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RESEARCH PROJECT EASA.2022.HVP.01

D-2.2 - REPORT ON THE STAKEHOLDER WORKSHOPS, INCL. PRESENTATIONS, BRIEFINGS AND FEEDBACK COLLECTED

Digital transformation - Case studies for aviation safety standards – Data Science Applications (DATAPP)

An Agency of the European Union

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CONTRACTOR / AUTHORS:	ALG/C. Cuesta, A. Feliubadaló, A. Olivera, A.Cabeza & A. Bujor
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APPROVED BY:	**AUTHOR**	**REVIEWER**	**MANAGING DEPARTMENT**
ALG	ALG	Núria Alsina	ALG
EASA	EASA	Guillaume Aigoin	EASA
EASA	EASA	Joana Vieira Gomes	EASA

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SUMMARY

Problem area

Data stays at foundation of decision-making, accelerating the digital transformation across industry. Strong data systems and new technology have been embraced in aviation with significant changes to the traditional working processes, business models, standards and regulations. In this context, EASA faces new challenges on what the required changes in safety standards and regulations are needed in response to the introduction of innovative solutions and processes. Anticipating what is to come in the industry in the field of data science applications is key to make sure safety levels are maintained without slowing innovation down.

The objective of this project is to identify and assess relevant changes to the existing aviation safety standards to support the deployment of the digital solutions under three case studies:

- Case Study 3: Flight training data for EBT/CBTA (Evidence-Based Training / Competence-Based Training and Assessment).
- Case Study 4: Digital fuel management.
- Case Study 5: Flight data models for safety.

The project aims to provide a comprehensive evaluation of benefits, constraints, standardisation and deployment issues, including the recommendations for adjusting safety regulations and related standards, and how new digital technologies could contribute to addressing the identified issues.

Description of work

This report represents deliverable “DATAPP D-2.2 Report on the stakeholder workshops, incl. presentations, briefings and feed-back collected” of “Digital Transformation – Case Studies for Aviation Safety Standards” project (EASA.2022.HVP.01- Horizon Europe Project). It describes the stakeholder consultation process in each of the three (3) case studies and resumes the feedback received through the webinars and workshops organised under the scope of the project.

Results and Application

The results presented in this document come from the webinars and workshops held as part of the stakeholder consultation process of the project. The aim of the first webinars was to ensure the understanding of the current working processes and existing limitations are aligned with the community’s view, while the objective of the technical workshops was to validate the development made and the relevance of the proposed solutions to the identified limitations. The online sessions open to the audience were complemented by online questionnaires, which had limited participation despite being open for 3 months online. The received feedback came mainly from aircraft operators indicating their endorsement of the project results. The technical workshops included live surveys that incentivised the participation of the stakeholders. This wide range of perspectives coming from the workshop attendees gives reliability to the analysis and helps concluding on the next steps of the project. The validation results related to the proposed solution will support the development on Task 3, in particular for the solutions’ adoption and roadmap definition.

CONTENTS

ABBREVIATIONS

ACRONYM	DESCRIPTION
AMC	Acceptable Means of Compliance
AOC	Air Operator Certificate
ATO	Approved Training Organisations
AU	Airspace Users
CAT	Commercial Air Transport
CBTA	Competency-Based Training and Assessment
CS	Case Study
D4S	Data4Safety
EAA	European Aviation Authorities
EAFDM	European Authorities Flight Data Monitoring forum
EASA	European Union Aviation Safety Agency
EBT	Evidence-Based Training
ECA	European Cockpit Association
EOFDM	European Operators Flight Data Monitoring forum
FDAU	Flight Data Acquisition Unit
FDM	Flight Data Monitoring / Management
FDX	Flight Data Exchange
FSF	Flight Safety Foundation
GM	Guidance Material
IATA	International Air Transport Association
IFALPA	International Federation of Air Line Pilots' Associations
KPI	Key Performance Indicator
LFL	Logical Frame Layout
LOSA	Line Operations Safety Audit
MRO	Maintenance, Repair and Overhaul
NAA	National Aviation Authority
NOTAM	Notice To Airmen
OEM	Original Equipment Manufacturer
QAR	Quick Access Recorder
SMS	Safety Management System
SPI	Safety Performance Indicators
SRM	Safety Risk Assessment
UC	Use Case

1. Introduction

1.1 Scope of the document

This report represents deliverable “D-2.2 Report on the stakeholder workshops, incl. presentations, briefings and feed-back collected” of “Digital Transformation – Case Studies for Aviation Safety Standards” project (EASA.2022.HVP.01- Horizon Europe Project). This document collects and describes the stakeholder consultation process under the project, focusing on the feedback received through the webinars and workshops organised under the scope of the project. The description includes an overview of the whole process and detailed information on the webinars and workshops, from preparation to results analysis.

This document complements “D2.1 Development of the case studies”, also delivered by DATAPP project. While D2.1 presents the complete development of the 3 case studies under the scope of the project, D2.2 describes the preparation, content and results of the webinars and workshops organised as part of the investigation for the project. The feedback collected through these means has been used as input to the development of the cases studies presented in D2.1. The webinar’s focus was on an initial list of limitations identified in the current processes related to the topics under each case studies and the potential solutions to them. This represented the first step into the development of the case studies, which progressed with the analysis and provided a more detailed view on the exiting limitations and an extended proposal of solutions, reflected in D2.1. The workshops had as focus the validation of the proposed solutions to the identified limitations.

The present document is structured as follows:

- Section 1 as an introduction presenting the scope of the document.
- Section 2 presents an overview of the stakeholder consultation process made so far in the context of the project to involve the industry and collect their feedback, being the main input for the analysis.
- Section 3 analyses the webinars attendance and the feedback collected through the questionnaires launched during the webinar sessions for each of the project’s case study.
- Section 4 presents the summary of the workshops’ objectives, attendance and collected feedback through the live surveys included in the sessions.
- Section 5 concludes on the feedback collected and how the input has been incorporated into the development of the case studies.
- Section 6,7,8 and 9 list the annexes complementary to this report gathering the supporting materials prepared for the webinars and workshops, the questionnaires results and also the live surveys reply.

1.2 Structure of the research

The scope of this project includes the development of three case studies developed in parallel with the final objective of identifying relevant changes to the existing aviation safety standards to support the deployment of the digital solutions. The analysis has been broken down into use cases within each one of the three case studies:

- Case Study 3: Flight training data for EBT/CBTA (Evidence-Based Training / Competence-Based Training and Assessment).
- Case Study 4: Digital fuel management.
- Case Study 5: Flight data models for safety.

The definition of use cases within each of the case studies under the scope of the project has been based on the identification of core processes related to the case study that allow addressing the main challenges identified through the desk research. These use cases have evolved and have been adjusted in line with the feedback received through the stakeholder consultation process. The final list of use cases for each of the cases studies is presented in the table below together with each ones' objective.

Table 1-1 List of Use Cases for each Case Study

ID	Name	Objective
Case Study 3: Flight training data for EBT/CBTA		
UC3.1	**Use of flight crew training and instructor data to drive EBT programmes**	Understand the limitations that operators face and propose solutions for managing the training data for benchmarking and training needs identification and for standardisation of the way in which instructors assign grades, ensuring data reliability.
UC3.2	**Syllabus customisation and scenario contextualisation using operational data**	Identify the constraints faced by operators when using operational data to customise EBT programmes and contextualise training scenarios to develop pilot competencies to ensure safe and efficient operations. In addition, propose digital solutions to address these constraints, and define their potential impact.
UC3.3	**Authorities support and role within EBT programmes**	Comprehend the current position of the authorities within the EBT implementation from its design and implementation towards its continuous improvement. Identify processes to be reinforced and strengthen the collaboration with the operators.
Case Study 4: Digital fuel management		
UC4.1	**Leveraging aircraft-specific fuel data for fuel performance-based schemes**	Identify relevant fuel data derived from different origin sources (fuel consumption monitoring systems, ACARS…) and explore best-practices regarding its use, processing, and management to implement performance-based schemes.
UC4.2	**Characterising the safety performance indicators for fuel schemes**	Characterise safety performance indicators, including their definition, calculation process and potential thresholds; and define potential procedures for monitoring and reporting fuel consumption and for re-assessment of established SPIs
UC4.3	**Using operating conditions data to support**	Perform the mapping of key data sources related to operating conditions required by regulation, perform their basic

ID	Name	Objective
	performance-based fuel schemes	characterisation, and define best practices for their implementation within fuel schemes to facilitate regulatory compliance to CAT operators.
Case Study 5: Flight data models for safety		
UC5.1	**Identification, decoding and processing of flight data for an FDM programme**	Understand the limitations that operators face regarding the technical elements of flight data usage within their FDM programmes and propose digital solutions that can help them succeed.
UC5.2	**Usage of flight data for FDM and other safety-relevant activities**	Detail and analyse the processes related with the usage of flight data, on one hand, for the validation and analysis of FDM events and, on the other hand, for other safety-relevant activities. It also looks at the data access policies and how these are implemented by the operator.

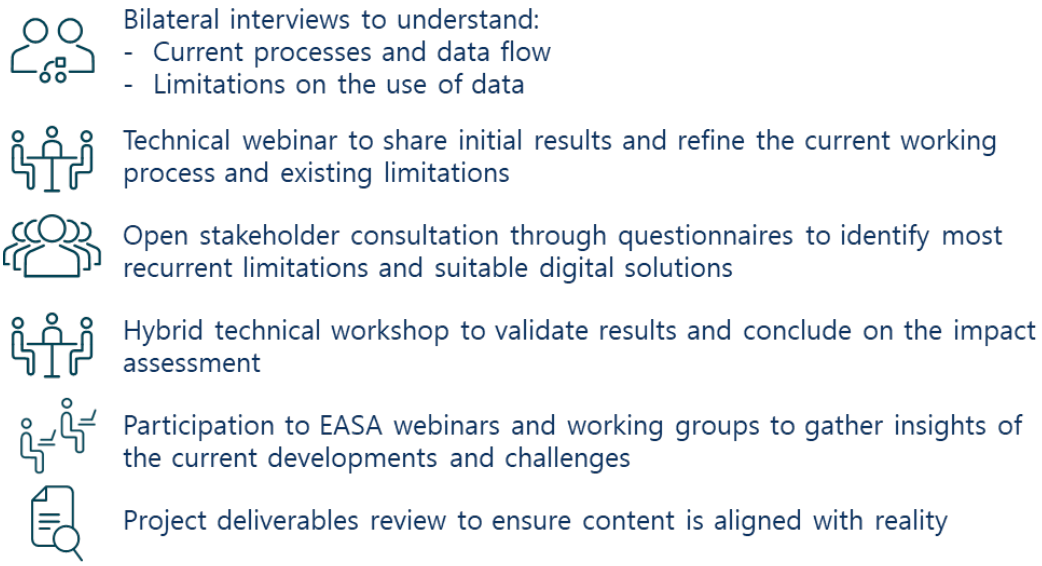
2. Stakeholder consultation

This section provides an overview of the means and channels by which stakeholders have been involved in the research, their input representing the main input for the development of the case studies under the scope of the project.

Figure 2-1 below presents the involvement of the stakeholders within the development process. The consultant has given the highest importance to the bilateral interviews with the stakeholder to allow a closer connection with them and provide a safe space where to dig into the current processes and the challenges faced. The received feedback from the interviews has been complemented by the questionnaires' results and feedback from the webinars and workshops.

As the topics under the scope of the project are under continuous development and refinement, the consultant has been attending to the working groups addressing aspects that might impact on the research, being aware of the latest parallel developments.

Figure 2-1 Stakeholder involvement in the use case development



2.1 Bilateral interviews

Up to 34 individual interviews have been conducted with representative stakeholders from different operational environments and business natures that provide broad perspective on the processes under each case study. The stakeholders presented in Figure 2-2 have contributed to this phase of the project, their input representing the main input for the case studies development.

Figure 2-2 Stakeholders interviewed for the scope of the project

Each interview consisted in a semi-structured meeting, supported by a set of topics to be addressed, to allow new ideas to be brought up during the interview following the different lines of thought of the discussion with the interviewee. The topics have been selected based on the stakeholder type and driven by the desk research completed in the first task of the project, to provide more insights into the existing limitations in terms of data usage and digital tools available.

Stakeholder engagement has been challenging due to the limited availability, summer period being highly demanding for operators, and due to the high number of missing replies. This has led to the extension of the interview period and an adjustment in the project plan to organise a higher number of interviews and broaden the feedback received. Around 50 stakeholders were invited to the consultation process, which materialised in 34 meetings throughout a period of 4 months. Figure 2-3 below provides an overview of the number of interviews held for each of the case studies.

Figure 2-3 Number of interviews per case study

The recurrent themes identified among stakeholders, as well as the conclusions drawn from the various individual interviews are reflected in “D2.1 Development of the case studies” document, being the main input for the case studies development.

2.2 First webinars concluding on existing limitations

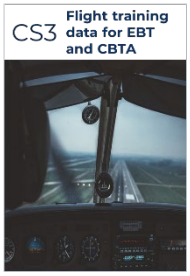
The investigation started with the desk research and has been enriched with the bilateral interviews that leaded to a set of initial limitations and allowed the team to have insight into the activities linked to the use cases for each case study. The main findings were shared with the community through 3 webinars, presented in Figure 2-4 below.

The webinars main objectives were to:

- Present the initial limitations and problems encountered by stakeholders in the processes related to each case study and the use of the data.
- Ensure alignment between the feedback captured through the interviews performed and the wider community.
- Launch a questionnaire to capture validation on the presented preliminary conclusions and propose solutions to existing constraints to enhance the use of data science.

The webinars were held remotely, making use of Webex platform and **slido**. The duration of each session was of one (1) hour where the consultant explained the status of the context of each case study together with the main limitation identified through the bilateral interviews held at the time of organising the webinar. The last fifteen 15 minutes of the sessions were dedicated to the questions and answers where the consultant captured feedback from the attendees and clarified their concerns.

Figure 2-4 First webinars description

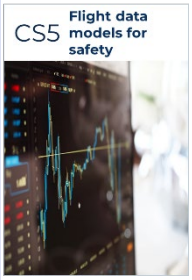


Current barriers and challenges for the implementation and enhancement of EBT/CBTA programmes - 26th July 12:00 – 13:00

Evidence Based Training (EBT) changes the training paradigm, and it is still maturing at European level. Operators are attracted by the effectiveness of this new programme, but its implementation is still new and requires additional resources and effort. Data is at the very heart of EBT programmes, its usage presents a set of challenges in terms of data identification, fusion, reliability, and processes definition.

Unveiling key challenges in current operations for fuel management - 28th July 12:00 – 13:00

The transition to digital fuel management allows operators for more flexibility and enable the application of specific fuel schemes, serving as a basis for defining and implementing new data-driven decision processes. Digitalisation is becoming a powerful proxy for fuel optimisation, but there are still development points and missing gaps in both regulations and digital capabilities.



Overcoming limitations and unleashing the potential of Flight Data - 31st July 12:00 – 13:00

Risk management driven by safety intelligence relies on flight data, a unique source of information on the state of the aircraft and its components, on the interactions of the pilot and of the interactions of the aircraft with its surroundings. Challenges are still to be addressed to unlock the potential of flight data usage for proactive risk management.

The feedback collected and the analysis of the audience is presented in detail in section 3 of this document.

2.3 Open questionnaire for initial limitations and digital solutions

The objective of the data collection through the questionnaire launched during the first webinars was to validate the initial limitations identified by the consultant and to guide the investigation on the potential solutions to solve these limitations. For this purpose, a dedicated questionnaire to each Case Study was launched. These remained open until 31st October 2023. The tool used for the development of the questionnaires is *EUSurvey - Welcome (europa.eu)*.

The feedback received through the questionnaires is presented in section 3 of this document. It has also leaded to additional interviews, for those including the contact details in the questionnaire. These have been used by

the consultant to continue the discussions and take the opportunity for refining the investigation with additional feedback.

2.4 Hybrid technical workshops for validating the proposed solutions

A hybrid workshop was held on 14-15th November where the research results on the development of the case studies were presented to the stakeholders with the aim of validating the proposed solutions and the evaluated impact. The workshop was performed in three sessions, each one dedicated to the cases study and structured as follows:

- 60 minutes where the consultant presented the limitations and proposed solutions, fostering the interaction with the audience through online surveys to weigh impact of the proposed solutions. The common structure of this part includes:
    - Brief introduction from the EASA's Technical Lead
    - Presentation of the Case study and Use Cases
    - Current status and stakeholder participation to DATAPP project
    - Identified limitations and proposed solutions broken down in specific areas, each one including a dedicated survey and Q&A session using **slido** platform
    - Next steps
- 30 minutes for an invited panellist to present the best practice case of their organisation.

The best practice case in each session will be presented by a representative from the industry, shown in Figure 2-5 below.

Figure 2-5 Workshop sessions and panellists

CS3 Session	CS4 Session	CS5 Session
- 14th November 10:00 - 11:30 - Panellist: A. Grammaticas (EasyJet)	- 14th November 14:00 - 15:30 - Panellists: Thomas Borer & Georg Wilckens (Lufthansa Group)	- 15th November 10:00 - 11:30 - Panellist: Leopold Sartorius (ATR)

The workshop was organised in a hybrid format, being open to the industry for registration and with invites sent to the targeted stakeholders (interviewed people, participants to the webinar held in July and those expressing interest in the project).

2.5 Participation to webinars and EASA working groups

The case studies development has also been nurtured through the consultant's participation in meetings and webinars organised by EASA. The consultant has participated to the meetings organised by the following working groups on each of the three topics under the scope of the project:

- Safety Promotion Task (SPT) 0012 Promotion of the new European provisions on pilot training;
- Safety Promotion Task (SPT) 0097 Promotion of the new European provisions on fuel /energy planning and management;
- Safety Promotion Task (SPT) 0126 Integrating the flight data monitoring (FDM) programme with safety risk management (SRM)

The attendance to these working sessions has helped the consultant to understand development rolling in parallel to this research project and to ensure the results make sense in the current context.

6. Project deliverable review

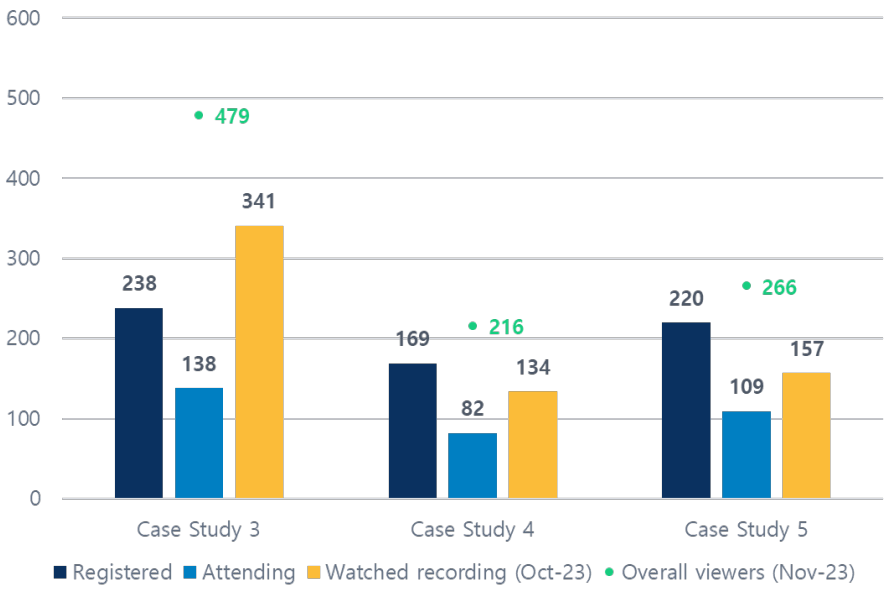
The documentation elaborated in the context of the project follows the consultant's internal quality review and EASA's review, following the deliverable acceptance procedure defined at project management level.

3. Webinars and questionnaires on identified limitations

The first webinars of the project have been organised when the early results become available to refine the direction of the research and capture initial feedback. The consultant organised the sessions remotely to allow a wide number of stakeholders to attend. Annex I – Webinar materials provides the materials generated in preparation of the webinar and reflecting the discussions held with the attendees.

The webinars had high number of registrations reflecting the dissemination efforts made. The people that really connected to watch the webinar live dropped 42%, 51% and 50% for each session respectively. Despite this drop, the attendance was as expected and fruitful discussions were held, which helped refine the message and the results of the research at that stage. In terms of further dissemination, the three webinars were recorded and uploaded on the DATAPP website so that they could be visualised online even after the event. This has allowed multiple reproductions of the webinars to interested parties who could not make it to the direct event. If we sum both attendees of the webinar and the reproductions afterward, we can conclude that we reached in all cases a wider audience than even the initially registered ones.

Figure 3-1 Webinars registration, attendance and watchers of the recording summary



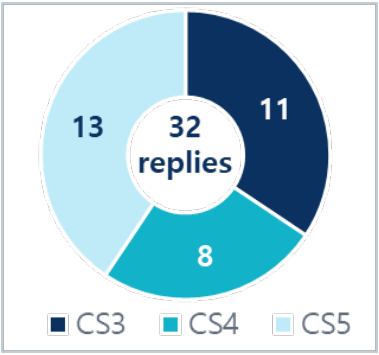
The webinar and the presentation of the initial limitations identified in the current working processes related to the use cases under study represented the suitable context to launch the investigation on the potential digital solutions. This has been done through a questionnaire announced during each of the webinar sessions.

The objective of the questionnaires was twofold: on one hand to validate the initial limitations identified representing the preliminary results of the current processes analysis and, on the other hand, to identify the most suitable solutions to investigate and propose to solve the identified limitations. The questionnaires remained open from the date of the webinar sessions until 31st October 2023. The tool used for the development of the questionnaires is *EUSurvey - Welcome (europa.eu)*. Annex II - Questionnaires complementary to this document provides the questionnaires launched for each of the case studies together with the results obtained.

The questionnaires' dissemination through the projects' website and LinkedIn posts translated into 32 replies, as presented in Figure 3-2. The feedback received validated the initial limitations identified, showing a similar understanding of the weak points within each case study. In addition, the received answers indicated the direction of the definition of solutions, which were considered when proposing each one of the solutions D2.1 of DAATAPP project. There is a clear need for guidance and sharing of best practice to better understand how to analyse data, which metrics to use and how to build the governance around it in each of the case studies.

The results received from the questionnaires are presented in section 3.1, 3.2 and 3.3 for each of the case studies, respectively.

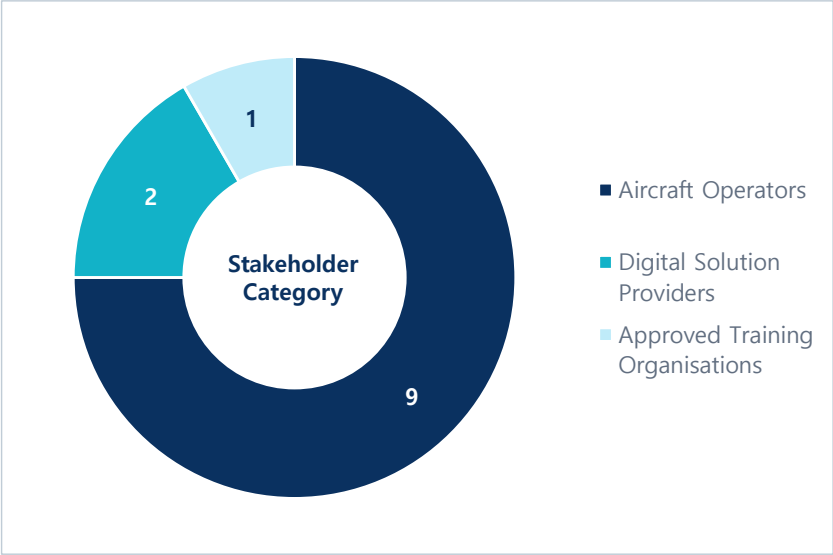
Figure 3-2 Questionnaire replies



3.1 Case Study 3 - Questionnaire results

In the case of the questionnaire distributed to the various stakeholders in the context of the EBT, responses were received from 8 aircraft operators, 1 digital solutions provider, plus 1 additional operator who is also a digital solutions provider, and 1 approved training organisation. This represents a total of 11 responses. Among the different operators, there are 3 in EBT Baseline, 3 in EBT mixed and 3 that are not in EBT, thus representing participation from the entire spectrum of possibilities in the context of the different phases of EBT implementation.

Figure 3-3 EBT questionnaire stakeholders' participation



One of the objectives of such questionnaire was to gather information on the relevance of some of the initial identified limitations and on the adequacy of the preliminary proposed solutions, which are listed in the following table where the area or activity in which they are framed is also specified:

Area	Initial limitations & Proposed solutions[1]
A1 - Customisation of the EBT programmes	**L1 - Lack of governance framework between training and safety departments:** An additional level of coordination between safety and training departments is required. More emphasis should be placed on encouraging a close collaboration and integration between both departments.
	L2 - Safety and training departments do not share a common taxonomy: In most operators, training and safety departments do not share a common taxonomy, which means that the exchange of safety events information to introduce into the training programmes is not always efficient.
	S1 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices on how to ease integration and governance of safety and training department cooperation in the context of EBT programmes **[Applicable to L1]**
	S2 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices to integrate / fuse inner loop data for customisation and contextualisation of scenario elements **[Applicable to L1]**
	S3 - Regulatory requirements / Guidance Material explicitly capturing the need for integration of the EBT programme with the operator's management system to be used together with other relevant data sources for supporting safety risk management and evaluate effectiveness of mitigation actions **[Applicable to L1]**
	S4 - Regulatory requirements to explicitly cover integration between FDM and EBT, identifying requirements for transmission of information and scope of data to be shared, similar to the FDM-related conditions captured in AMC1 ORO.FC.A.245 for ATQP programmes **[Applicable to L1]**
	S5 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices to standardize taxonomy between FDM methods and EBT training topics **[Applicable to L2]**
A2 - Evaluation of pilots and key training data gathering	**L3 - Complexity in conducting the assessment of competencies mainly due to the large amount of data to be captured by the instructors:** Gathering of OBs and relevant contextual notes is resource-demanding and challenging during sessions, what translates into difficulties when deriving grades for the competencies.
	L4 - Compromised data quality due to flexible methodologies for competency assessment and data collection: The current methodology for performing the assessment and the grading is standard but leaves room for interpretation by each operator and conditions the assessment, as it becomes a more subjective approach that can affect the quality of the output training data.
	L5 - Lack of a metric on the difficulty of the programme or module: There is not a metric or reference to measure the difficulty of the module of the programme to contextualise the pass-fail percentages, the grading data, the concordance of the instructors and the evolution of such metrics.

[1] The limitations and solutions numbering differs from the one in D2.1 document of DATAPP project. The limitations and solutions presented in this table are an initial list that has been evolved into the final lists presented in D2.1 with the complete development of the case studies.

	S6 - Publication and promotion by industry bodies or relevant regulatory working groups of baseline golden standards for assessment of EBT training topics **[Applicable to L3, L5]**
	S7 - Regulatory requirements / Guidance Material explicitly capturing desirable capabilities for EBT software or services supporting EBT evaluations **[Applicable to L3]**
	S8 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices for standardised application of grading system **[Applicable to L4]**
	S9 - Regulatory requirements / Guidance Material providing example of relevant methods and analytical techniques for assessment of pilot competencies **[Applicable to L4]**
A3 - Instructor Concordance Assurance Programme	**L6 - Operators lack clear guidelines on techniques for detecting and assessing instructor alignment, and current techniques, such as the creation of "Golden Standards", are very resource-intensive**
	L7 - Operators lack guidance for the implementation of the Instructor Concordance Assurance Programme, making it challenging to implement it in an effective manner
	L8 - Operators lack guidelines to monitor reliability of concordance data, what might make it difficult to identify situations of not representative concordance: As an example, there is a possibility that a forced concordance may appear due to instructors assigning a grade trying to avoid falling outside the concordance or due to the use of pre-marked templates.
	S10 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices for standardised metrics and methods to assess instructor-group assessment homogeneity and accuracy **[Applicable to L6, L7, L8]**
	S11 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices for implementation and continuous improvement of ICAP **[Applicable to L6, L7, L8]**
A4 - Link and communication with the authorities and its role in the EBT	**L9 - Operators receive limited support and recommendations from the authorities, mostly due to the lack of resources and EBT expertise. This is translated into the operators mainly relying on the inner loop for the identification of training needs.**
	L10 - Authorities have limited guidance on data and metrics that should be shared by the operators, what prevents them for effectively monitoring of EBT programmes, their continuous improvement and enriching state-level safety risk management.
	L11 - There is no framework of performance indicators to monitor the effectiveness of EBT programmes and their consistency over time. As a result, it might be difficult for the aviation system to proactively monitor the progressive shift in the grading curves as instructors and pilots improve or deteriorate, leading to over or downgrading.
	S12 - Incentivise the creation of collaborative data-driven mechanisms among Authorities supporting the continuous customisation of EBT programmes through evidence gathered from external safety-relevant sources **[Applicable to L9]**

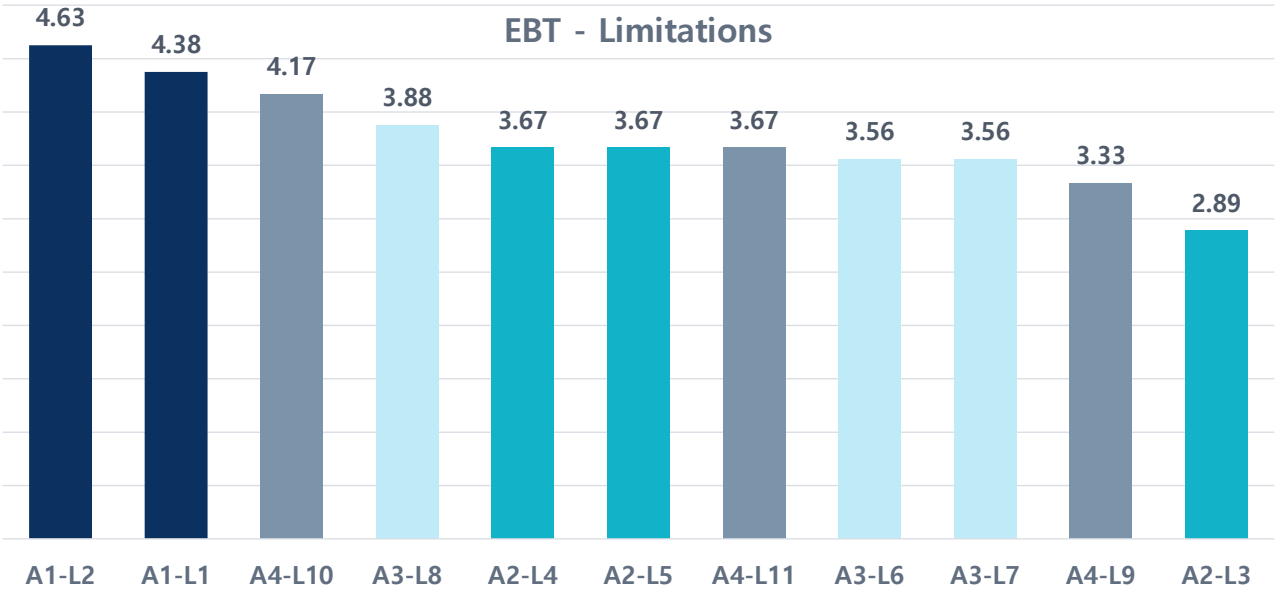
S13 - Regulatory requirements / Guidance Material defining a recommended framework of KPIs for oversight of EBT programmes by Authorities, supporting the continuous evaluation of their effectiveness and acceptable instructor concordance **[Applicable to L10]**

S14 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices for standardised metrics to monitor the consistency of instructor concordance along time **[Applicable to L11]**

S15 - Publication and promotion by industry bodies or relevant regulatory working groups to research on alternative means other than Part-FCL Appendix 9 to verify the accuracy of the grading system **[Applicable to L11]**

Based on the participation of the different stakeholders to the questionnaire, it has been possible to identify the limitations that are potentially the most representative or that affect the most on the implementation and functioning of the EBT programmes. To quantify it, the different stakeholders were asked to rate on a scale of 1 to 5 which limitations they considered most relevant in the context of their EBT programmes, 5 being the most relevant. Thus, the following chart shows the average of the answers received from stakeholders for the given limitations and ranks their relevance:

Figure 3-4 Ranking of the EBT related initial limitations based on the average of replies



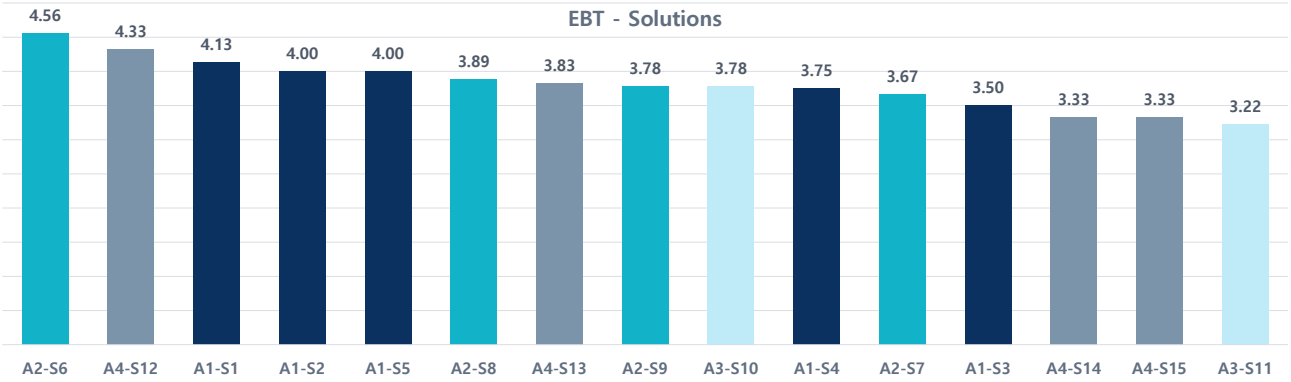
The collected feedback shows that the limitations related to the area of customisation of the EBT programmes are the most relevant for the stakeholders who participated. Specifically, the lack of a common taxonomy to facilitate the data sharing between the training and the safety departments and the lack of governance between these departments. That fact highlights the need to continue promoting and strengthening the collaboration between training and safety departments, which ultimately enhances the programmes' customisation capabilities. These first two limitations are followed by the limitation on authorities having limited guidance on data and metrics that should be shared by the operators, what hinders the effective monitoring of the programmes. This means that the authorities need further guidance and support to be able to effectively perform their functions, especially the approval and monitoring of programmes. In fourth place, the next limitation with the highest average relates to the appearance of forced concordance among instructors

and is closely followed by a group of limitations with similar scores. This group includes limitations related to the flexibility of methodologies and techniques for conducting evaluations, the need for metrics for programme difficulty and the lack of a framework of KPIs to help monitor programme effectiveness.

In general, it can be observed that on a scale of 1 to 5, the identified limitations seem relevant for the stakeholders, and that there is a certain equality in terms of their relevance. Therefore, solutions to these limitations should be explored to enable stakeholders to progress in the implementation and the enhancement of EBT programmes.

Similarly, the questionnaire invited the stakeholders to rate the adequacy of a series of preliminary solutions proposed to address the explained limitations on a scale of 1 to 5. The average of the responses received for each of the preliminary proposed solutions is presented ordered from highest to lowest in Figure 3-5 below.

Figure 3-5 Ranking of the EBT related proposed solutions based on the average of replies

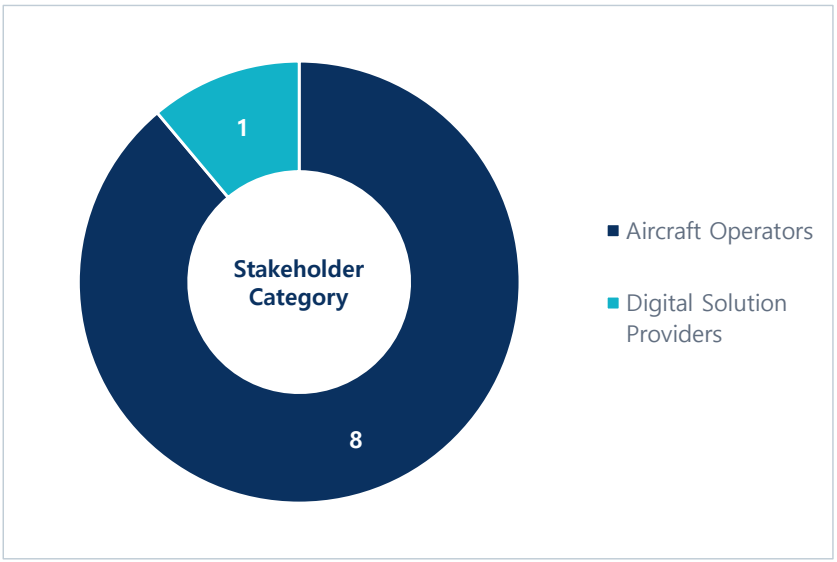


It is noticeable that the proposed solutions received considerably high scores, suggesting that they may be adequate in most cases for mitigating the encountered limitations. Considering that, for the subsequent organised workshop the intention was to give continuity to most of the preliminary solutions, seeking to further validate them with stakeholders. Particularly, the solutions with the highest average scores are, in the first place, the provision of reference materials known as "Golden Standards" for assessing the alignment of the instructors, and in the second place the creation of collaborative data-driven mechanisms among authorities supporting the customisation of programmes. This indicates that one of the major stakeholders' concerns is to ensure the concordance of their instructors and, therefore, the reliability of data. In addition, the customisation of the programmes is also an area where stakeholders need further support, since following these solutions, there is also a group of solutions framed in this area of programme customisation. The first one covers the collaboration and governance framework between safety and training department, and the second solution deals with the integration of safety data for customisation and contextualisation of the programmes. Finally, the last solution of this group aims to ease the exchange of information between departments with the standardisation of the taxonomy between FDM methods and EBT training topics or competencies. Therefore, the conclusion in this case is that it is of vital importance to introduce solutions that focus on improving the collaboration between the training and safety departments for an effective customisation.

3.2 Case Study 4 - Questionnaire results

Regarding the questionnaire distributed to stakeholders related to the Case Study 4, the participation was from 8 aircraft operators, 1 of them being also a digital solution provider, specifically of Fuel Consumption Monitoring Software, representing a total of 8 responses, as shown on the following Figure.

Figure 3-6 Fuel questionnaire stakeholders' participation



The aim of this questionnaire was to collect feedback on the significance of initial identified limitations and the appropriateness of the initially suggested solutions. These limitations and solutions are detailed in the table below, along with the corresponding area or activity to which they are related.

Area	Initial limitations & Proposed solutions[2]
A1- Definition of fuel data input for fuel reduction schemes (selection of data sources & parameters, and data quality)	**L1** - Limited actionability of fuel data in ACARS (limited fuel parameters with potential accuracy limitations) results in a blocking point for using this data source for fuel-related analysis
	L2 - Limited granularity of parameters in ACARS (only collected at specific points of the flight) results in a blocking point for using this data source for specific fuel-related analysis
	L3 - Delayed availability / transmission of FDM data (not available in real-time or received with delays) results in a blocking point for using this data source for fuel-related analysis
	L4 - Current FDM data governance results in a blocking point for using this data source for fuel related analysis
	L5 - Insufficient set of parameters outlined in CAT.OP.MPA.185 to implement fuel reductions (off-block fuel, take-off fuel, MINIMUM FUEL declarations, MAYDAY MAYDAY MAYDAY FUEL declarations, fuel after touchdown, on-block fuel)
	L6 - Manually collected data is not easily processed and managed, as it is not commonly digitalised and/or entails too much effort for its analysis due to data quality

[2] The limitations and solutions numbering differs from the one in D2.1 document of DATAPP project. The limitations and solutions presented in this table are an initial list that has been evolved into the final lists presented in D2.1 with the complete development of the case studies.

	L7 - Regulation is not explicit on which parameters should be recorded and stored for future implementations of Basic Fuel Scheme with Variations or Individual Fuel Schemes, making it challenging to anticipate to compliance with the minimum 2 years of data required for such fuel reduction schemes
	L8 - Minimum accuracy requirements for fuel-related parameters are not defined to ensure data quality for any fuel-related analysis and/or application
	L9 - There are inconsistencies identified among same fuel parameters derived from different sources (ACARS vs. FDM data) and there are no guidelines on how these should be prioritised to support fuel reduction schemes
	L10 - There are common data quality issues from fuel data streams, such as errors in sensors, degradations, spurious peaks, or lack of granularity, with limited regulatory provision on what is acceptable and guidance on how should be addressed
	S1 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices that establish minimum requirements and selection criteria of fuel-related data for specific fuel-related analysis and models **[Applicable to all limitations]**
	S2 - Collaborate with industry experts / operators to define a comprehensive set of fuel parameters for each fuel scheme **[Applicable to L5 and L7]**
	S3 - Publication and promotion by industry bodies or relevant regulatory working groups of Industry best-practices for data validation guidelines to address data quality issues and ensure consistency and reliability across parameters **[Applicable to L8, L9 and L10]**
	S4 – Regulatory requirements / Guidance Material accounting for specificities in regard with validation of fuel data (data reliability) by the adoption of EUROCAE ED-76(A) standards or similar standards **[Applicable to L8, L9 and L10]**
A2 - Development of statistical and predictive models for fuel reductions (standardization & generalization of fuel models, definition of statistically relevant set of data and capitalisation	**L1** - There is limited guidance material or regulatory references to develop statistical or analytical models to justify specific fuel reductions, making it difficult for operators and Authorities to define an acceptable framework of models that justify reductions
	L2 - The regulation is restrictive and not very explicit about the possibilities of generalization of statistical analyses or other models (extrapolation between aircraft tails or operational contexts) which may make it difficult to adopt certain reductions in the representativeness of the data at the required granularity even with the 2 years of data
	L3 - The regulation is not explicit as to what is considered "statistically" relevant, making it difficult to define the minimum sample data to be used to build the reduction models
	L4 - Operators have limited availability of historical statistically relevant data for fuel reduction models
	L5 - Difficulty in accessing algorithm details for statistical estimations and models integrated in acquired software (e.g., flight planning systems) resulting in difficulties in the post-ops analysis of the associated fuel metrics

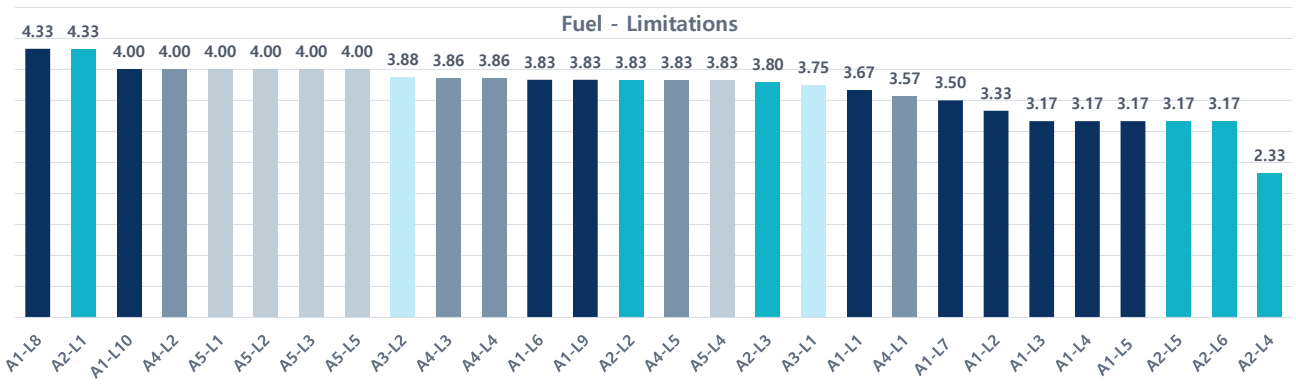
	L6 - Lack of adequate promotion and change management mechanisms around the introduction and explanation of models/statistics that justify fuel reduction schemes results in a lack of visibility and distrust on the part of the pilots, who mitigate reductions on a discretionary basis
	S1 - Regulatory requirements / Guidance Material explicitly capturing detailed guidelines for operators and authorities to develop statistical models for fuel reductions **[Applicable to L1]**
	S2 - Regulatory requirements / Guidance Material explicitly establishing a standardized framework for generalizing statistical models across different aircraft or operational contexts **[Applicable to L2]**
	S3 - Regulatory requirements / Guidance Material explicitly capturing what constitutes statistically relevant data, considering factors like representativeness, completeness, and timeliness **[Applicable to L3 and L4]**
	S4 - Publication and promotion by industry bodies or relevant regulatory working groups of establish standardized statistical methods and best-practices for advanced fuel-reduction models other than statistical **[Applicable to L1 and L2]**
	S5 - Encourage data sharing and collaboration among operators to enhance the availability of statistically relevant data for fuel reduction models **[Applicable to L4]**
	S6 - Regulatory requirements / Guidance Material explicitly capturing the need for transparency in algorithm details for fuel reduction schemes when these are provided by vendors, at the level required to ensure traceability, support decision-making and ease oversight by Authorities **[Applicable to L5 and L6]**
A3 - Validation and deployment frameworks of fuel reduction models (deployment of models into daily operations, trustworthiness of models	**L1** - Lack of technical expertise or manpower, coupled with little guidance on fuel reduction model development (statistical or others), hinders the ability of operators to propose and adopt more advanced fuel reduction plans.
	L2 - There is no framework to ensure a trustworthy deployment of data-driven models (statistical or any other potential future solution) that support fuel-reduction schemes, as it could be guarantees on stability and robustness of models, assurance of results through performance verification or traceability of data used for the models, which may make it difficult to investigate more advanced models for individual schemes, either by the Authority for approval or by the operator.
	S1 - Regulatory requirements / Guidance Material explicitly capturing detailed guidelines for operators and authorities to ensure trustworthy deployment of fuel-related models (both statistical and other AI applications) in alignment with future industry standards (e.g., EUROCAE WG-115 / SAE G- 34) **[Applicable to all limitations]**
A4 - Definition and monitoring of safety performance for fuel schemes	**L1** - Proposed Safety Performance Indicators (SPIs) in GM2 CAT.OP.MPA.180 are not complete enough to capture a comprehensive range of safety considerations to justify and monitor equivalent level of safety in all possible individual fuel reduction schemes
	L2 - There are limited guidelines for definition and continuous monitoring of baseline safety performance indicators (SPIs) for Operators to evaluate deviations from the equivalent level of safety and Authorities to support the continuous oversight of fuel reduction schemes

	L3 - Lack of manpower/resources make it challenging for operators to define and monitor safety baseline performance under fuel reduction schemes
	L4 - Regulatory requirements for fuel consumption monitoring systems on individual fuel schemes are too specific and do not allow for flexibility, as it refers to ICAO Doc 9976 requirements, which might not be relevant for all kind of operational contexts
	L5 - There is limited guidance or regulatory provisions for the governance and organisational management of fuel initiatives within the SMS / FDM departments, being coordination mechanisms between fuel and safety-related departments sometimes ineffective (e.g., not clear reporting mechanisms, ineffective data exchange, duplicated analytical processes…)
	S1 - Publication and promotion by industry bodies or relevant regulatory working groups of detailed frameworks of SPIs to measure and monitor the equivalent level of safety, applicable to specific fuel reductions **[Applicable to L1, L2 and L3]**
	S2 - Incentivise the creation and promotion of collaborative data programmes (e.g., Data4Safety) that provides factual-based information at national or European level for the monitoring of equivalent level of safety for fuel-related initiatives, definition of thresholds and for the analysis of specific trends **[Applicable to L1, L2 and L3]**
	S3 - Study some additional regulatory provisions that allow for more flexibility regarding the requirements specified for fuel consumption monitoring systems, in accordance with the operational nature of operators and the expected fuel initiatives **[Applicable to L4]**
	S4 - Regulatory requirements / Guidance Material explicitly capturing standardized reporting framework and requirements for fuel and safety-related parameters to authorities **[Applicable to L1 and L2]**
	S5 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines to promote the effective integration of fuel initiatives and the monitoring of equivalent level of safety within the SMS/FDM department **[Applicable to L5]**
A5 - Collection and management of operating conditions data for fuel planning, in-flight re-planning and post-ops analysis (reliability of data, consistency of data along fuel	**L1** - Limited availability of data sources for operating conditions data (e.g., anticipated meteorological conditions, anticipated delays...
	L2 - There are no detailed guidelines for assessing the reliability, completeness and accuracy of all required operating conditions data (e.g., reliability of anticipated delays data)
	L3 - There is inconsistent availability in the data sources for operating conditions data used for fuel planning and post-ops analysis (e.g., fuel statistical model developments), which is a potential barrier to the development and deployment of more advanced fuel reduction models
	L4 - There is inconsistent availability in the data sources for operating conditions data used for fuel planning and post-ops analysis (e.g., fuel statistical model developments, which makes it difficult to compare data used at the planning stage with actual flight conditions (re-validation of the assumptions during planning)
	L5 - There is a dispersed / federated ecosystem of digital applications and solutions that use operating conditions data from different sources (e.g., pilots and Dispatch use different

	sources for planning and management), what might be a challenge to ensure common governance and traceability on decision-making at different fuel management stages
	S1 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines that establish minimum requirements for operating conditions data sources in collaboration with authorities and stakeholders for specific fuel reduction applications **[Applicable to L1, L2, L3 and L4]**
	S2 - Regulatory requirements / Guidance Material accounting for specificities in regard with validation of operating conditions data (data reliability) by the adoption of EUROCAE ED-76(A) standards or similar standards **[Applicable to L2, L3 and L4]**
	S3 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines to promote the implementation of systems that consolidate operating conditions data from various sources into a centralized platform **[Applicable to L3 and L4]**
	S4 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines to define clear communication channels / OCCs to share operating conditions data seamlessly **[Applicable to L5]**
	S5 - Publication and promotion by industry bodies or relevant regulatory working groups of guidelines on coordination between pilot/dispatch/fuel team to ensure consistent data usage across different phases (planning, in-flight re-planning, management, and post-ops analysis) **[Applicable to L5]**

As explained in the case of the questionnaire for the EBT topic, the answers of the stakeholders who responded to the fuel questionnaire have allowed to obtain a ranking of the limitations according to their representativeness. Again, participants were asked to assign a score from 1 to 5 for each limitation, and the average of the responses received for each limitation is shown in Figure 3-7.

Figure 3-7 Ranking of the fuel related initial limitations based on the average of the answers

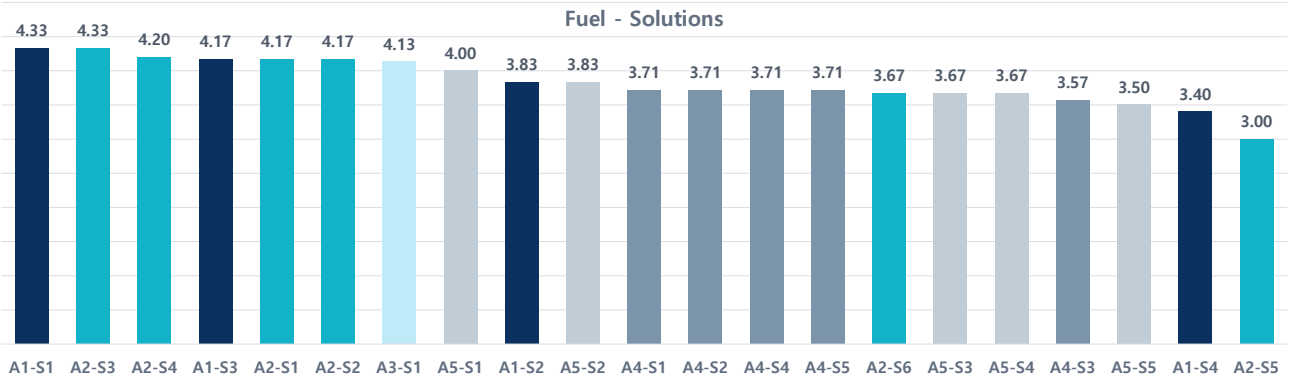


As it can be appreciated in the figure above, two of the three limitations with the highest average belong to the area of the definition of fuel data input for fuel reduction schemes. In particular, the first and the third one is related to the minimum accuracy requirements for fuel-related parameters and to common data quality issues from fuel data streams. This indicates that one of the current concerns of the operators is to ensure data quality. In the second place, there is a limitation related with the Development of statistical and predictive models for fuel reductions. This limitation indicates that there is limited guidance material to develop such models, something that is hindering the operators' possibilities and capabilities to justify fuel reductions. With

the same average as the previous limitation, the next one is on the lack of guidelines for the definition and monitoring of SPIs. What can be derived from this is that there is a need to provide some clarity, thus supporting and easing the continuous oversight of fuel reduction schemes. Finally, with the same average value, the next four solutions are all related to the collection and management of operating conditions data, which also seems to be an important area for the stakeholders. In that context, stakeholders indicate that there are issues regarding the availability of data sources, the reliability and accuracy of the operating conditions data and the ecosystem of digital applications that use this data. These limitations are a clear barrier for the development and deployment of more sophisticated fuel reduction models. In general, but especially for the previously discussed limitations, it is observed that the averages are high, which can be translated into the fact that the limitations presented are indeed aligned with a wider community and stakeholders found them relevant.

In a similar manner, the opinion of the participating stakeholders was collected in terms of the preliminary solutions proposed to address the various limitations detected. The following chart provides an overview of the potential prioritisation of the proposed solutions based on the average of the responses received.

Figure 3-8 Ranking of the fuel related proposed solutions based on the average of the answers



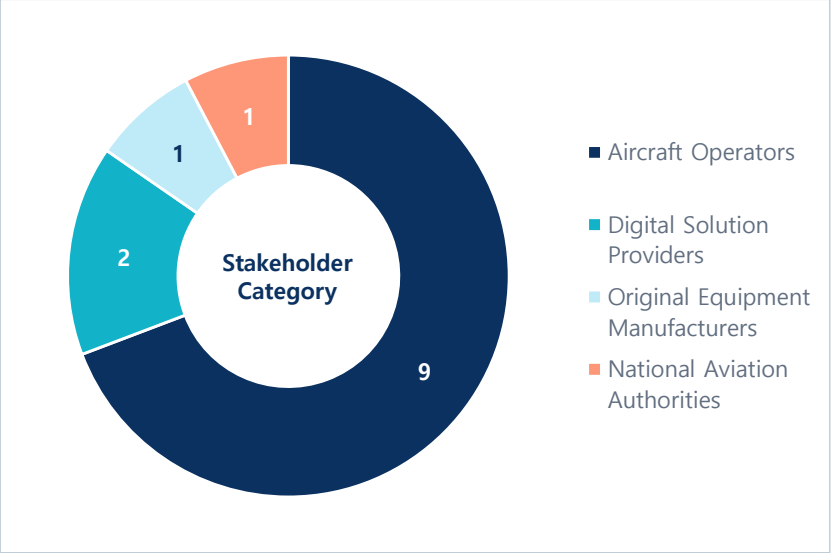
It is possible to infer from the figure above that one of the main focal points for the stakeholders, confirming what has been discussed in the case of the limitations, should be to ensure the quality of the data. That is because the highest scored solution relates with the development of best-practices that establish minimum requirements of fuel-related data for the analysis and models, and the fourth one focuses on the development of best-practices for data validation guidelines to address data quality issues. Likewise, stakeholders also show strong interest in several of the solutions for the area of the development of statistical and predictive models for fuel reductions. Particularly, the second most adequate solution according to the stakeholders relates to guidance capturing what constitutes statistically relevant data, considering factors like representativeness, completeness and timeliness, and the third one focuses on standardised statistical methods and best-practices for advanced fuel-reduction models other than statistical. In both cases, the solutions would serve to reduce the confusion surrounding the models by providing clarity and encouraging standardisation. In the same direction, the fifth highest ranked solution is the publication of guidelines to develop statistical models for fuel reductions, and the sixth one is the development of guidance material establishing a standardised framework for generalising statistical models across different aircraft or operational contexts.

Again, the scores were relatively high in a general basis, so it was considered that the proposed solutions represent a good approach to address the limitations and to be further developed under this case study.

3.3 Case Study 5 - Questionnaire results

With respect to the responses received from the various stakeholders to whom the questionnaire on the FDM topic was distributed, the opinions of 9 operators, 2 digital solutions providers, 1 Original Equipment Manufacturer and 1 National Aviation Authority were collected. Among these operators there are 7 operators with more than 50 aircraft, and 2 with between 10 and 50 aircraft. Thus, the total number of responses received is 13.

Figure 3-9 FDM questionnaire stakeholders' participation



Similarly to the other two case studies, the purpose of the questionnaire was to obtain insights into the significance of certain key limitations identified and the potential adequacy of the initial proposed solutions. The following table outlines these initial limitations and solutions, along with their respective areas:

Area	Initial limitations & Proposed solutions[3]
A1 - The Data Frame Layout (DFL)	**L1** - Operators are limited in their capacity to customise their DFLs due to the cost of the service, the long waiting times and/or their dependence on the disposition of the manufacturer
	L2.1 - Usage of older versions of the ARINC 717 (or 543) standard with less capacity results in a smaller number of parameters recorded, and a degraded performance
	L2.2 - Retrofitting of aircraft with newer versions of the ARINC 717 standard is not possible due to its high cost and/or lack of service from the manufacturer
	L3.1 - Manufacturers generally providing operators only with text-based documentation of their DFLs is a barrier to operator access to flight data, as they lack the expertise and must subcontract the production of a decoding file
	L3.2 - Production of a decoding file is a labour-intensive data entry process, which represents additional work and complexity to software vendors, without adding much value to their product offering

[3] The limitations and solutions numbering differs from the one in D2.1 document of DATAPP project. The limitations and solutions presented in this table are an initial list that has been evolved into the final lists presented in D2.1 with the complete development of the case studies.

	L4 - Formal, direct channels of communication are missing between software vendors and manufacturers. The operator must act as an intermediary, delaying the production of the decoding file
	L5 - For a single aircraft fleet, an operator can have multiple DFLs. This results in higher costs for operators to acquire additional decoding files, and additional complexity for vendors when producing them
	L6 - Usage of proprietary formats for the decoding file, or not allowing its export in an open format, restricts an operator's access to their own data, as they cannot decode data by themselves nor share the file with other vendors
	L7 - The wide variety of aircraft types, and the fact that FDM is not mandatory for them, results in very few suppliers of recording equipment (QARs or equivalent) for FDM purposes
	L8 - Many aircraft are not equipped from factory with a QAR or equivalent equipment and associated cabling, with retrofitting being too expensive
	L9 - Manufacturers may be less experienced in FDM than others whose aircraft must be included into an FDM programme. This results in suboptimal DFLs for FDM purposes
	S1 - Regulatory requirement for manufacturers to provide operators with the possibility to customise and/or update their DFLs (via themselves or a third-party service) **[Applicable to L1, L2.1, L2.2]**
	S2 - Regulatory requirement for manufacturers to provide operators with a decoding file in an open format (such as FRED) together with the documentation **[Applicable to L3.1, L3.2, L6]**
	S3 - Incentivise the creation of formal channels of communication between manufacturers and providers (e.g., repository of DFL-specific manufacturer contact addresses) **[Applicable to L4]**
	S4 - Specific engagement from Authorities or industry bodies (e.g., EOFDM) with manufacturers of aircraft for which an FDM programme is not mandatory, focused on operator needs and industry best-practices **[Applicable to L8, L9]**
A2 - Transitioning to the cloud	**L1.1** - Data processing capacity cannot be efficiently scaled, which does not allow big operators to exploit all the data they generate
	L1.2 - In-house server solutions are generally managed by the operator, which adds complexity to the FDM programme of small operators with few resources
	L2 - Software vendors have many more difficulties updating and maintaining their software (need to integrate and coordinate with operator IT systems)
	L3 - As cloud solutions are adopted, legacy in-house solutions may be increasingly deprecated. If operators want to enjoy new capabilities, they will have difficulties remaining in-house
	L4 - The usage of proprietary decoding file formats, proprietary event algorithms and proprietary programming languages can be a barrier to operators changing providers and moving from in-house to cloud solutions

	L5 - Operators may lose continuity in their FDM programmes, as the analysis of trends will be impacted if it cannot import previous results or cannot modify event definitions to what it had been using
	L6 - Software transitions of any type (in-house to cloud, vendor to other vendor) represent an important workload to operators in order to be trained, configure the system, and validate all software outcomes
	L7.1 - Some tasks required to work with flight data (such as production of a decoding file) have an ill-fitting with the SaaS model, given that they are expensive to perform, infrequent and cannot be automated
	L7.2 - Related with the above limitation, such tasks require vendors to either charge operators for additional fees, or absorb the cost
	L8 - There is a knowledge shift from operators to software vendors. Operators may lose analytical capacity, face more difficulties when changing providers, and lose all visibility over advanced and non-deterministic algorithms (AI)
	S1 - (Equivalent to S2 from "the Data Frame Layout" topic) Regulatory requirement for manufacturers to provide operators with a decoding file in an open format (such as FRED) together with the documentation **[Applicable to L4, L6, L7.1, L7.2]**
	S2 - Regulatory requirement for operators to maintain sufficiently detailed documentation on the events computed, the parameters and algorithms used, and the rationale behind them **[Applicable to L4, L5, L8]**
	S3 - Specific engagement industry bodies (e.g., EOFDM, EAFDM) to ensure the knowledge shift to software vendors does not represent a capability loss for operators **[Applicable to L8]**
	S4 - Clarify the regulatory framework for the usage of non-deterministic algorithms in safety-related processes and the documentation available to the operator **[Applicable to L8]**
A3 - Event definition and documentation	**L1** - Benchmarking of event trends and rates are hampered, requiring the operator to assume a degree of error or compute a second set of standardised events (e.g., large data exchange programmes)
	L2 - Knowledge sharing among operators is less efficient and effective, which can reduce the willingness to share as the benefit is smaller
	L3 - Software vendors may have to define multiple algorithms to capture the same event, as operators may use different definitions
	L4 - Operators and software vendors lack reference information on how to define events they have not evaluated before. Partially addressed by EOFDM/EAFDM publications, but limitation remains

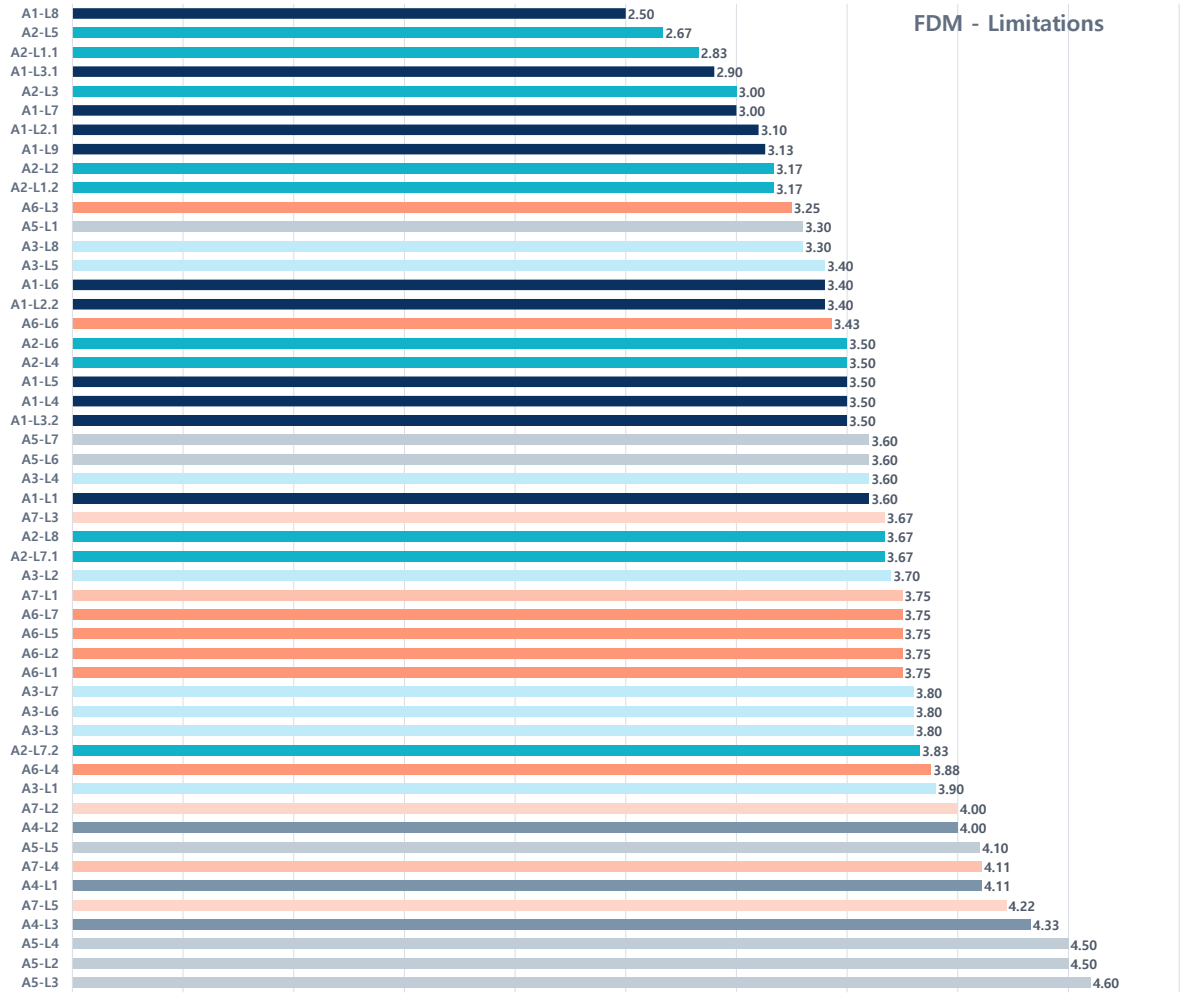
	L5 - Given the difficulties, operators may take a more hands-off approach to event definition, using software vendor-defined logics. This can limit their understanding of the logics and become a liability if changing providers
	L6 - There are no widespread methodologies on how to monitor for risks that are yet to be identified or for which the operator has no visibility (the known unknowns and the unknown unknowns)
	L7 - Loss of knowledge and lack of understanding of the rationale behind a particular event definition and its implementation as time passes (due to rotation of key personnel, simply forgetting, etc.)
	L8 - Soft limit to the number of events that can be maintained, as increasing the number can become unmanageable for a small team of FDM analysts
	S1 - Publication and promotion of industry-agreed event definitions in the context of large data exchange programmes (e.g., FDX, Data4Safety) **[Applicable to L1, L2, L3, L4, L5, L7, L8]**
	S2 - Publication and promotion by industry forums (e.g., EOFDM) of guidelines and industry best-practices on how to define events in general, as well as specific event definitions currently the focus of EASA's European Plan for Aviation Safety (EPAS) **[Applicable to L4, L5, L7]**
	S3 - (Equivalent to S2 from "Transitioning to the cloud" topic) Regulatory requirement for operators to maintain sufficiently detailed documentation on the events computed, the parameters and algorithms used, and the rationale behind them **[Applicable to L7, L8]**
A4 - Fusion of flight data with other data sources	**L1** - Many software solutions still incorporate limited fusion capabilities. Legacy software may not be able to fuse data, requiring in-house developments by the operator
	L2 - Access to data sources is not easy neither for software vendors nor operators. Some sources do not offer public access through APIs, charge fees or are limited in scope
	L3 - Data sources may not follow standardised formats, using instead proprietary or complex formats that require decoding or significant processing. This impact both the cost of fusing a data source, and the utility of doing it
	S1 - Publication and promotion of technical documentation on guidelines and industry best-practices for fusion, supporting both operators and software vendors in adopting these capabilities **[Applicable to L1, L3]**
	S2 - Specific engagement from industry bodies (e.g., EOFDM) or authorities to identify and review potential data sources (in line with "EOFDM - Breaking the Silos" document), and to produce both a repository of access points and recommendations to access such data **[Applicable to L1, L2]**
A5 - Data Governance (access policies	**L1** - Software vendors must adapt their offering to the access policy of each operator. While generally addressable, some conditions can be very limiting (e.g., storage of data in operator servers/in country of operator)
	L2 - Many current access policies are not developed for usage of flight data beyond FDM, as neither unions nor operators were prepared for the wave of digitalisation occurring

	L3 - Operators may be met with significant resistance from flight crews when trying to share flight data for usage outside the operator, such as in exchange programmes
	L4 - Individualized reporting of events and/or flight data to flight crews is still a contentious topic. While some operators have fully adopted such solutions, other stakeholders (e.g., training department, IFALPA, FDM departments) have raised concerns regarding the potential misuse of data
	L5 - Standardised methods for data integration between FDM and SMS have not been stablished. Vendors can try to integrate with other vendors, but the market is so fragmented that the impact of such solutions is limited.
	L6 - Operators trying to integrate information into a BI solution tool separate from both SMS and FDM depend on both their software solutions allowing for timely extraction of data
	L7 - Some vendors offer both FDM and SMS software, which may present difficulties to operators using only one of the two software solutions and who may try to integrate it with a 3rd party solution
	S1 - Specific engagement from authorities or industry bodies (e.g., EAFDM) with operators and crew representatives to identify and review recommendations for data access policies to incorporate new uses of flight data beyond FDM **[Applicable to L2, L3]**
	S2 - Specific engagement from authorities or industry bodies (e.g., EOFDM) with software vendors and operators to further understand the technical challenges behind integration, current experience from operators, and a way forward **[Applicable to L5, L6, L7]**
A6 - Extra topic: Data availability	**L1** - Acquisition costs of wireless transmission equipment (WQAR, ground station, etc.) are high
	L2 - Operators with mixed equipment (wireless and non-wireless) require multiple data pipelines and processes, increasing the overall cost if the whole fleet is not retrofitted
	L3 - Wireless transmission may be too expensive or not reliable enough from particular airports, depending on the operator's network
	L4 - Delays in the reception of data by the operator, as it is retrieved every few days or weeks
	L5 - Risk of data loss if not transmitted in time, as on-board memory may be limited (particularly for older aircraft)
	L6 - Significant cost of retrieving data for operators with few bases or outsourced maintenance, as a certified technician is required
	L7 - Higher risk of issues resulting from human intervention: problems accessing the avionics bay, storage devices not properly inserted, faster wear and tear of storage devices, etc.
	S1 - Regulatory requirement to have a minimum level of flight data availability (e.g., minimum percentage of flights retrieved, maximum time from flight operation to data reception) **[Applicable to all limitations]**

	S2 - Regulatory requirement to equip wireless transmission technology on all aircraft with a newly issued CofA **[Applicable to all limitations]**
A7 - Extra topic: Flight data usage in other safety-relevant processes	**L1** - Delays to the reception of flight data can have outsized impact on other uses of flight data, as these processes can be very time-sensitive
	L2 - The current system of independent decoding by multiple vendors is a cost, governance and efficacy concern for operators. Current solutions based on the ad-hoc collaboration of vendors requires a sometimes long and complex process to establish the necessary agreements and channels of communication and data transfer.
	L3 - Issues arise when having to adapt DFLs to the needs of the different teams. As data needs increase, capacity constraints become more and more critical
	L4 - Operators without proper data governance procedures may have different definitions, logics or algorithms for the same concepts in multiple programmes, blocking interoperability, efficient information sharing and knowledge capitalization (e.g., different definitions of what represents a take-off in fuel management and in FDM)
	L5 - Data access policies in many cases have not developed in parallel to the technical advancements. Such situations risk devolving into two extremes, with either crews not being properly protected, or operators being blocked from realizing these safety and operational benefits
	S1 - (Equivalent to S1 from "Data Availability" topic) Regulatory requirement to have a minimum level of flight data availability (e.g., minimum percentage of flights retrieved, maximum time from flight operation to data reception) **[Applicable to L1]**
	S2 - (Equivalent to S2 from "the Data Frame Layout" topic) Regulatory requirement for manufacturers to provide operators with a decoding file in an open format (such as FRED) together with the documentation **[Applicable to L2]**
	S3 - Publication and promotion by industry bodies (e.g., EOFDM) of guidelines and industry best-practices for data governance **[Applicable to L3, L4]**
	S4 - Publication and promotion by industry bodies (e.g., EOFDM, EBT working groups, etc.) of logic and definition mappings across domains (FDM take-off and fuel take-off, FDM event with EBT observable behaviour, etc.) **[Applicable to L4]**
	S5 - (Equivalent to S1 from "Data Governance" topic) Specific engagement from authorities or industry bodies (e.g., EAFDM) with operators and crew representatives to identify and review recommendations for data access policies to incorporate new uses of flight data beyond FDM **[Applicable to L5]**

The questionnaire provided to the different stakeholders allowed to capture their opinion about the limitations initially identified from the interviews. Responses were obtained for each limitation with a score from 1 to 5 according to their relevance, with 5 being “very relevant” and 1 “not relevant”, and the averages of these responses are shown in Figure 3-10.

Figure 3-10 Ranking of the FDM related limitations based on the average of the answers



Regarding the relevance of the limitations included in the questionnaire, the results show that stakeholders consider various limitations contained in the area of data governance as the most relevant in their context. In that group, the limitation with a higher score is the resistance from flight crews that the operators may encounter when trying to share flight data for usage outside the operator, such as in data exchange programmes. The following limitation relates with the fact that many current access policies are not developed for usage of flight data beyond FDM. And finally, on the third position, the individualised automatic reporting of FDM events and/or flight data to flight crews still raises concerns. While some operators have fully adopted such solutions, others (e.g., training department, IFALPA, FDM departments) have raised concerns regarding the potential misuse of data. In addition, flight crews might have reservations with the automatised system of individual performance monitoring based on FDM, without any human support, as explained in the section "II.3.d Emerging issues" of the EOFDM "Breaking the silos" document. This suggests that more effort still need to be directed towards promoting the correct use of data, including aspects such as data access control and data protection. This is particularly important in the scenario of potential data sharing, where mechanisms should be clearly defined to prevent misuse of data. Afterwards, two of the following three limitations belong to the area of the fusion of flight data with other data sources. In this case the limitation with the most votes is that many software solutions still incorporate limited fusion capabilities, requiring in-house developments by the operator since legacy software may not be able to fuse data. And on the fifth place on the global ranking, the second most relevant limitation in that area is that the data sources may not follow standardised formats, using instead proprietary or complex formats that require decoding or significant processing. This impact both

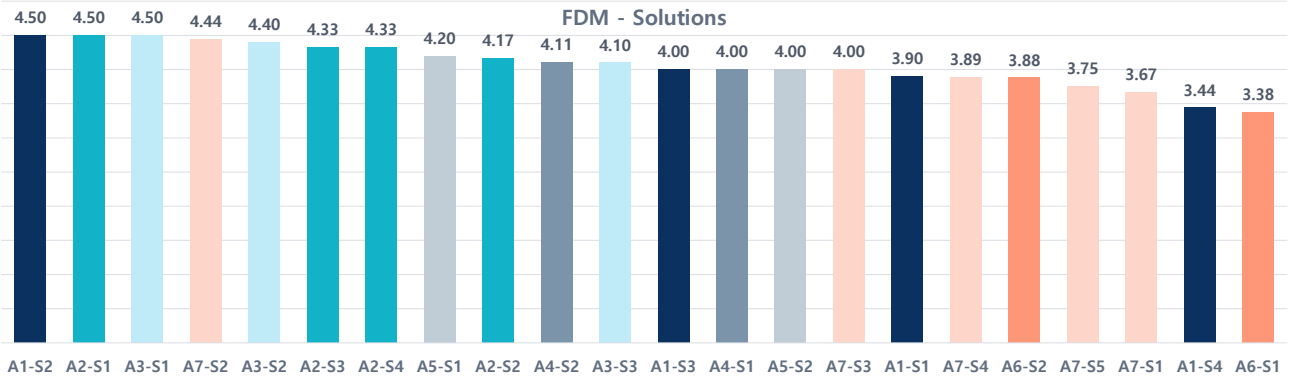
the cost of fusing a data source, and the utility of doing it. Thus, what can be drawn from this is that operators indicate that the capabilities in terms of data integration and fusion need to be further developed, especially with regard to third party tools that could support operators in this domain.

Also relevant is the limitation regarding data access policies which in many cases have not developed in parallel to the technical advancements, which belongs to the area of the flight data usage in other safety-relevant processes. Such situations risk devolving into two extremes, with either crews not being properly protected, or operators being blocked from realising these safety and operational benefits. Hence, once again, operators highlight the relevance of addressing data access policies and modernising them.

From this limitation onwards, the scores for the rest of the limitations are reasonably similar. And finally, there is a group of solutions, mostly from the area of the Data Frame Layout and the area related with transitioning to the cloud, which received the lowest scores, but which should still be considered.

Subsequently, stakeholders were also asked to assign a score from 1 to 5 according to their opinion on the appropriateness of the proposed solutions to address the different limitations presented. The average of the received answers is presented in Figure 3-11.

Figure 3-11 Ranking of the FDM related solutions based on the average of the answers



Although it is true that in the case of the limitations the area to which the three most voted options belonged was the area of data governance, in the context of the possible solutions the results show that the stakeholders pointed out a solution related to the Data Frame Layout area. This solution is a regulatory requirement for manufacturers to provide operators with a decoding file in an open format (e.g., FRED) together with the documentation.

The next solution is tied with the first one in terms of the average of the answers and is an equivalent solution to the one just explained in the Data Frame Layout area (A1-S2), but in this case it relates to the topic of transitioning to the cloud. The position of both solutions allows to determine that stakeholders may consider simplifying the production of the DFL file and to reduce costs as a key point. In addition, it would eliminate the commercial incentive to protect the investment in digitising the documentation, with proprietary formats remaining only for matters of software compatibility.

The third solution, which is also tied in the average of the answers with the two previous solutions, relates to the area of the event definition and documentation. This solution is the publication and promotion of industry-agreed event definitions in the context of large data exchange programmes (e.g., FDX, Data4Safety).

These first three solutions ranked on the top based on the opinion of the stakeholders are closely followed by the next one, which is linked with the area of flight data usage in other safety-relevant processes. However, this solution is again equivalent to the first two solutions on the regulatory requirement for manufacturers to provide operators with a decoding file in an open format together with the documentation. So, it can be considered that stakeholders see it as an even more relevant and adequate solution. In the fifth position, there is again a solution related to the topic of event definition and documentation, as in the third one. But in this

case, the solution is the publication and promotion by industry forums (e.g., EOFDM) of guidelines and industry best-practices on how to define events in general, as well as specific event definitions covering risk areas that are currently the focus of EASA's European Plan for Aviation Safety (EPAS). That indicates that the industry recognises the impact that lack of standardisation and of published guidelines for FDM events and measurements has over their capacity to rapidly and seamlessly include them within their own FDM programmes. This solution is especially relevant when specific risk areas are highlighted in the EPAS and operators do not currently have the means to monitor them. Finally, it shows that industry stakeholders are interested in both the definitions itself and the methodologies followed to produce them, particularly when these are proposed and validated within industry forums (EOFDM).

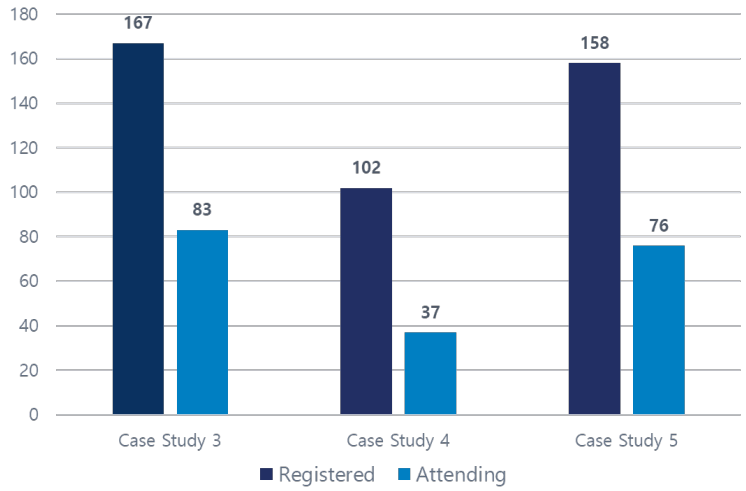
On a general basis, the scores provided were high, which served to validate that the proposed solutions were aligned with the stakeholders interests and that they agree with the appropriateness of such solutions.

4. Workshops on proposed solution strategies

The technical workshops in the context of the project were organised to involve stakeholders in concluding on the results of the development of the case studies. The sessions were designed to be dynamic and encourage the participation of the attendees. For this purpose, the consultant's presentation of the results was intercalated with short live surveys whose results are presented in this section.

As the workshop was structured on three different sessions, each one dedicated to one case study, valuable feedback has been gathered from a diverse group of participants. The total number of attendees is depicted in Figure 4-1 below, together with those previously registered to the session. As expected, the attendance figures drop with respect to the registered, but still maintaining an average of 53% people with availability and high interest in the sessions.

Figure 4-1 Workshops registration and attendance



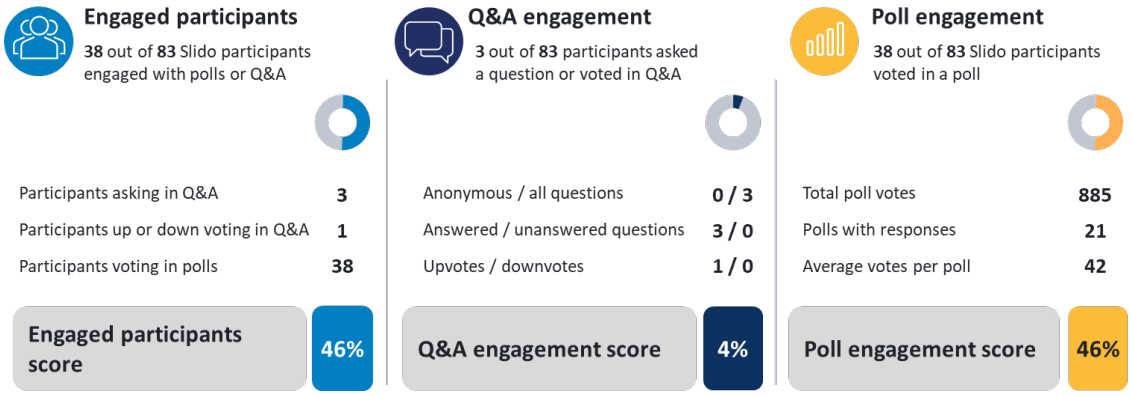
The sessions addressing training data for EBT (Case Study 3) and the flight data models for safety (Case Study 5) had the highest participation, being in line with the maturity of these concepts and their presence on the market. Fuel management, namely the fuel schemes, were launched in 2022 in the regulatory context. This implies lowest maturity being reflected in the lower interest in the session.

The workshop participants generously shared their thoughts and replied to the surveys launched during the sessions using **slido** tool. The following sub-sections present the insights that not only highlight the relevance of the proposed solution strategies, but also serve as a compass for the highest priorities. The data presented reflects the collective voice the community, offering a snapshot of their feedback on the project's results.

4.1 Case Study 3 – Live survey results

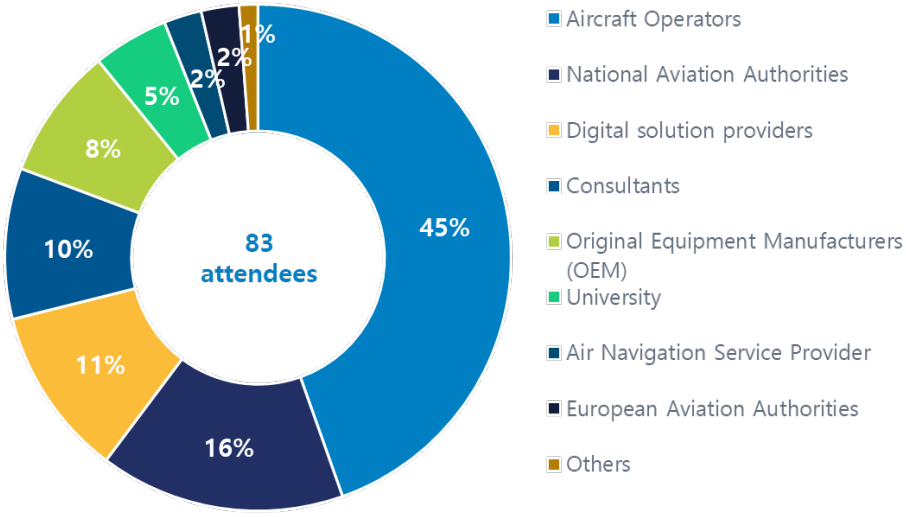
The objective of the workshop was to engage with the attendees and capture their feedback to contribute to the richness of this report. Case Study 3 session achieved 46% of participation from the attendees, as presented in Figure 4-2. Regarding open questions and comments, few were shared and these were to thank and congratulate the best practice example presented by EasyJet as part of the session.

Figure 4-2 Case Study 3 workshop session engagement



The surveys launched as part of the session aimed to uncover stakeholders' preferences and opinions, shedding light on the directions that should be taken to solve the existing limitations in terms of usage of data in the context of EBT programmes implementations and continuous improvement. The results are subjective and aim to reflect the perspective of those responding the polls. Therefore, Figure 4-3 shows that 45% of the attendance was representing the aircraft operators, followed by national aviation authorities, digital solution providers and consultants experts in the topic. Additional stakeholder types had representation in the session, including OEM, universities, ANSPs, EASA and few others that did not reveal their field.

Figure 4-3 Case Study 3 workshop stakeholder types participation



As EBT programme applies to recurrent training, the aircraft operators are the first ones interested in the topic and in looking for solutions to the existing challenges in the current working processes. EBT programme implementation must be validated by the NAAs, thus this category is the second one represented in the session.

The workshop session for EBT was structured in 4 (four) main areas, each one addressing a topic and including a survey on the proposed solutions and elements that should be considered when defining them. For each of these areas, the Figure 4-4 below provides the results on the live survey on the relevance of the solutions proposed by the consultant.

Figure 4-4 Case Study 3 solution prioritisation by workshop attendees

Workshop session area	Cooperation with safety department & programme's customisation	Evaluation of pilots and key training data gathering	Instructor Concordance Assurance Programme	Link with the authorities and their role in EBT
Highest priority Solutions prioritisation	1. **Best-practices to standardise taxonomy between FDM methods and EBT competencies and training topics** 2. Best-practices for easing integration and governance of safety and training department cooperation 3. Best-practices to integrate or fuse inner loop data for customisation and contextualisation of scenarios	1. **GM for standard application of grading system and assessment method and techniques** 2. GM on how to satisfy the established Observable Behaviours 3. GM explicitly highlighting the importance of the debriefing 4. Definition and introduction of a metric for programme difficulty 5. GM capturing desirable capabilities for EBT software supporting EBT evaluations, and its associated risks	1. **Best-practices for standardised metrics and methods to assess agreement and alignment** 2. Creation and provision of "Golden Standards" as reference videos to be used by any operator 3. GM for normalisation of instructors' data 4. Definition of a framework of indicators to assess the appearance of forced concordance 5. Implementation of a tool that allows the operators to manage the ICAP related data	1. **Industry best-practices for standardised metrics to monitor the consistency of EBT programmes** 2. GM defining a recommended framework of KPIs for oversight of EBT programmes 3. Best-practices for sharing authority data with operators 4. Incentivise the creation of collaborative data-driven mechanisms among Authorities and operators 5. Support the definition of specific trainings for the enhancement of the authorities' IT capabilities

The list of solutions is ordered by priority, according to the results obtained in the workshop live survey. The solutions with highest priority are for aircraft operators and those with lowest priority for NAAs, being in line with the stakeholder representativeness at the workshop.

Therefore, the solutions with lowest priority in the survey should also be considered and this report provides the received feedback for all included solutions. The elements for each solution have also been ranked through the workshop live survey. These results are summarised below by indicating the most voted element under each solution, highlighting its importance to be considered when implementing the proposed solutions. The detailed results are provided in Annex IV – Workshop surveys.

1. Cooperation with safety department & programme's customisation

In addition to the **standardised taxonomy between FDM methods and EBT competencies** and training topics, the attendees indicated the key element to be included when defining the other two proposed solutions. The **safety data, events and occurrences to be shared** is the key element to be considered when defining the best practices for easing integration and governance of safety and training department cooperation. The **mapping between events and competencies** represents another key element for the workshop participants in the context of integrating inner loop data for customisation and contextualisation of scenarios within the EBT programme.

2. Evaluation of the pilots and key training data gathering

The **assessment methodologies clarification** has shown the highest interest for the workshop participants in the view of achieving a standard application of grading system and assessment method, the prioritisation of instructors' tasks being the less voted element to be considered. Another urgent need indicated through the survey votes is the **recommendation of debriefing techniques** to highlight its importance for training assessment and evaluation. In the view of defining the capabilities for EBT software supporting evaluations and its associated risks, the **quality of the collected data** should be the key element included with indications on how this can be done. The attendees also consider that the **criteria for assigning the difficulty level** (e.g., included training topics, scenarios or malfunctions) should be the key element to achieve the evaluation of the programme difficulty.

3. Instructor Concordance Assurance Programme (ICAP)

In the framework of ICAP to be defined by operators, there is a clear need for guidance on the **methodologies to assess agreement and alignment**. ICAP related data analysis could be supported by specific tools, which

most of the time are developed in house. The survey shows that the audience consider that the most relevant in this context is the **development of a generic tool for analysing the data,** allowing the implementation event to those operators with limited resources. When defining guidance material for the normalisation of instructors' data, both the **granularity & level of grading metrics to be used** and the **normalisation methods** should be included. The **methodologies to detect and assess forced concordance** also represent high interest among the attendees.

4. Link and communication with the authorities and their role in the EBT

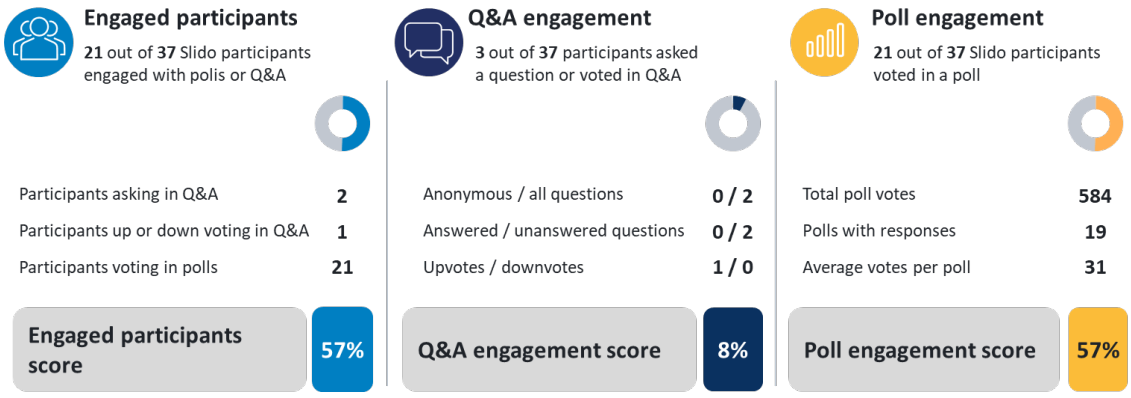
In the context of the sharing of data from authorities to the operators, attendees find the **data sharing methodologies or standards** as a key element to be defined. The **definition of the relevant KPIs** is clearly the most voted aspect regarding the establishment of a framework for supporting the oversight of the programmes by authorities, since defining these KPIs would allow authorities and operators to exchange and use the proper information and indicators. Similarly, the participants showed high interest on the definition of the **relevant metrics to assess and monitor the consistency of the EBT programmes,** which would be beneficial to ensure that consistency**.**

The received feedback guides the ongoing efforts to adjust the proposed solutions and recommendations to address the existing limitations.

4.2 Case Study 4 – Live survey results

Despite the lower attendance to the session dedicated to digital fuel management, the participation reached 57% as presented in Figure 4-5.

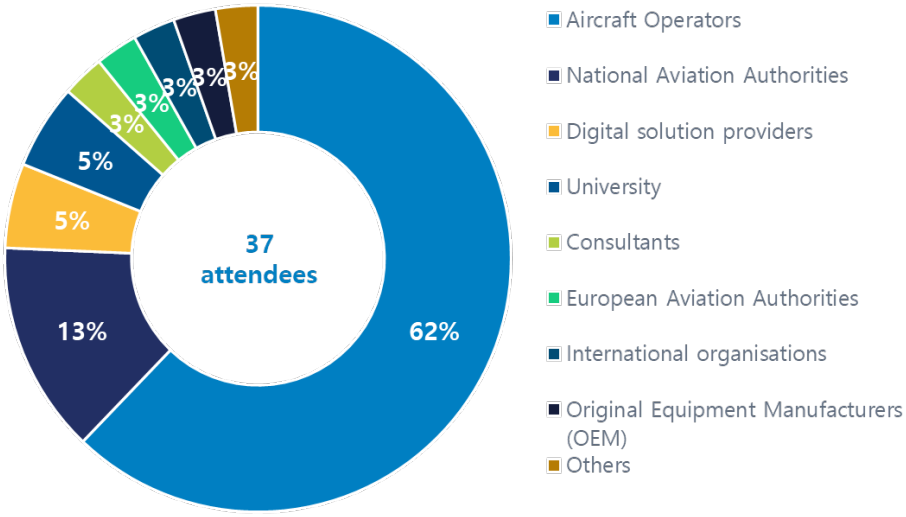
Figure 4-5 Case Study 4 workshop session engagement



Regarding open questions and comments, only two were shared on two different topics. The first comment was related to the consultant's proposal of building a common platform created for fuel efficiency and was raising the concern on the potential benchmark among airlines, which might affect safety margins since not every airline have the same resources to manage those risk. The other statement was congratulating the best practice examples shared by the panellists from Swiss invited to the session.

The analysis on the types of stakeholders attending the workshop sessions reveals that the highest representativeness came from the aircraft operators, followed by the national aviation authorities. The remaining categories only had 1 representative except 2 attendees from digital solutions providers and 2 others from universities.

Figure 4-6 Case Study 4 workshop stakeholder types participation



The fuel workshop was divided into 4 (four) main sections, each of which covered an area and included a survey on suggested solutions and aspects to be considered when defining them. The outcomes of the live survey regarding the suitability of the suggested solutions are presented in Figure 4-7 below for each of these categories.

Figure 4-7 Case Study 4 solution prioritisation by workshop attendees

Workshop session area	Fuel-related data collection & validation	Fuel consumption models	Definition of safety frameworks	Collection & integration of operating conditions
Highest priority Solutions prioritisation	1. **GM/AMC for minimum requirements and selection criteria of fuel-related data sources** 2. Best-practices for the definition of a comprehensive fuel data framework 3. GM/AMC for the alignment of FDM and fuel schemes regulatory requirements 4. GM/AMC for data validation methodologies	1. **GM/AMC that establish a standardised framework for statistical fuel consumption models** 2. Best-practices for the validation and deployment of fuel-related models 3. GM/AMC specifying what constitutes statistically relevant data 4. Best-practices for data sharing and collaboration among operators 5. GM/AMC capturing the need for transparency in algorithm details provided by vendors	1. **GM/AMC for the definition of standardised SPIs frameworks specific to fuel reductions** 2. GM/AMC for the continuous monitoring and reporting of fuelrelated safety performance 3. Collaborative data programmes for the definition and monitoring of safety frameworks 4. GM/AMC for the alignment of fuel initiatives with Safety Management System	1. **Best-practices for the use and monitoring of operating conditions data** 2. GM/AMC for minimum requirements for operating conditions data & its integration 3. Development of centralised platforms

The prioritisation of the proposed solutions for the different areas, based on audience opinion and votes, is depicted in Figure 4-7. It should be considered that a major portion of the participants in the audience were aircraft operators, so these priorities may not be fully representative for all stakeholders. Therefore, it is important not to dismiss any proposed solutions as they could be relevant to other stakeholders. The audience also provided their views on which elements should be considered for certain solutions or areas. The key elements identified and preferred by most of the participants are outlined below, with further detailed information available in Annex IV - Workshop Surveys.

1. Fuel-related data collection & validation

In terms of the minimum requirements and selection criteria of fuel-related data sources, the workshop attendees indicated that the key elements to be included were the **necessary granularity for different types of analyses** and the **recommendation of specific sources for different applications**, both having the same number of votes. In addition, **defining scheme-specific data requirements** was appointed as the key element for a comprehensive fuel data framework. Regarding the data validation methodologies, the most voted option was to include the **minimum accuracy requirements**, closely followed by the **methodologies to ensure data consistency across different aircraft models and sensors.**

2. Fuel consumption models

Regarding the solution **"GM/AMC that establish a standardised framework for statistical fuel consumption models",** the **standardised statistical methods to ensure consistency and reliability in fuel modelling** and the **methodologies for generalising statistical models and guidelines on how to apply them to different aircraft or operational scenarios** were tied in votes as the key elements that should be included. The selected element when specifying what constitutes statistically relevant data was to **provide recommendations on effective data sampling techniques**. And finally, with respect to the transparency in algorithm details provided by vendors, the most popular option was the **traceability of the calculated indicators**.

3. Definition of safety frameworks

Including the **standardised list of SPIs** was the preferred element to be included for the definition of frameworks specific to fuel reductions. While for the continuous monitoring and reporting of fuel-related safety performance, the most voted options for being included were **safety margins** and **monitoring frequency and format**, both tied. For the case of the alignment of fuel initiatives with Safety Management System, the **communication channels and protocols for monitoring SPIs related to fuel initiatives** was the selected element.

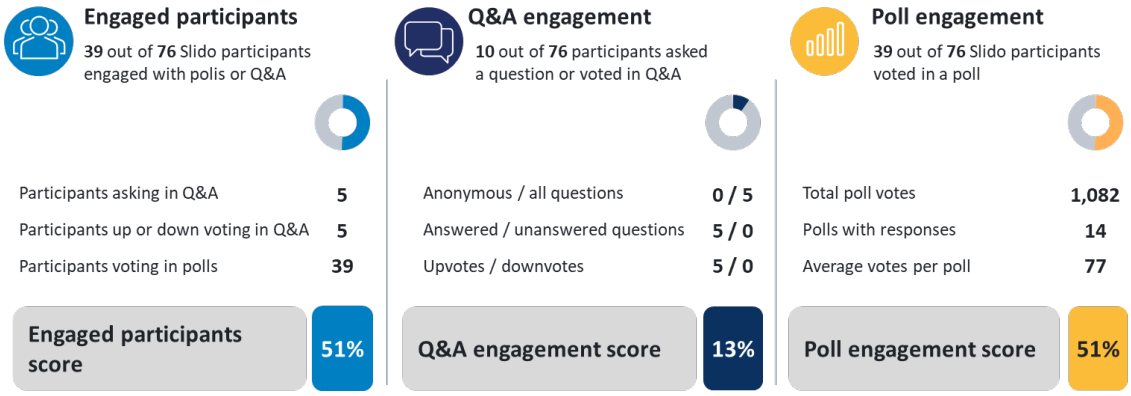
4. Collection & integration of operating conditions

When discussing on the minimum requirements for operating conditions data and its integration, the workshop's participants selected the **reliability, accuracy and completeness** as the most important element to be considered over the **quality assessment methods** and the **standardised data formats**. Similarly, the **communication protocols and channels between dispatch and flight crew** was the key element appointed by the attendees regarding the use and monitoring of operating conditions data.

4.3 Case Study 5 – Live survey results

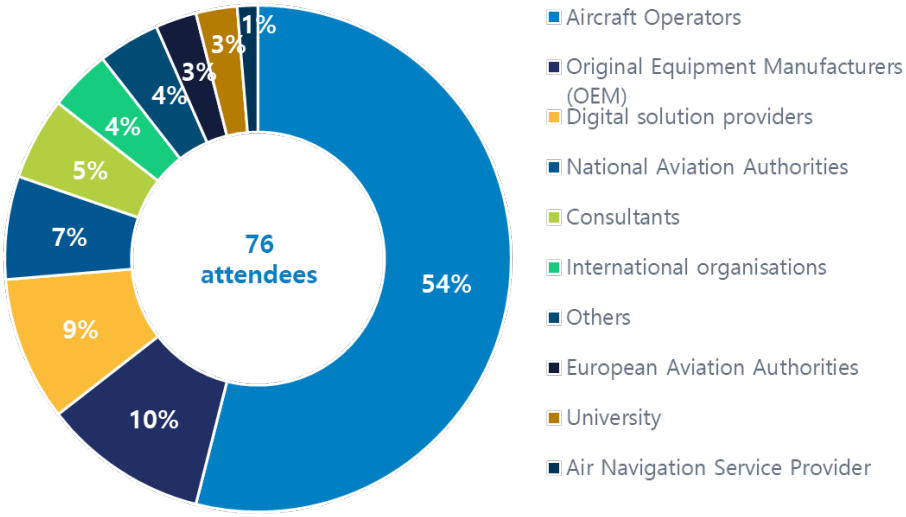
In the case of Case Study 5, 51% of those who attended actively participated, as shown in Figure 4-8. Furthermore, this workshop was the one that received the most questions from the attendees, with a total of 5 questions.

Figure 4-8 Case Study 5 workshop session engagement



The live survey aimed to collect valuable inputs from the stakeholders who attended the workshop, with the objective of considering them to validate and even refine the preliminary solutions presented. In this context, and as reflected in Figure 4-9, more than half of the audience (54%) came from aircraft operators. In addition, the 10% of the participation was coming from Original Equipment Manufacturers (OEM), the 9% from Digital solution providers, all along with other types of stakeholders with a smaller presence such as NAAs, consultants, international organisation, Universities, ANSPs or EASA.

Figure 4-9 Case Study 5 workshop stakeholder types participation



The FDM workshop session was distributed in 3 (three) main areas, each one addressing a topic and including a survey on the proposed solutions and elements that should be considered when defining them. For each of these areas, the results of the live survey on the prioritisation of the different proposed solutions are presented in Figure 4-10 below.

Figure 4-10 Case Study 5 solution prioritisation by workshop attendees

Workshop session area	Production of the Data Frame Layout decoding file	Standardising flight data collection and processing	Knowledge management for FDM programmes
Highest priority Solutions prioritisation	1. **Generalisation of DFL electronic documentation through regulatory requirement**	1. **Development of Flight Parameter Reference document with flight parameters and recommended performance** 2. Promotion of the "Developing Standardised FDM-based indicators" document 3. Promote manufacturer definition of Data Frame Layouts with extensive selection of flight parameters 4. AMC on minimum list of risk areas to be monitored by operators 5. Large data exchange programme	1. **Guidance Material on analysis of causal factors for FDM events and definition of corrective measures within the SRM process** 2. AMC for minimum set of documentation and information to be maintained by the operator 3. Invite and integrate manufacturers and software vendors to the European Operators FDM forum (EOFDM forum) 4. Develop a mandatory course for FDM analysts (and associated certification) on the flight data and analysis methodologies

The figure above shows the order of priorities in terms of the proposed solutions for each of the presented areas, which are based on the opinion and votes received from the audience. These priorities are influenced by the participation of the audience, which, as mentioned above, included a majority of aircraft operator representatives. For this reason, none of the proposed solutions should be dismissed as they may be even more relevant for other types of stakeholders. In addition, the audience was also asked for their opinion on what elements should potentially be considered for some of the solutions or areas. The elements identified as key by most participants are explained below, and the full details or vision are provided in Annex IV - Workshop surveys.

1. Production of the Data Frame Layout

The stakeholders who responded the live survey claimed that the **diversity in the number of existing Data Frame Layouts** was the most relevant factor to explain the elevated costs of producing the decoding file, also pointing to the **slow and/or manual data entry process** as the second most voted option. In terms of impacts of the production costs, the selected top priority is addressing the **cost for operator to have a decoding file produced**. While regarding the elements to be included for the generalisation of DFL electronic documentation through regulatory requirement, the preferred ones were the **production of the electronic document by the manufacturer** and the **usage of open formats such as FRED**.

2. Standardising flight data collection and processing[4]

For promoting the manufacturer definition of Data Frame Layout with extensive selection of flight parameters, attendees selected the **parameters need for other safety-relevant purposes** as the key element to be considered, however, the **minimum list of parameters and performance to be captured** was ranked on the second place being close in terms of votes. Workshop's participants also selected the **list of necessary or**

[4] The title has been modified after the workshop, where the initial title was "Standardising FDM programmes".

recommended parameters for FDM as the main point to be included in the development of Flight Parameter Reference document, being the standardised nomenclature the second most selected option. Regarding the sharing of algorithms, definitions and logics within a large data exchange programme, the preferred element to be considered was the **definition of the FDM event and the associated algorithm**. And finally, attendees chose the **FDM events definitions or algorithms that can be used to monitor the risk area** as the element to be considered in the context of the AMC on minimum list of risk areas to be monitored by operators through their FDM programmes.

3. Knowledge management for FDM programmes

The **flight parameters collected or used in FDM programme** were clearly highlighted by the attendees as the key element to be considered in the AMC for minimum set of documentation and information to be maintained by the operator. Similarly, the a**nalysis of individual events and trends, including the identification of causal factors** was the most voted topic for being considered for the proposed mandatory course for FDM analyst on the flight data and analysis methodologies, but in that case the other included options also had a high number of votes. In terms of the Guidance Material on the analysis of causal factors for FDM events and definition of corrective measures within the SRM process, the **mapping between FDM events or trends and causal factors** should be the key element to be considered, following the opinion of the attendees. The **official channels for knowledge transmission** were selected as the main element over other options such as **specific manufacturer or software vendor forum** for being considered in the context of inviting and integrating manufacturers and software vendors to the European Operators FDM forum (EOFDM).

5. Conclusions

The case studies development has been highly dependent on the stakeholder consultation process. Information and feedback coming from the stakeholders represents the main input for the current situation description and the identification of challenges. The webinars and workshops held under the scope of the project have allowed sharing the project results with the community and validating the proposed solutions through dedicated questionnaires and live surveys.

The first webinars of the project have been organised when the early results become available to refine the direction of the research and capture initial feedback. The webinar session itself represented the first event where the project team shared details on the work done and the preliminary results. The average attendance to the webinar was around 110 participants, CS3 session reaching the maximum attendance, while CS4 the lowest. The recording of the discussion allowed the sharing of projects' details after the sessions, giving the opportunity to get informed on the project progress to those not available to join live. The consultant received a generalised feeling that the research was going into the right direction and allowed the launch of a questionnaire dedicated to each case study.

The objective of these questionnaires was to validate the identified limitations in current processes, thus supporting and providing guidance for the search of appropriate solutions. Up to 32 responses were received through dissemination on the project's website and LinkedIn postings, specifically 11 responses for EBT in CS3, 8 for fuel management in CS4 and 13 for FDM in CS5.

In the context of EBT, the results show that concerns centre around the absence of a common taxonomy facilitating data sharing between training and safety departments, coupled with a lack of governance between these departments. Recognising these challenges highlights the necessity of promoting and strengthening collaboration between departments, ultimately enhancing the EBT programmes' customisation. Additionally, stakeholders express the need associated to the limited guidance available to authorities regarding the data and metrics that operators should share, hindering the effective monitoring of EBT programs. Another significant limitation identified is the occurrence of forced concordance among instructors, closely followed by concerns about the flexibility of methodologies and techniques for evaluations, the need for metrics assessing programme's difficulty, and the absence of a framework of Key Performance Indicators (KPIs) for monitoring the programme effectiveness.

Regarding the preliminary solutions included in the questionnaire, the ones with the highest average scores prioritise the establishment of "Golden Standards" for instructor alignment assessment and the creation of collaborative data-driven mechanisms among authorities. This underscores stakeholders' primary concern for instructor concordance and data reliability. In addition, the customisation of programmes emerges as a key area requiring support, with solutions addressing collaboration frameworks between safety and training departments, integration of safety data, and standardisation of taxonomy for effective information exchange.

For the case of the fuel-related questionnaire, the results underscore stakeholders' current emphasis on ensuring data quality, since two of the three limitations with the highest average relate to defining fuel data input for fuel reduction schemes, focusing on minimum accuracy requirements and common data quality issues. The second highest scored limitation involves the development of statistical and predictive models for fuel reduction, indicating a lack of guidance material hindering operators' ability to justify fuel reductions. Similarly, the lack of guidelines for defining and monitoring SPIs is also underlined, signalling a need for clarity to facilitate continuous oversight of fuel reduction schemes. In addition, the results also reveal stakeholders' concerns about data source availability, reliability, and the ecosystem of digital applications in the context of operating conditions data.

In terms of the proposed solutions, stakeholders place a crucial emphasis on ensuring data quality, aligning with the earlier discussion of limitations. The highest-rated solution revolves around developing best practices that set minimum requirements for fuel-related data, while the fourth solution targets data quality issues

through the establishment of validation guidelines. Additionally, stakeholders express substantial interest in solutions for developing statistical and predictive models for fuel reductions, focusing on guidance for determining statistically relevant data, addressing factors like representativeness and completeness. Similarly, the third solution advocates standardised statistical methods for advanced fuel-reduction models, aiming to provide clarity and standardisation.

And finally for the CS5 questionnaire, the results underscore the paramount importance placed by stakeholders on data governance limitations, particularly in the context of flight data sharing. Flight crews concerns about sharing data with third parties, the inadequacy of current access policies for broader flight data usage, and the contentious issue of individualised and automated reporting highlight challenges that demand focused efforts. The need for promoting correct data use, emphasising aspects like access control and protection, emerges as crucial, especially in scenarios of potential data sharing. Subsequently, the answers regarding limitations related to the fusion of flight data with other sources reveal the operators' concerns about the limited capabilities of current software solutions and non-standardised data formats, emphasising the call for further development in data integration capabilities, especially for third party tools.

The stakeholders' focus on data governance limitations doesn't fully align with their prioritisation of the preliminary solutions since the top-ranked solution involves regulatory requirements for manufacturers to provide operators with an open-format decoding file and documentation. This underscores a keen interest in simplifying Data Frame Layout production and reducing costs. This interest is reinforced as the next highest ranked solution is tied for the second place and is equivalent to the previous solution.. The third equally preferred solution addresses event definition and documentation, calling for the publication and promotion of industry-agreed event definitions within large data exchange programs. These solutions highlight stakeholders' expectations regarding standardisation, cost reduction, and industry collaboration, underlining the importance of aligning data practices across the aviation sector. In the fifth position, there is again a solution related to the topic of event definition and documentation, which is the publication and promotion by industry forums (e.g., EOFDM) of guidelines and industry best-practices on how to define events in general. This reflects the industry's recognition of the lack of standardisation and published guidelines on FDM events and measurements. The emphasis on both event definitions and the methodologies proposed and validated within industry forums highlights stakeholders' keen interest in ensuring comprehensive and standardised practices within their Flight Data Monitoring (FDM) programmes.

Similarly for all three questionnaires, the results obtained suggested that the solutions identified, and the proposed solutions were fairly aligned with the stakeholders' opinions. Therefore, the approach of most of them has been maintained when planning the different technical workshops where the aim was to further validate the proposed solutions, gathering relevant inputs from stakeholders to refine these solutions.

The technical workshops were organised in hybrid mode to validate the results and prepare the next steps of the project. The event was disseminated through the project website, LinkedIn posts and also through invitations to targeted stakeholders. This resulted in sessions with high participation, namely 83 attendees for CS3, 37 for CS4 and 76 for CS5. The sessions addressing training data for EBT (CS3) and the flight data models for safety (CS5) had the highest participation, being in line with the maturity of these concepts and their presence on the market. Fuel management, namely the fuel schemes, were launched in 2022 in the regulatory context that implies lowest maturity being reflected in the lower interest in the session.

The sessions were designed to be dynamic and encouraged the participation of the attendees. Each of the sessions included short live surveys to which 50% of the attendees replied and provided feedback related to the proposed solutions and the elements that should be considered within their definition.

The assessment of the replies received to the live survey during each of the sessions allows identifying the priority for the implementation of the proposed solutions. This might be seen in the perspective of the industry representatives at the sessions. Most of the attendees were aircraft operators, followed by national aviation authorities and digital software providers. OEMs were also highly represented in CS5 session where they have a direct role and impact.

As a data-driven programme, EBT's implementation implies the collection of data from multiple sources, both internal and external to the programme and the operator. CS3 has analysed the data related processes and identified the main areas where limitations exist and where solutions are proposed to ease the adoption of EBT making maximum use of the data. According to the live survey replies, highest priority should be given to the development of best-practices to standardise taxonomy between FDM methods and EBT competencies and training topics; guidance material for standard application of grading system and assessment method and techniques; best-practices for standardised metrics and methods to assess agreement and alignment and also industry best-practices for standardised metrics to monitor the consistency of EBT programmes. All solutions apply to aircraft operators, being 45% of the attendance to the session.

The investigation of the digital fuel management process done under CS4 has allowed identifying the most frequent limitations related to fuel-related data collection, the development of fuel reductions models, safety performance and operational conditions data. For each one of these areas, the workshop participant expressed their priority for the solutions that should be adopted to solve the limitations and ease the implementation of fuel scheme towards higher flight efficiency and ultimately lower environmental impact. The survey replies indicate that there is an urgent need for guidance material or even development of applicable means of compliance where to outline the minimum requirements and selection criteria of fuel-related data sources and to define standardised SPIs frameworks specific to fuel reductions. In addition, best-practices for the use and monitoring of operating conditions data is also perceived as a priority from the community. This feedback comes from the stakeholders participating to the workshop session, 62% of which being aircraft operators.

CS5 addresses the flight data models for safety purposes, going from the decoding to the exiting tools within FDM programmes. The perspective shown during the workshop session on the identified limitations from the deep analysis of the current working process has allowed the audience to have the information needed for the prioritisation of the proposed solutions. The live survey results show that the development of Flight Parameter Reference document with minimum list of flight parameters and recommended performance should be given priority as well as the analysis of causal factors for FDM events within the SRM process.

The prioritisation obtained within each of the sessions, together with the details on the key elements voted by the participation for each of the solutions in the survey represent a key input in concluding the development of the case study and in the development of Task 3 under the scope of the project, where the necessary changes to the standards and regulatory material will be recommended. It is worth highlighting that the results of this research will consist in a list of recommendations with an associated roadmap together with a set of more detailed solutions for EASA to evaluate which would be the further evolution of these proposals.

6. Annex I – Webinar materials

6.1 Presentations

Available material on project's website in downloads.

6.2 Recordings

Each of the sessions held was recorded and is currently available on EASA's YouTube channel at the following links:

- Current barriers and challenges for the implementation and enhancement of EBT/CBTA programmes – Watch here
- Unveiling key challenges in current operations for fuel management – Watch here
- Overcoming limitations and unleashing the potential of Flight Data – Watch here

7. Annex II - Questionnaires

Complementary document to this report: “DATAPP D-2.2 Annex II – Questionnaires”

8. Annex III - Workshop materials

Available material on project's website in Past events.

9. Annex IV - Workshop surveys

Complementary document to this report: “DATAPP D-2.2 Annex IV – Workshop surveys”

European Union Aviation Safety Agency

Konrad-Adenauer-Ufer 3
50668 Cologne
Germany
DATAPP (Digital Transformation - Case Studies for Aviation Safety Standards – Data Science Applications) | EASA (europa.eu)

Mail **EASA.research@easa.europa.eu**
Web **www.easa.europa.eu**

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