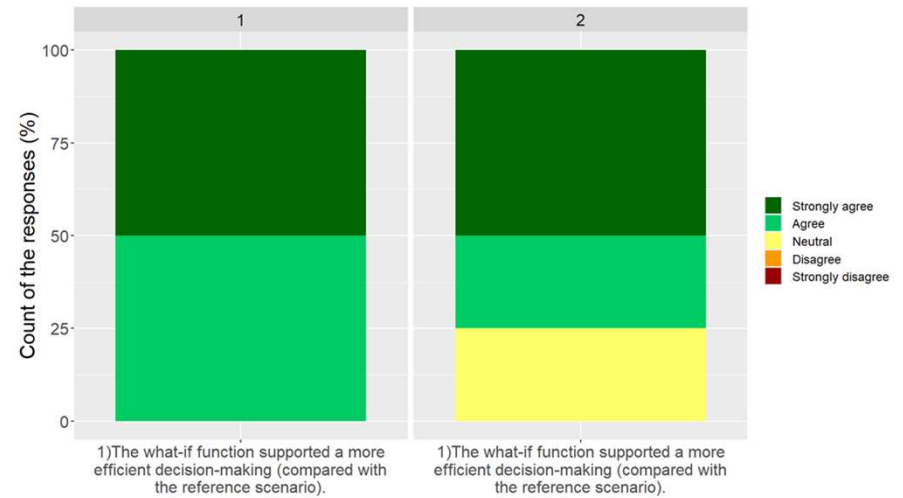
Results - SITUATION AWARENESS

SASHA-Q



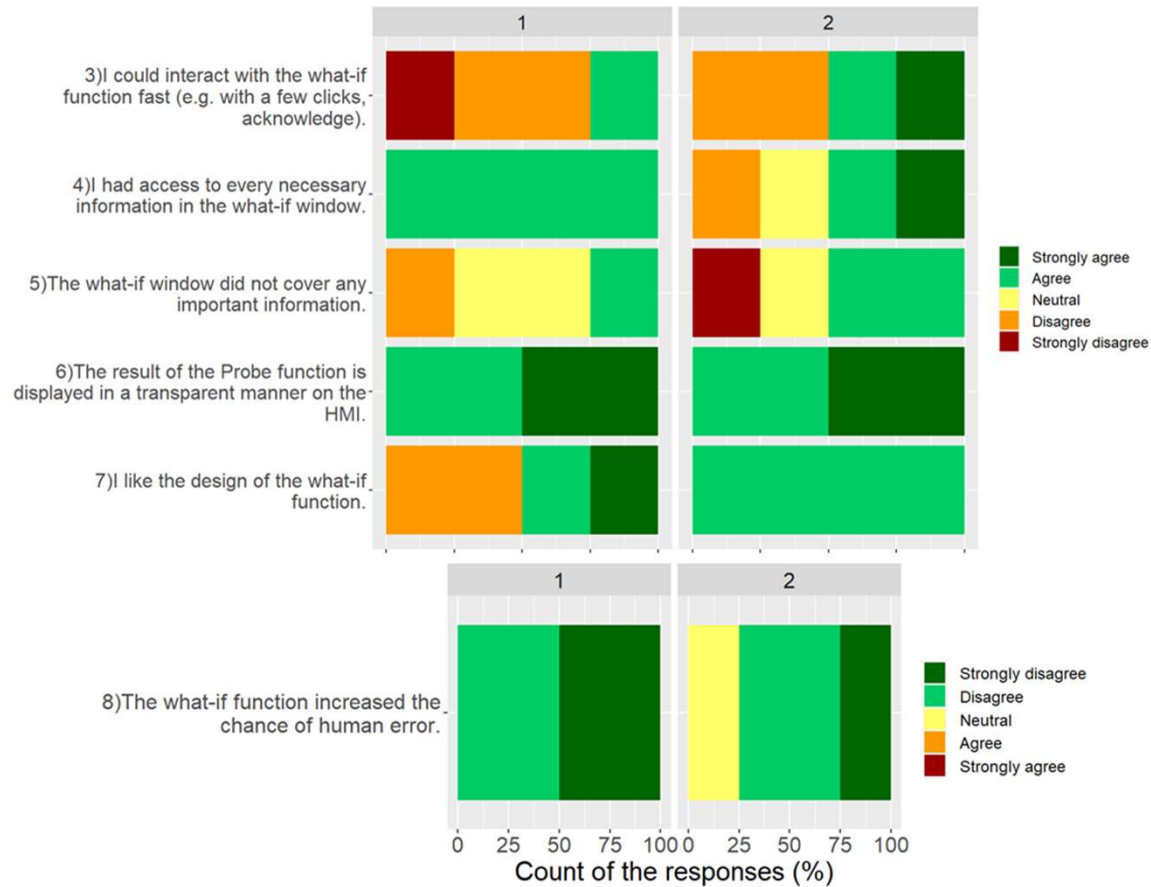
Median values of the SASHA-Q situational awareness score for the reference and the solution scenario

POST SIM QUESTIONS



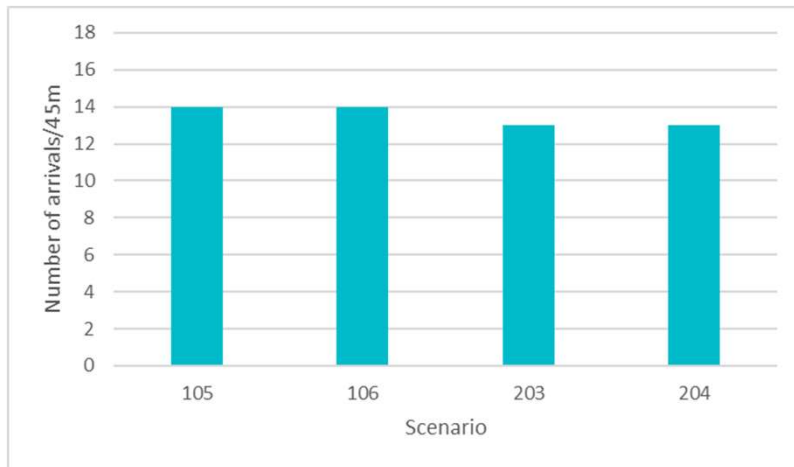
Post-simulation questionnaire about decision-making in the two iterations

Results - USABILITY, TRUST

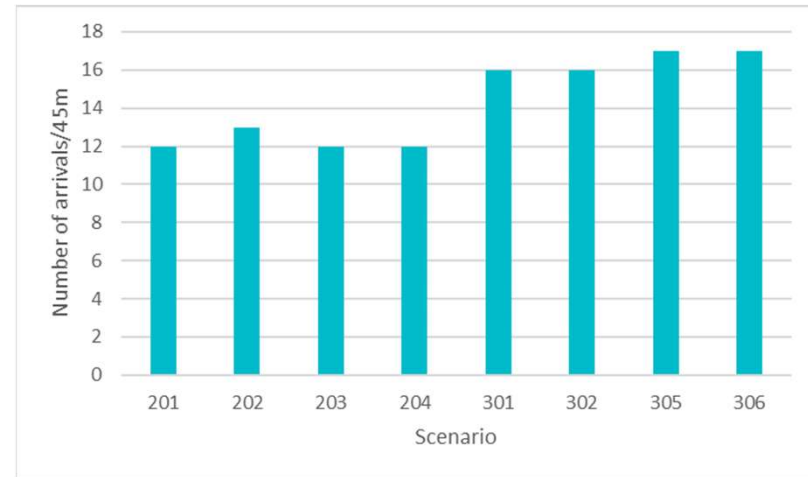


Results - CAPACITY

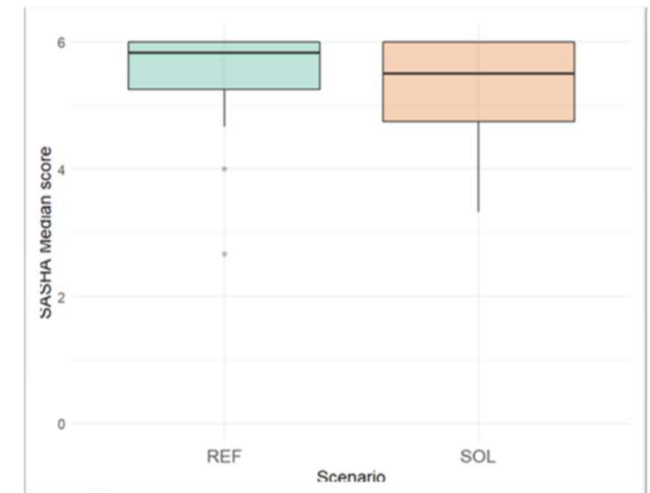
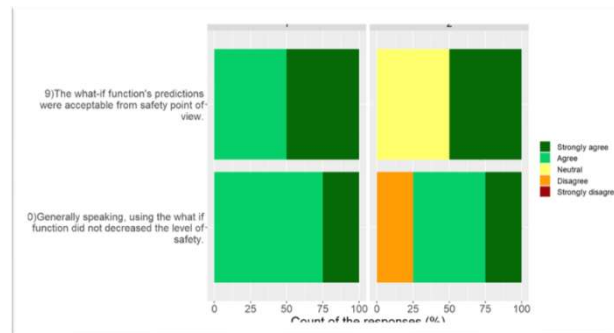
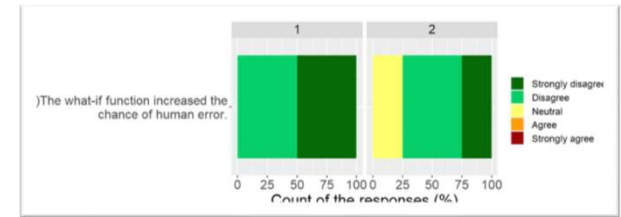
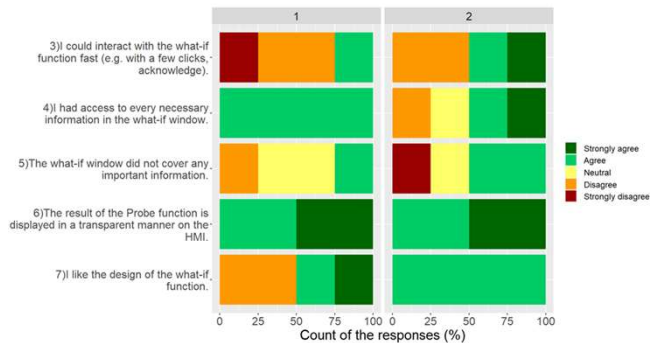
➤ FIRST ITERATION



➤ SECOND ITERATION



RESULTS of Simulator validation – in graphs



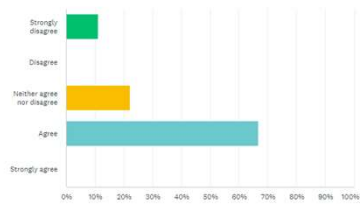
Validation in OPS Room environment

- **Date:** 31st March – 13th April 2023
- **Time slots:** 0945-1130, 1545-1700 and 2030-2200 (UTC)
- **Testing hours:** 63 hours altogether – and more
- **Roster:** 11 ATCOs
- **Validation method:** Shadow mode
 - Testing ATCO used/tested MergeStrip 3.0 (besides EC+PC)
 - All three functionalities developed will be tested (What-if, Improved ETA, Optimizer)
- **Environment:** Daillyfuel for establishing savings in NMs, tons of fuel and CO₂

RESULTS of OPS Room validation – in graphs

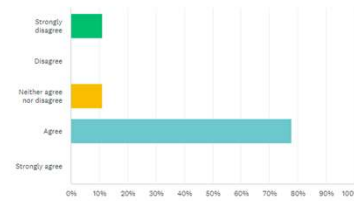
I could interact with the system functions fast (e.g. with a few clicks).

Answered: 9 Skipped: 0



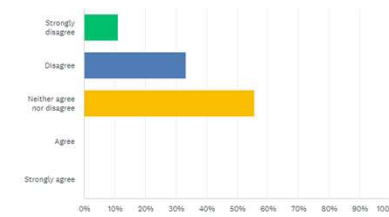
The result of the Probe/what-if function is displayed in a transparent manner on the HMI.

Answered: 9 Skipped: 0



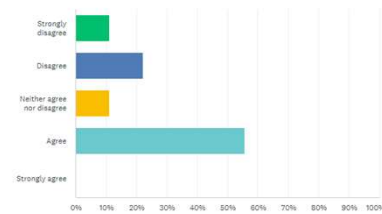
The what-if function increased the chance of human error.

Answered: 9 Skipped: 0



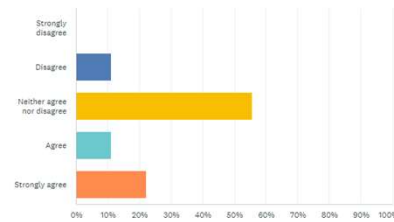
I like the design of the what-if function.

Answered: 9 Skipped: 0



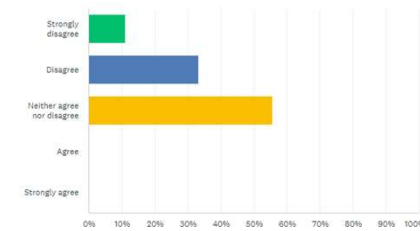
The displayed ETA seemed more accurate than in the current MS.

Answered: 9 Skipped: 0



The what-if function increased the chance of human error.

Answered: 9 Skipped: 0



Outcomes of OPS Room validation

- ✓ Test New Speed worked well, as position change can be seen at once
- ✓ VPV shows the one minute vectors as well → rate of descent appears at once
- ✓ Automatic detection of Arrivals is a huge help in high traffic
- ✓ „Distance to previous” seems more accurate than in the current version
- ✓ Does not only calculate with the current speed: good point
- ✓ Bigger radar coverage than the current one
- ✓ Calculation with waypoints
- ✓ Enabled handling 7-8 aircrafts (vs 5-7 currently)

Conclusions

Context:

- With the redesign of Budapest TMA entering into effect in January 2020, the local maximum level of efficiency has been achieved
- Budapest TMA traffic is still below the pre-COVID level, and also below what was expected for 2023 → just below the level where enhanced support software could provide significant added value
- as a consequence of the war in Ukraine, the number and occurrence of TRAs have increased significantly, and these TRAs hinder aircrafts to fly the optimal vertical profile.

Conclusions and outlook:

- The developments on TRL-4 level (as prescribed by the Call for Proposals) overall proved well
- There is a potential for further research and development
 - Inclusion of wind
 - Besides ADS-B, maybe other data source?
- More guidance from EASA and more importantly regulation on AI/ML in ATM is of absolute necessity

2019	january	february	march	april	may	june	july	august	sept	october	november	december
Length of additional distance flown compared to T-bar reference arrival path, RWY 31 (NM)	4195	2988	5087	2762	2783	7589	7228	5687	4485	3978	2296	3935
RWY 31, proportion of aircrafts arriving via T-bar reference arrival path (%)	65	70	68	78	76	61	72	74	69	77	83	79

2023	january	february	march	april	may	june	july	august	sept	october	november	december
Length of additional distance flown compared to T-bar reference arrival path, RWY 31 (NM)	1549	1640	1960									
RWY 31, proportion of aircrafts arriving via T-bar reference arrival path (%)	90	90	87									

Major strategic goals

Increasing ACC capacity

2023-25

2027-

2032/37-

Phase 1.

- Overview of the impact of ATCO tools on capacity (e.g. CPDLC)
- Flow
- Hotspots

Phase 2.

- ACC competence development: multisector planner in next build

Phase 3.

- Dynamic Airspace Configuration
- Sectorless

Performance monitoring tool (FABCE)

Extended Projected Profile (EPP, TBO)

Thank you very much!

