



# Innovation Track

-

## Summary of results and future research needs

Hartmut Fricke

# Structure of the track

- ▶ We had 8 Papers: 4 European and 4 US Papers
- ▶ *Innovative ATM* did call for a potentially wide range of (conceptual) topics and did suggest a rather long term perspective and as such virtually a rather low readiness level of the ideas.
- ▶ We got: A clear mixture of specific and strategic papers, but all under the scheme:
  - Provide ideas on how the Future ATM System can cope with the expected growth in demand until 2025 while still staying safe and efficient

# In Detail: Interpretation CfP – Research Community

Specific ideas  
new Tools,  
new type of  
information  
gathering &  
presentation



Conceptual Ideas  
on how to  
design the  
future system  
while  
Identifying  
problem areas

# Major Research Findings

- ▶ We did open the door for “Non ATM” people in the design and concept finding phase. A promising attempt.
- ▶ Necessity for a real Paradigm Shift: Need for breakthrough technologies clearly identified.
- ▶ Uncertainty on how to extrapolate from empirical know how and data to forecast future system behavior when this shift is taking place.
- ▶ Consensus that new role assignment of ATM players, enabled by air & ground automation, is needed to provide requested capacity
- ▶ Future ATM System must (still) work in disrupted conditions safely.

# Future research needs

- ▶ Find a useful (economical) way to allow for communication with “Non ATM Beings”.
- ▶ Find procedures and techniques on how to forecast the “unknown”.
- ▶ New system design includes new financing strategies in challenging economic times.
- ▶ Innovative techniques to present complex information and situations to the ATM players.
- ▶ Find techniques to proof safe system behavior in disrupted mode.

# Self Criticism

- ▶ The INNO Track did not really reflect its original intent:
  - Some papers could easily be grouped elsewhere
  - Some had a greater maturity level than expected
- ▶ Recommendation: Reexamine for the INNO track. If the INNO track continues:
  - Encourage Research Community to share Paradigm changing concepts earlier
  - Rather forget (a bit) about how the transition path will have to look: Let us be more open Minded !

# QNAs

The floor is open

# Statistical Performance



- ▶ Station keeping (A/C – A/C) to optimize landing sequences (linear/non linear feedback loop). Statistical Performance Evaluation for both loops.
- ▶ Both loops deliver similar results for minimum distance but non linear slightly better for speed variation. All better compared to the “no loop scenario”
- ▶ Speed variation during maneuvers not yet tackled.



# Delay Propagation



- ▶ BN to verify delay.
- ▶ Pure statistical data (expertise may be included). How to use this model for future configurations of the ATM system ?
- ▶ Downstream/Upstream effects considered through BN (delay as waves through the system)
- ▶ Scenarios: How to assure that all assumptions fit to each other ? (delay set high at XYZ, VMC/IMC conditions downstream) ?
- ▶ No casual explanation of modifications done. Scenarios only may help to understand NAS behavior on some constraints
- ▶ Critical step to set up the probabilities. How to validate ?
- ▶ Twofold feeling in the session.
- ▶ Approach should be compared to the micro level (Individual aircraft being traced).

# Route Charging



- ▶ We see how route charges are being computed (SU). Full cost recovery principle (follow up process).
- ▶ Go away from this principle not yet discussed.
- ▶ Unit rates do vary tremendously over the states (even within CEATS)
- ▶ 30% of the costs go to CEATS.
- ▶ Charging differently: Scenarios presented.
- ▶ Low Unit rate in AUS means extremely high rates in the LAS: hits „Regional Airlines“
- ▶ Eurocontrol / EU will have to decide.
- ▶ CEATS is dramatically changing economically – these scenarios are still under consideration ?

# Agent Based Simulation



- ▶ Appropriate decomposition for large scale systems:
- ▶ The question: If all „agents“ would follow its rules, would it be safe ?
- ▶ MIDAS explanation (rep.) applied to time based sep. vs. MIT sep.
- ▶ Workload is equal – AB Model gives us an unique inside View...Workload source Analysis. Causal Mechanisms to understand the effects.
- ▶ Maximizing the Utility of simulations (Data Analysis, Use Network of Simulations)
- ▶ Idea: Integrated Model for capacity, delay and safety (risk).
- ▶ Transition of micro to macro level (Implement specific rules, new tech. And see what comes out on the macro level ?
- ▶ Agent Based model covers controller & Pilots so far: Extend to dispatcher et al ? Yes, not yet done. Agent specification on pilot side still poor.
- ▶ Agent do not adapt to lessons learned. Iterative Design process ? Does exist but not yet done.
- ▶ Clear Statement for safety evaluation thorough Agent Emergence.
- ▶ Implicit experiment definition already done in the experiments.

# 3-D in ATC



- ▶ 3D: Using immersive displays (stereoscopic display). Innovative MMI (gloves, eye tracker..). Voice commands.
- ▶ Virtually resolve conflicts by drawing according to „try and see“.
- ▶ Does recognize, that information overload is a problem.
- ▶ Wake vortex issue not yet covered. Time over delay could be useful ?
- ▶ Speech to be used for specific task could be beneficial ?
- ▶ Heavy traffic load is considered but yet not solved.

# SHIFT



- ▶ Program SHIFT (of paradigm) as Top Down approach.
  - „Contract of objectives“
    - ▶ Arriving on time. Be flexible to handle disruptions (deal with uncertainty).
    - ▶ „Target Window“ = Global objective + local constraints + disruption management (uncertainty)
    - ▶ Try to find „local optimum“ for each ANSP. (How defined and how being measured ?)
  - and „Dual Airspace“
    - ▶ A way to increase capacity: Segregate traffic for attitude / directions (Highway and Districts (Airports))
- ▶ No idea so far how to get uncertainty being modeled.

# CREA!



- ▶ Continuation of a presentation in BUD. CREA! Has come to its end
  - Design is an opportunity to find new solution.
  - People included having no idea about ATM as „divergence“ + ATCOs as „convergence“
  - Very generic tool set (Hardbook, ...). Quite simply produced, but with detailed information on it (?). Mock up ended up with a low fidelity prototype.
  - Technical support for briefing after leave, hand-over, individual aircraft, debriefing.
  - Multidisciplinary work is a challenge. To overcome communication problems: efficiency.
  - Integration of the system is not yet integrated. This is to do but feasible.
  - Training of students was very strange. (No access to controllers at the first stage).

# CO-ATM



- ▶ CO-ATM. Motivation is driven from DAG-TM results: Potential for greatly improving cap. If sep. responsibility (Controller Managed / Free Maneuvering) is split among multiple operators
- ▶ Addresses the costs: Benefit-driven. Who invests will earn credits. Getting the best TP for him.
- ▶ Ranges from „Near term Transition (2012)“ til „CO-ATM in 2025“
- ▶ Transition path includes „Multi Sector planning“ (Sector Planning, Strategic conflict probe, Trajectory Coordination).
- ▶ Interaction between uncontrolled / controlled aircraft. Maybe by introducing „blunders“.
- ▶ How to align capacity increase between en-route sectors and airports (closely parallel RWY operations).
- ▶ How to deal with R/T COM in this DL driven concept (unequipped aircraft). ?
- ▶ Conflict and risk Management mainly controlled by using 4 D Trajectories (obliged to follow).
- ▶ D/L in relationship with throughput, reliability. Only problem seen: latency.
- ▶ Trajectory prediction on ground is essential for the concept.
- ▶ Even though capacity may increase, the complexity of resulting conflict may increase.
- ▶ How small can a sector be and still work ?