



Data-driven Trajectory Prediction

Results of the Brainstorming

Groups

- Network Manager (NM)
- Airspace User (AU)
- Air Navigation Service Provider (ANSP)

Facilitated by Dirk Schaefer and Ramon Dalmau

Engage thematic challenge 2 workshop
Universitat Politècnica de Catalunya
6 November 2018



Founding Members



Brainstorming Technique

Facilitated Brainstorming₁



We will split into **three** stakeholder groups

- **Network manager**
- **Airspace user**
- **ANSP**

Taking the perspective of the stakeholder they represent groups will brainstorm **“What specific follow-up research is likely to be useful to mature the state of the art”**

Facilitated Brainstorming₃

1. **Brainstorming:** I WISH... (IW) or HOW TO...? (H2) on Post-It notes, pin up notes on the wall in no specific order (20 min)
2. **Grouping** into themes: participants move Post-Its around to create groups of related ideas (ideally 3-5 themes)
3. **Naming** the theme: each group finds a suitable title for the themes they have identified and writes them on larger Post-Its
4. **Defining** the theme on the flipchart: participants stick large Post-Its on a flipchart page (each) or copy the name of the theme, then they write “this theme is mainly about:” producing 3-4 bullet points per theme, one flipchart page per theme
5. **Prioritising** themes: groups select what they think are their top 2 based on group discussion
6. For the top 2 challenges identify **measures of success** could be used to assess progress of challenge:
 - a. **short-term:** wholly within catalyst funded project
 - b. **longer-term:** outside/beyond such a project
7. Identify **likely barriers** to prevent progress towards maturing challenge – how might we overcome them?

Plenary debriefing and Pareto voting

Stakeholder groups present their conclusions

- Theme description, measures of success, likely barriers
- Use PowerPoint and templates provided in this presentation
- 5 min per groups
- Clarifications and comments – but no endless discussions!
- Some refinement and adaptations based on discussion



Pareto voting



Stakeholder Network manager/Airspace user/ANSP

Theme Please name theme



This theme is mainly about:

- ...
- ...
- ...

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

Overall Results Brainstorming

Stakeholder Airspace user

Theme Self-separation challenges

35 votes

This theme is mainly about:

- Automation: pilot, A/C
- Enabler technologies / capabilities
- Coordination among TP (ontology)
- TP requirements (accuracy, robustness)

Measures of success could be used to assess progress of challenge:

- short-term: a common language framework among stakeholders to solve a conflict
- longer-term: increased capacity

Likely barriers

- Accuracy of TP (mainly vertical)
- Liability for acceptance
- Scalability

Stakeholder ANSP

Theme Capacity, demand, planning

32 votes

This theme is mainly about:

- Match capacity to demand
- Control the “planning game”
- Retain appropriate buffers to cope with uncertainty
- Measure capacity demand w.r.t. ATCO workload
- Design sector configurations to match demands in cost optimal way
- Calculate demand (from uncertain trajectories) in a robust manner

Measures of success could be used to assess progress of challenge:

- Lowest AU costs
 - Flight cost (delays, efficiency)
 - Variable ANSP cost (cost for opening sector)
- No overloads

Likely barriers

- TE (TP, data)
- Capacity wall
- Agreed definition of workload

Stakeholder Network manager

Theme: AUs' behaviours & preferences



31 votes

This theme is mainly about:

- Predicting/understanding preferences and behaviours
- Equity
- Trade-off flexibility-predictability

Measures of success could be used to assess progress of challenge:

- short-term:
 - approved/validated models by AU community
 - Quantitative validation
- longer-term: deployment of models

Likely barriers

- Validity of data
- Changing mindset/culture change of ATM community

Stakeholder ANSP

Theme CD&R

19 votes

This theme is mainly about:

- Multi-sector collaborative CD&R
- ATCO tools proposing “optimal” (to be defined)
 - Clearances, instructions respecting the constraints

Measures of success could be used to assess progress of challenge:

- ANSP: Higher sector production
- AU: Value Flight better served (compromising others?!)

Likely barriers

- TE (TP, data)
- Risk of ATCO workload increase
- Needs buy-in from AU
- Nobody takes the lead (only scattered initiatives)

Stakeholder Network manager

Theme: Network integration of local planning activities

10 votes

This theme is mainly about:

- Network effect
- Optimise local measures
- Common awareness

Measures of success could be used to assess progress of challenge:

- short-term:
 - approved/validated models by AU community
 - Quantitative validation
 - Gain acceptability of network metrics from community
- longer-term: effective cooperation between all actors

Likely barriers

- Changing mindset/culture change of ATM community
- Acceptance of data sharing
- Technical barriers/standardisation

Stakeholder

Airspace user

Theme

Data Sharing

6 votes

This theme is mainly about:

- Access to data (protocol, formats, nature, type)
- Incentives for AUs (anyway to validate their expected benefits?)
- Information shared (public / private)
- Data providers
- TP requirements on the info and access
- Impact on hardware / software (avionics, EFB, data link)

Measures of success could be used to assess progress of challenge:

- short-term: Transparent databases
- longer-term: An improved understanding of the needs and benefits for data sharing

Likely barriers

- Business model
- Complexity to obtain meaningful information
- Capacity, performance

Network Manager (NM)

Stakeholder Network manager

Theme: AUs' behaviours & preferences



31 votes

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Stakeholder Network manager

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Likely barriers

- Changing mindset/culture change of ATM community
- Acceptance of data sharing
- Technical barriers/standardisation

10 votes

Stakeholder Network manager

Theme: Airspace architecture design



This theme is mainly about:

- TP in dynamic airspace configuration
- TP in free-route airspace

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

Stakeholder Network manager

Theme: Performances



This theme is mainly about:

- Metrics and KPIs
- System performance requirements
- Performance benefits

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

Stakeholder Network manager

Theme: SBT/RBT data management



This theme is mainly about:

- Sensitive data sharing
- Early SBT
- Incentives for data sharing

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

This theme is mainly about:

- Interdisciplinarity and synergies
- Standard datasets and scenarios

Measures of success could be used to assess progress of challenge:

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- ...
- ...

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Airspace Users (AU)

Stakeholder Airspace user

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Likely barriers

- Business model
- Complexity to obtain meaningful information
- Capacity, performance

Stakeholder Airspace user

Theme Predictability, validation and benefits



This theme is mainly about:

- Robustness in TP (from AU perspective)
- Adaptability of the TP function to disruptions in the network
- Consideration of AUs' objectives (cost minimisation)
- Benefits and investment required
- Means to verify benefits (validation)
- Computational performance of the system

Measures of success could be used to assess progress of challenge:

- ...

Likely barriers

- ...

Stakeholder Network manager/Airspace user/ANSP

Theme UAV challenges



This theme is mainly about:

- Different dynamic than commercial A/C
- Environment (urban, altitude, size)
- Certification
- Missions
- Automation

Measures of success could be used to assess progress of challenge:

- ...

Likely barriers

- ...

Air Navigation Service Providers (ANSP)

Stakeholder ANSP

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- TE (TP, data)
- Risk of ATCO workload increase
- Needs buy-in from AU
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This theme is mainly about:

- Identification of the TP inputs
- Prediction “techniques” and models
 - Signal processing
 - Data vs model design
- Duality indicators
 - How to design accurately

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

This theme is mainly about:

- Loss of control
- Change of skills
- Who is responsible in cases when the system fails

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

Stakeholder ANSP

Theme Data



This theme is mainly about:

- “Generate” data supporting future operations
- Share more data between stakeholders

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
- how might we overcome them...

Stakeholder ANSP

Theme Hazards



This theme is mainly about:

- Graceful failure of “black box” tools
- Planning robustness

Measures of success could be used to assess progress of challenge:

- short-term: wholly within catalyst funded project
- longer-term: outside/beyond such a project
- ...
- ...

Likely barriers

- Likely barriers to prevent progress towards maturing challenge...
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Engage KTN

Thank you



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Founding Members



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