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RESEARCH PROJECT EASA.2022.HVP.01

D-3.1 REPORT OF THE MAIN CHANGES REQUIRED TO REGULATORY MATERIALS AND STANDARDS

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

An Agency of the European Union

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EXECUTIVE SUMMARY

Problem area

Digitalisation is reshaping the aviation business at quick pace, bringing efficiency and wider opportunities to manage information. The deployment of digital solutions throughout the air transport industry is a fact and brings significant changes to the traditional working processes, business models, standards, and regulations.

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 in order 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 is part of the "Digital Transformation – Case Studies for Aviation Safety Standards" project (EASA.2022.HVP.01- Horizon Europe Project) and builds on the work presented in 'D-2.1 Development of the case study' which identified current limitations and proposed solutions across the three case studies. To support the implementation of the proposed solution, a review of these solutions was conducted with reference to the current EASA regulatory framework and the Notice of Proposed Amendments 2024-02. The regulatory review has identified where the existing regulations are still applicable, or where amendments or addition to the current regulations, acceptable means of compliance and guidance material will be required.

Results and Application

Case study 3: Flight training data for EBT/CBTA

- A total of 56 solutions were proposed, of which:
    - Three were identified as requiring new regulation, AMC or GM
    - 10 require partial modification to existing regulation, AMC or GM
    - Seven do not require updates to regulation, AMC or GM

- 36 are Non-regulatory solutions[1]

Case study 4: Digital fuel management

- A total of 55 solutions were proposed, of which:
  - One was identified as requiring new regulation, AMC or GM
  - 19 require partial modification to existing regulation, AMC or GM
  - One not requiring updates to regulation, AMC or GM
  - 33 are Non-regulatory solutions[1]

Case study 5: Flight data models for safety

- A total of 25 solutions were proposed, of which:
  - Four were identified as requiring new requirements, AMC or GM
  - Two require partial modification to existing requirements, AMC or GM
  - Four require partial modification to existing requirements, AMC or GM if NPA 2024-02 is adopted
  - Five not requiring updates to requirements, AMC or GM if NPA 2024–02 is adopted
  - 10 are Non-regulatory solutions[1].

[1] These are explicitly excluded from the regulatory analysis.

CONTENTS

ABBREVIATIONS

ACRONYM	DESCRIPTION
ACARS	Aircraft Communication Addressing and Reporting System
AMC	Acceptance Means of Compliance
AOC	Air Operator Certification (Subpart)
APCH	Approach
ARO	Authority Requirements for Air Operations (Part)
ASF	Aeroplane Stable Frame
ASIAS	FAA Aviation Safety Information Analysis and Sharing
ASR	Aerodrome Surveillance Radar
ATC	Air Traffic Control
ATQP	Alternative Training and Qualification Programme
ATS	Air Traffic Services
CA	Cabin Attendant
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT	Commercial Air Transport Operations (Part)
CBTA	Competency Based Training and Assessment
CDM	Collaborative Decision-Making
CofA	Certificate of Airworthiness
CS	Certification Specification
D4S	Data4Safety
DFDR	Digital Flight Data Recorder
DFL	Data Frame Layout
EASA	European Union Aviation Safety Agency
EBT	Evidence Based Training
EBTI	Evidence Based Training Implementation
EC	European Commission
EFB	Electronic Flight Bags
EOFDM	European Operators Flight Data Monitoring
ERA	En Route Alternate
EU	European Union
FAA	Federal Aviation Administration
FC	Flight Crew (Subpart)
FCL	Flight Crew Licencing (Part)
FCM	Fuel Consumption Monitoring
FDAP	Flight Data Analysis Program
FDM	Flight Data Monitoring
FDR	Flight Data Recorder

ACRONYM	DESCRIPTION
FDX	IATA Flight Data Exchange
FMS	Flight Management System
FPFM	Flight Planning and Fuel Management
FPR	Flight Parameter Reference
FRCS	Flight Recorder Configuration Standard
FRED	Flight Recorder Electronic Documentation
FRF	Final Reserve Fuel
FSTD	Flight Simulation Training Device
GDPR	General Data Protection Regulation
GEN	General requirements (Subpart)
GM	Guidance Material
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICAP	Instructor Concordance Assurance Programme
IDE	Instruments, Data and Equipment (Subpart)
IE	Instructor Evaluator
IPR	Intellectual Property Rights
IT	Information Technology
KPI	Key Performance Indicator
LOQE	Line Oriented Quality Evaluation
LOSA	Line Operations Safety Assessment
LVO	Low Visibility Operations
LVP	Low Visibility Procedures
MAB	Mass and Balance
MLR	Manuals, Logs and Records (Subpart)
MPA	Motor-Powered Aircraft
MCTOM	Max Commercial Take Off Mass
NAA	National Aviation Authority
NDA	Non-Disclosure Agreement
NM	Nautical Mile
NOTAM	Notice to Air Mission
NPA	Non-Precision Approach
OB	Observable behaviour
OM	Operations Manual
OMD	Operations Manual Part D
OPS	Air Operations (Subpart)
OPS	Operation
ORG	Organisation
ORO	Organisations Requirements for Air Operations (Part)
PNR	Point of no Return
POL	Performance and Operating Limitations (Subpart)

ACRONYM	DESCRIPTION
QAR	Quick Access Recorder
RCF	Reduced Contingency Fuel
RNAV	Remote continental airspace and in area Navigation
RNP	Required Navigation Performance
SAB	Stakeholder Advisory Body
SAR	Specific Air Range
SARPs	Standards And Recommended Practices
SCF	Statistical Contingency Fuel
SFC	Specific Fuel Consumption
SME	Subject Matter Expert
SMS	Safety Management Systems
SOL	Solution
SOPs	Standard Operating Procedures
SPA	Operations requiring Specific Approvals (Part)
SPI	Safety Performance Indicator
SPT	Safety Promotion Task
SRM	Safety Risk Management
TEC	Technology & Data
UAS	Unmanned Aircraft System
UC	Use Case
UK	United Kingdom
VCA	VTOL-capable aircraft
VNAV	Vertical Navigation
VTOL	Vertical Take-Off and Landing
WQAR	Wireless GroundLink Quick Access Recorder
ZFW	Zero Fuel Weight

1. Introduction

1.1 Background

Digitalisation is reshaping the aviation business at quick pace, bringing efficiency and wider opportunities to manage information. The deployment of digital solutions throughout the air transport industry is a fact and brings significant changes to the traditional working processes, business models, standards, and regulations.

In its role of EU Aviation Safety Regulator, 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. For that, identifying the key main applications in that area in the form of case studies, allows to better picture us in what is to come and will allow translating that future into recommendations for standardisation and regulations.

This project aims at evaluating a series of changes applied to aviation products, processes and operations resulting from the deployment of new digital solutions with a focus on measuring the impact on safety standards and regulatory materials as well as to prepare their evolutions. The project is built upon three case studies allowing to develop a comprehensive investigation of the key changes at stake:

- Case Study 3: Flight training data for EBT/CBTA. The case study will encompass the development of comprehensive guidelines for moving towards the implementation of EBT and CBTA concepts.
- Case Study 4: Digital fuel management. The project will encompass the in-depth analysis of the benefits and constraints associated to state-of-the-art digital solutions for fuel management, considering the current safety issues reported, as well as the preparation of comprehensive documentation to support the proposed evolution of standards and regulatory requirements.
- Case Study 5: Flight data models for safety. The proposed case study will investigate the development of comprehensive data models 'bridging' between the flight data sources and their use for the operator's safety-relevant processes and for industry-wide data exchange programmes.

1.2 Scope of the report

This report represents deliverable 'D-3.1 Report of the main changes required to regulatory materials and standards' of "Digital Transformation – Case Studies for Aviation Safety Standards" project (EASA.2022.HVP.01- Horizon Europe Project). It provides an overview of the current regulatory framework of each of the Case Studies under the scope of the project.

The present document is structured as follows:

- Section 2 provides a summary of the review of the requirements, AMC and GM against each case study and presents the key findings.
- Section 3 provides the in-depth review of the requirements, AMC and GM for the Flight training data for EBT/CBTA case study.
- Section 4 provides the in-depth review of the requirements, AMC and GM for the Digital fuel management case study.
- Section 5 provides the in-depth review of the requirements, AMC and GM for the Flight data models for safety case study.
- Section 6 concludes on the review of the requirements, AMC and GM performed for each of the cases studies.
- Section 7 lists the reference material consulted during the development of this analysis.

1.3 Methodology

Each case study was assigned to an individual to conduct the review of the solutions proposed by DATAPP project against the current EASA requirements, AMC and GM as well as other relevant requirements, standards and documents that were considered relevant to each case study. Where it was determined that the proposed solution was not a regulatory requirement, (e.g. industry best practice) it was explicitly excluded from the regulatory gap analysis. The details on the solutions can be found in "D2.1 Development of the case studies", also delivered by DATAPP project.

The review focused on the following aspects:

- Do the current requirements, AMC or GM provide sufficient information for the solution to be enacted upon without the need for modifications or amendments?
    - If NPA 2024-02 is adopted is the above statement is correct?
    - Do the current requirements, AMC or GM partial enable the proposed solution, and where the gaps are? If NPA 2024-02 is adopted is the above statement is correct?
- Do the current requirements, AMC or GM not enable the implementation of the proposed solutions?
- What non-aviation standards may be applicable?

Where either no, or only partial requirements, AMC or GM could be identified, recommendations or consideration were provided as to what changes may be required to enable the solutions proposed by DATAPP project.

The following template has been used to structure the analysis and capture the existing gap between the proposed solutions and the existing AMC, GM and standards.

Solution
ID and title of the solution proposed and defined under "D2.1 Development of the case studies" of DATAPP project
Description
Description of the solution, extracted from D-2.1
Limitation(s):
ID and title of the limitation identified in "D2.1 Development of the case studies" of DATAPP project
EU AMC, GM & Standards (applicable, but not to be amended)
Current Requirements, AMC, GM or regulations applicable to the proposed solution. These might be impacted, **but not to be amended**.
Is the solution covered by the existing EU requirements, AMC and GM?
Identification of existing requirements, AMC, GM cover the proposed solution • Yes = current Requirements, AMC, GM cover the proposed solution • Yes if NPA adopted = proposed amendments in NPA 2024-02, if adopted cover the proposed solution • Partial = current requirements, AMC, GM cover some of the proposed solution, but modifications would be required • Partial, if NPA adopted = proposed amendments in NPA 2024-02, if adopted cover some of the proposed solution, but some modifications would still be required • No = the current requirements, AMC or GM do not cover the proposed solution
Gaps in Regulation vs Recommendations
Information on the gaps identified and potential solutions or approaches where applicable

2. Regulatory review summaries

2.1 Case study 3 Flight training data for EBT/CBTA

The regulations applicable to the Approval of an Operator's EBT programme are comprehensive and provide sufficient guidance to enable the Operator to develop and introduce a compliant training system.

However, consideration of the specific issues associated with the management of training data and the identification of key challenges with development of EBT programmes have revealed some minor gaps in regulation, but further development of the EBT Manual to enhance guidance material should be the focus.

A summary of the identified gaps is in Table 3-1. The full analysis is in chapter 3 (page 18).

Reference materials used within the review of Flight raining data for EBT/CBTA:

- EASA Easy Access Rules for Air Operations (Regulation (EU) No 965/2012)
- Notice of Proposed Amendment 2024-02 - Enhanced implementation of FDM programmes and miscellaneous amendments
- The General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679
- CAP 700 – Operational safety competences, training, and proficiency checks 2023
- CAP 737 – Flight crew human factors handbook 2023
- CAP 1715 – Competency assessment guidance document 2019.

Table 3-1 Summary of regulatory review - Case study 3 - Flight training data for EBT/CBTA

Solution	Gaps in regulations/AMC/GM	Description
UC3.1-SOL.1	Non-regulatory solution	
UC3.1-SOL.2	Non regulatory solution	
UC3.1-SOL.3	Non-regulatory solution	
UC3.1-SOL.4	No	
UC3.1-SOL.5	Non-regulatory solution	
UC3.1-SOL.6	Non-regulatory solution	
UC3.1-SOL.7	Partial	Addition of guidance to EBT manual
UC3.1-SOL.8	Non-regulatory solution	
UC3.1-SOL.9	Non-regulatory solution	
UC3.1-SOL.10	Non-regulatory solution	
UC3.1-SOL11	Non-regulatory solution	
UC3.1-SOL12	Non-regulatory solution	
UC3.1-SOL.13	Non-regulatory solution	
UC3.1-SOL.14	Non-regulatory solution	
UC3.1-SOL.15	Non-regulatory solution	
UC3.1-SOL.16	Non-regulatory solution	
UC3.1-SOL.17	Non-regulatory solution	
UC3.1-SOL.18	Non-regulatory solution	
UC3.1-SOL.19	Non-regulatory solution	
UC3.1-SOL.20	Non-regulatory solution	
UC3.1-SOL.21	Non-regulatory solution	
UC3.1-SOL.22	Non-regulatory solution	
UC3.1-SOL.23	Non-regulatory solution	
UC3.1-SOL24	Non-regulatory solution	
UC3.1-SOL.25	Non-regulatory solution	
UC3.1-SOL.26	Non-regulatory solution	
UC3.1-SOL.27	Non-regulatory solution	
UC3.2-SOL.1	Yes	More well-defined regulatory link between FDM and EBT required.
UC3.2-SOL.2	No	
UC3.2-SOL.3	Partial	• Amend ORO.GEN.200 to include text encouraging the sharing of data with industry

Solution	Gaps in regulations/AMC/GM	Description
		• Amend ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data
UC3.2-SOL.4	Non-regulatory solution	
UC3.2-SOL.5	Partial	Additional GM added to ORO.FC.231(a)
UC3.2-SOL.6	Partial	Additional GM added to ORO.FC.131(a)
UC3.2-SOL.7	Partial	• Amend ORO.GEN.200 to include text encouraging the sharing of data with industry • Amend ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.
UC3.2-SOL.8	Partial	• Amend ORO.GEN.200 to include text encouraging the sharing of data with industry • Amend ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.
UC3.2-SOL.9	Partial	• Amend ORO.GEN.200 to include text encouraging the sharing of data with industry • Amend ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data
UC3.2-SOL.10	Yes	Enhance ORO.AOC.130 AMC and GM to include relevant guidance
UC3.2-SOL.11	Partial	Enhance provisions within ORO.GEN.200 (GM) to include controls of access to safety data
UC3.2-SOL.12	No	
UC3.2-SOL.13	Non-regulatory solution	
UC3.2-SOL.14	No	
UC3.2-SOL.15	No	
UC3.3-SOL.1	Partial	Amend 376/2014 to encourage CAs to collate, analyse and share safety data with operators
UC3.3-SOL.2	No	
UC3.3-SOL.3	Non-regulatory solution	
UC3.3-SOL.4	Non-regulatory solution	
UC3.3-SOL.5	Non-regulatory solution	
UC3.3-SOL.6	Non-regulatory solution	
UC3.3-SOL.7	Non-regulatory solution	
UC3.3-SOL.8	Partial	Add GM to ARO.OPS.226 detailing KPIs - "what does good look like?"
UC3.3-SOL.9	Non-regulatory solution	
UC3.3-SOL.10	Non-regulatory solution	
UC3.3-SOL.11	No	
UC3.3-SOL.12	Yes	No regulation required
UC3.3-SOL.13	Non-regulatory solution	
UC3.3-SOL.14	Non-regulatory solution	

2.2 Case study 4 Digital fuel management

This analysis identifies gaps in the EASA Easy Access Rules for Air Operations (Regulation (EU) No 965/2012) concerning fuel data for aircraft operations. The findings of this analysis are intended to propel the development of more comprehensive regulations that ensure the effective use of fuel data for safe and efficient aircraft operations. The analysis considers relevant industry standards and best practices in fuel data management, including guidance from the ICAO Doc 9976, - Flight Planning and Fuel Management Manual. This comprehensive approach ensures a thorough evaluation of the current regulations and identifies areas for improvement.

The analysis examines the EASA regulations in relation to:

- data source and performance measurement,
- Fuel Control Monitoring (FCMS),
- data collaboration and information exchange,
- data standardisation and validation,

- statistical analysis and modelling,
- digital tools and training,
- Safety Performance Indicators (SPIs), and
- data sharing and communication.

The analysis identified several key gaps in the EASA regulations regarding fuel data management. These gaps limit the effectiveness of data utilisation for optimising fuel efficiency and safety. A summary of the analysis is in Table 3-2. The full analysis is in chapter 4 (page 35)

The key findings identified during the gaps analysis:

1. Standardised Lists and Fuel Safety Parameters: The EASA regulations lack clear distinctions between fuel performance metrics and safety event monitoring parameters. Additionally, there's no established framework for categorizing SPIs. This lack of clarity leads to confusion, inconsistent data collection, and hinders the ability to effectively analyse the relationship between fuel efficiency initiatives and potential safety risks.
2. Fuel-Related SPIs: There's no dedicated working group tasked with defining SPIs. This includes establishing categories for SPIs based on their, impact, and setting recommended target levels for each indicator. Without clear definitions, categorisation, and target levels, it's difficult to assess the effectiveness of fuel-saving strategies and prioritize areas for improvement.
3. Data integration and compatibility: The current EASA regulations lack guidelines for integrating data from various sources used in fuel planning and management. This incompatibility leads to data silos, hinders comprehensive analysis, and reduces the effectiveness of data-driven decision-making for fuel efficiency.
4. De-identification of fuel-related data: Clear guidelines for safe data sharing while ensuring confidentiality (protecting airline trade secrets) and privacy (avoiding identification of individual flights or crew) are missing. Without such guidelines, airlines may be hesitant to share valuable data for fear of compromising sensitive information, hindering collaboration and innovation in fuel efficiency initiatives.
5. Fuel performance modelling: Challenges exist in achieving seamless data integration from various sources for fuel performance modelling. Additionally, there's a lack of standardised data formats and protocols for operating conditions data. This inconsistency makes it difficult to develop accurate and reliable fuel performance models, which are crucial for optimising fuel consumption strategies.
6. Data sharing and collaboration: Currently, there are no well-defined data-sharing programs or established systems for consolidating operating conditions data from various stakeholders (airlines, airports, ATS). This lack of collaboration limits the ability to leverage collective knowledge and expertise in fuel efficiency improvement efforts across the aviation industry.
7. Operating conditions data sources: Traditional fuel efficiency calculations often rely solely on fuel uplift and flight time data. The EASA regulations lack guidelines for establishing a minimum set of operating conditions data sources required for specific fuel reduction applications and fuel schemes. A broader view that incorporates factors like weather, flight path, and airport infrastructure is crucial for a more nuanced understanding of fuel consumption patterns and targeted interventions.

8. Operating conditions data platform (Optional): A centralised platform accessible to airports, airlines, and relevant authorities for consolidating operating conditions data is not currently implemented. This lack of a central repository hinders the development and implementation of data-driven fuel efficiency and safety initiatives across the aviation ecosystem.
9. Safety Monitoring Systems: Best practices for operators to establish tailored safety monitoring systems aligned with their specific fuel reduction initiatives are not outlined in the EASA regulations. Integrating safety monitoring systems with fuel efficiency analysis is crucial to ensure that fuel-saving practices don't compromise safety standards. Without clear guidance, airlines may struggle to maintain a balanced approach.
10. Unified approach to monitor SPIs: A framework for collaboration between fuel and safety departments within airlines for evaluating the safety aspects of fuel initiatives while utilising operating conditions data is missing. This lack of a unified approach can lead to siloed decision-making and potentially overlook safety risks associated with new fuel-saving practices. Establishing regular communication channels and joint assessment procedures is crucial.
11. Reporting to competent authority: The current reporting requirements for fuel scheme safety performance, regulatory compliance, and operating conditions data may not be optimal. The lack of clear guidelines might lead to an excessive reporting burden on airlines while potentially not providing competent authorities with the most relevant data for effective safety oversight. Refining reporting requirements to ensure they are streamlined, standardised, and focused on collecting the most critical data is necessary.

Reference materials used within the review of DFM:

- ARINC647A-1 - Flight Recorder Electronic Documentation (FRED),
- CAP731 - Approval, Operational Serviceability and Readout of Aircraft Flight Recorders, Issue 4, 30 October 2023
- EASA Easy Access Rules for Air Operations (Regulation (EU) No 965/2012)
- ICAO Annex 6 - Operation of Aircraft Part I — International Commercial Air Transport — Aeroplanes, Twelfth Edition, July 2022
- ICAO Doc 10020 – Manual on Electronic Flight Bags (EFBs), Second Edition, 2018
- ICAO Doc 9976, - Flight Planning and Fuel Management Manual
- Notice of Proposed Amendment 2024-02 - Enhanced implementation of FDM programmes and miscellaneous amendments
- The General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679.

Table 3-2 Summary of regulatory review - Case study 4 - Digital fuel management

Solution	Gaps in regulations/AMC/GM	Description
UC4.1-SOL.1	Non-regulatory solution	•
UC4.1-SOL.2	Non-regulatory solution	
UC4.1-SOL.3	Non-regulatory solution	
UC4.1-SOL.4	Non-regulatory solution	
UC4.1-SOL.5	Non-regulatory solution	
UC4.1-SOL.6	Partial	No references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices
UC4.1-SOL.7	Non-regulatory solution	
UC4.1-SOL.8	Partial	No references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide

Solution	Gaps in regulations/AMC/GM	Description
		range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices
UC4.1-SOL.9	Partial	No references to ensuring the data is compatible when it's derived from the different sources. It also doesn't cover other fuel schemes except the basic fuel one
UC4.1-SOL.10	Non-regulatory solution	•
UC4.1-SOL.11	Partial	No references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices
UC4.1-SOL.12	Partial	There is no specific guidance material explicitly capturing what constitutes statistically relevant data, considering factors like representativeness, completeness, and timeliness
UC4.1-SOL.13	Partial	There is no specific guidance material explicitly capturing what constitutes statistically relevant data, considering factors like representativeness, completeness, and timeliness
UC4.1-SOL.14	Partial	• The regulations don't cover criteria for assessing the adequacy of data for statistical analysis while considering operational variations. • The regulations also don't provide detailed approach and methodology, similar to other specific regulations already in place such as passenger and baggage weight surveys for mass and balance (CAT.POL.MAB.100), • Recommendations on effective data sampling techniques and guidance on how to revalidate datasets over time.
UC4.1-SOL.15	Non-regulatory solution	
UC4.1-SOL.16	Non-regulatory solution	
UC4.1-SOL.17	Partial	The EU requirements don’t cover other-than-complex motor-powered aircraft operations and local operations
UC4.1-SOL.18	Partial	Additional guidance material
UC4.1-SOL.19	Non-regulatory solution	
UC4.1-SOL.20	Partial	EASA regulations allow for manual recording of fuel-related data, but they fall short on providing procedures for data collection, maintenance, and quality control
UC4.1-SOL.21	Non-regulatory solution	
UC4.1-SOL.22	Partial	No references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices
UC4.1-SOL.23	Non-regulatory solution	
UC4.1-SOL.24	No	NOTE – assuming NPA 2024-02 is adopted
UC4.1-SOL.25	Partial	GDPR will need to be consider in any form of data access (outside the scope of EASA), Addition of further guidance on GDPR and best practice required
UC4.1-SOL.26	Non-regulatory solution	
UC4.1-SOL.27	Partial	Establish standardized statistical methods for these models
UC4.1-SOL.28	Non-regulatory solution	
UC4.1-SOL.29	Non-regulatory solution	
UC4.1-SOL.30	Non-regulatory solution	
UC4.1-SOL.31	Non-regulatory solution	
UC4.1-SOL.32	Non-regulatory solution	
UC4.1-SOL.33	Non-regulatory solution	
UC4.2-SOL.1	Non-regulatory solution	
UC4.2-SOL.2	Partial	Details (AMC/GM) on Safety Performance Indicators
UC4.2-SOL.3	Non-regulatory solution	
UC4.2-SOL.4	Non-regulatory solution	
UC4.2-SOL.5	Non-regulatory solution	
UC4.2-SOL.6	Non-regulatory solution	
UC4.2-SOL.7	Non-regulatory solution	
UC4.2-SOL.8	Partial	Updates to guidance material
UC4.2-SOL.9	Partial	Regulations of specific de-identification methods like anonymisation or aggregation
UC4.2-SOL.10	Partial	Lacks AMC for frequency, format and content
UC4.2-SOL.11	Non-regulatory solution	
UC4.2-SOL.12	Non-regulatory solution	
UC4.3-SOL.1	Partial	Guidelines defining minimum data sets for various fuel schemes
UC4.3-SOL.2	Non-regulatory solution	
UC4.3-SOL.3	Partial	AMC/GM data collection methods or quality control
UC4.3-SOL.4	Partial	AMC/GM data collection methods or quality control
UC4.3-SOL.5	Partial	AMC/GM data collection methods or quality control
UC4.3-SOL.6	Non-regulatory solution	
UC4.3-SOL.7	Yes	Not currently under any regulations, Draw on industry for best practice
UC4.3-SOL.8	Non-regulatory solution	

Solution	Gaps in regulations/AMC/GM	Description
UC4.3-SOL.9	Non-regulatory solution	
UC4.3-SOL.10	Non-regulatory solution	
UC4.3-SOL.11	Non-regulatory solution	

2.3 Case study 5 Flight data models for safety

This analysis identifies gaps in the European Union Rules for Air Operations (Regulation (EU) No 965/2012) concerning flight data models for safety. The findings of this analysis are intended to propel the development of more comprehensive regulations that ensure the effective use of flight data monitoring for safe and efficient aircraft operations. The analysis considers relevant industry standards in flight data monitoring. This comprehensive approach ensures a thorough evaluation of the current regulations and identifies areas for improvement.

The analysis identified several key gaps in the EASA regulations regarding FDM. These gaps limit the effectiveness of data utilisation for FDM. A summary of the analysis is in Table 3-3. The full analysis is in chapter 5 (page 56).

The key findings were:

- ORO.AOC.130 Flight Data monitoring – aeroplanes, currently states "*The operator shall establish and maintain a flight data monitoring programme, which shall be integrated in its management system, for aeroplanes with a maximum certificated take-off mass of more than 27 000 kg.*". This excludes smaller aircraft from the requirement to have a FDM programme. This requirement will have to be changed to bring future aircraft into the scope of the FDM programme either by reducing the MCTOM or changing to a passenger carrying capacity, or a combination of both to ensure cargo aircraft are included.
- Standardised Data Frame Layout: There is currently no standard data frame layout (DFL) for the recording of data. This results in operators having to programme multiple DFLs with no assurance that a given flight parameter is recorded or has the required recoding resolution or frequency for use in FDM analysis.. The introduction of an agreed DFL for minimum performance would enable operators to review and analysis data across a blended fleet more easily.
- Contextual Data Fusion: Data from sources separate from the aircraft, such as aerodrome data, weather data, traffic data, to support the analysis of FDM data is not currently mandated, the addition of aerodrome data will help improve the understanding of factors that influence aircraft performance during take-off and landing events.

Reference materials used within the review of FDM:

- ARINC647A-1 - Flight Recorder Electronic Documentation (FRED)
- CAP739 Flight data monitoring June 2013 Second edition
- EASA Easy Access Rules for Air Operations (Regulation (EU) No 965/2012)
- EUROCAE ED-109A Software integrity assurance considerations for communication, navigation, surveillance and air traffic management (CNS/ATM) systems February 2021
- EUROCAE ED-12C Software consideration in airborne systems and equipment certification February 2021
- EUROCAE ED-153 Guidelines for NAS software safety assurance August 2009
- EUROCAE ED-203A Airworthiness security methods and considerations June 2018
- ICAO Doc 10000 Manual on flight data Analysis Programmes (FDAP) Second edition 2021

- Notice of Proposed Amendment 2024-02 – Enhanced implementation of FDM programmes and miscellaneous amendments
- The General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679,

Table 3-3 Summary of regulatory review - Case study 5 - Flight data models for safety

Solution	Gaps in regulations/AMC/GM	Description
UC5.1-SOL.1	Non-regulatory solution	
UC5.1-SOL.2	No, if NPA adopted	
UC5.1-SOL.3	Partial, if NPA adopted	• Regulatory gaps regarding FDM/FRM and DFL • Industry wide agreed layout for DFL
UC5.1-SOL.4	Partial, if NPA adopted	DFL is not regulated currently. Baseline requirements for FDM data recording could be added to regulation to unify data collection
UC5.1-SOL.5	Partial	• ORO.AOC.130 Flight Data monitoring – aeroplanes – MCTOM will need revising to encompass smaller aircraft • GM2 ORO.AOC.130 Flight data monitoring – aeroplanes – need revising to encompass smaller aircraft
UC5.1-SOL.6	Yes	Industry wide agreed layout for DFL
UC5.1-SOL.7	No, if NPA adopted	
UC5.1-SOL.8	No, if NPA adopted	
UC5.1-SOL.9	Partial	The need for a defined and agreed list of logics and algorithms to be used across industry would be required if this was to be enforced
UC5.1-SOL.10	Non-regulatory solution	
UC5.1-SOL.11	Non-regulatory solution	
UC5.1-SOL.12	Yes	IPR is not part of EASA remit, however reference to guidance on IPR maybe required
UC5.1-SOL.13	No, if NPA adopted	
UC5.1-SOL.14	No, if NPA adopted	
UC5.1-SOL.15	Non-regulatory solution	
UC5.2-SOL.1	Partial, if NPA adopted	• No regulation exists for FDM software capabilities, this is dependent on the desire to regulate for minimum data sets in FDM which would be a factor or if industry is best placed to build on best practice through the EOFDM forum, for example • Guidance on approaches to assured software development could be included, such as NASA-STD-8739.8 (09/08/2022) Software Assurance and Software Safety Standard
UC5.2-SOL.2	Yes	• No standardised data format or data sharing agreements between different vendors, opportunity to develop best practice through EOFDM forum for example • Guidance on approaches to assured software development could be included, such as NASA-STD-8739.8 (09/08/2022) Software Assurance and Software Safety Standard
UC5.2-SOL.3	Non-regulatory solution	
UC5.2-SOL.4	Non-regulatory solution	
UC5.2-SOL.5	Yes	• No identified standards • industry and regulators would have to agree best practice and what should be written into minimum standards, and where this should sit (i.e. EASA, industry body etc)
UC5.2-SOL.6	Non-regulatory solution	•
UC5.2-SOL.7	Partial, if NPA adopted	The level of competency or training required is not specified within the guidance, which could lead to variance between operators FDM teams
UC5.2-SOL.8	Non-regulatory solution	
UC5.2-SOL.9	Non-regulatory solution	
UC5.2-SOL.10	Non-regulatory solution	

3. Case Study 3: Flight training data for EBT/CBTA

3.1 Use Case 3.1: Use of flight crew training and instructor data to drive EBT programmes

3.1.1 Solution Package UC3.1-PS.1 - Safety Promotion regarding the conduction of the programmes, assessments and data gathering

Solution
UC3.1-SOL.7 - Definition and introduction of a metric for programme difficulty
Description
Introducing a metric for the programme's difficulty is a valuable step for assessing and communicating the level of challenge or complexity associated with the programme, and it allows to contextualise the pass-fail percentages, the grading data, and the concordance of the instructors
Limitation(s):
UC3.1-TEC.5 – Programme difficulty metric
EU AMC, GM & Standards (applicable, but not to be amended)
Reference to difficulty of EBT scenarios in GM1 ARO.OPS.226(d); GM2 ORO.FC.231(d)(2) and equivalence of malfunctions in AMC1 ORO.FC.231(f) and GM4 ORO.FC.231(f). Reference is made to the EBT Manual, however the EBT Manual only provides limited information which doesn't address SOL 7.
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
SOL 7 suggests relatively complicated solutions, however, recommend using SMEs evaluating the scenario based on experience - add guidance to EBT manual.

3.1.2 Solution Package UC3.1-PS.4 - Safety Promotion regarding the Instructor Concordance Assurance Programme (ICAP)

Solution
UC3.1-SOL.4 – Promoting learning initiatives where forced concordance is addressed
Description
Operators should include and highlight the aspect of the potential appearance of forced concordance in the learning initiatives (e.g., trainings, workshops, dissemination material) that they conduct and provide on a regular basis to their instructors.
Limitation(s):
UC3.1-TEC.3 – Forced assessment by pre-filled templates
EU AMC, GM & Standards (applicable, but not to be amended)
AMC2 ORO.FC.146(c); GM2 ORO.FC.146(c); AMC1 ORO.FC.231(a); AMC1 ORO.FC.231(a)(4); GM1 ORO.FC.231(a)(4);
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
Concordance is adequately covered in regulations

3.1.3 Solution Package UC3.1-PS.7 - Initiatives to support the adoption of digital tools and capabilities for assisting training assessment and data analysis

Solution
UC3.1-SOL.8 – Regulatory requirements / Guidance Material explicitly capturing desirable capabilities for data analysis supporting solutions to identify training needs and programme improvements
Description
Since the use of digital solutions and data analysis tools is increasingly growing in the context of EBT programmes, and because they are necessary to perform the appropriate analyses to identify training needs and programme improvements, materials should be developed defining the requirements to be met by the software to be implemented
Limitation(s):
UC3.1-TEC.6 – Need for data collection and analysis tools
EU AMC, GM & Standards (applicable, but not to be amended)
No current regulations other than AMC1 ORO.FC.231(a)(4) regarding ICAP-specific data analysis and AMC2 ORO.FC.231(c), GM2 ORO.FC.231(c) regarding data protection.
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
None

3.2 Use Case 3.2: Syllabus customisation and scenario contextualisation using operational data

3.2.1 Solution Package UC3.2-PS.1 - Safety Promotion regarding integration of relevant safety data within the EBT programmes

Solution
UC3.2-SOL.1 - Development of best-practices to map FDM event definition and EBT competencies and training topicsUC3.2-SOL.1 - Development of best-practices to standardise taxonomy between FDM methods and EBT competencies and training topics
Description
Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices to map FDM event definitions with EBT competencies and training topics. Some mature operators have implemented some methods to smooth the sharing of data between the safety and the training departments. In those cases, the data coming from the safety department is provided with a mapping to the competencies or the behaviours used in training.
Limitation(s):
UC3.2-TEC.1 – Lack of a common taxonomy shared between the safety and training departments
EU AMC, GM & Standards (applicable, but not to be amended)
No current regulation
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
More well-defined regulatory link between FDM and EBT required.

Solution
UC3.2-SOL.8 - Development of guidelines and industry best-practices to integrate / fuse inner loop data (safety-relevant and training data) for customisation and contextualisation of scenario elements
Description
Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices to integrate / fuse inner loop data (safety-relevant and training data) for customisation and contextualisation of scenario elements. The fact that data sources with different origins have to be used for the customisation of programmes (e.g., safety data, training data) implies the need for the development of guidelines for data source integration to mitigate compatibility issues and ensure data accuracy and completeness
Limitation(s):
UC3.2-ORG.1 – Need for strengthening the integration between the training and safety departments
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130, GM4 ORO.GEN.200(a)(3)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Multiple regulations regarding output of SMS in to training topics and scenarios, but not the reverse. Amend ORO.GEN.200 to include text encouraging the sharing of data with industry. Also recommend amending ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.

3.2.2 Solution Package UC3.2-PS.2 - Safety Promotion regarding the proper governance of safety and training departments cooperation

Solution
UC3.2-SOL.7 – Development of best-practices on how to ease integration and governance of safety and training department cooperation
Description
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
Limitation(s):
UC3.2-ORG.1 – Need for strengthening the integration between the training and safety departments, UC3.2-OPS.1 – Need to share more than just the most serious occurrences, UC3.2-OPS.2 – Limited generation of documentation reflecting meeting discussions and programme implementations
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130, GM4 ORO.GEN.200(a)(3)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Multiple regulations regarding output of SMS in to training topics and scenarios, but not the reverse. Amend ORO.GEN.200 to include text encouraging the sharing of data with industry. Also recommend amending ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.

Solution
UC3.2-SOL.11 – Development of procedures to foster the access to safety data for training managers ensuring a secure access
Description
Promote the development of Non-Disclosure Agreements (NDAs) to be signed by those employees who would be allowed to access the safety data
Limitation(s):
UC3.2-ORG.4 – Limited access to safety data and missing procedure
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130, GM1 ORO.AOC.130, ORO.FC.145(d)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Enhance provisions within ORO.GEN.200 (GM) to include controls of access to safety data and to reflect the existing provisions in other regulations specified here, enhancing if necessary.

3.2.3 Solution Package UC3.2-PS.3 - Regulatory initiative regarding the staff's responsibilities

Solution
UC3.2-SOL.12 – Promote the figure of the EBT Manager
Description
The figure of the EBT should be promoted and the importance of a role that has a key contribution in the EBT programmes should be highlighted.
Limitation(s):
UC3.2-ORG.5 – The EBT Manager is given limited importance
EU AMC, GM & Standards (applicable, but not to be amended)
Existing regulations contain several references to responsibilities of the EBT Manager: Part FCL Appendix 10 and elsewhere in ORO.FC.231.
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
None

3.2.4 Solution Package UC3.2-PS.4 - Regulatory initiative regarding the proper integration between the EBT training programme and the safety department processes

Solution
UC3.2-SOL.2 - Development of GM/AMC for avoiding operational data misuse
Description
Develop guidelines for avoiding operational data misuse, especially safety data, to ensure that the use of the data is justified, enabling safe sharing and collaboration across departments while ensuring the confidentiality and privacy of sensitive information. Guidelines should be provided considering that operators should follow data privacy and "just culture" policies, so that trainees remain protected, while also retaining the analytical value
Limitation(s):
UC3.2-TEC.2 - Need for protection of trainees from data misuse
EU AMC, GM & Standards (applicable, but not to be amended)
ORO.FC.231(c) and (d); AMC2 ORO.FC.231(c); GM2 ORO.FC.231(c);
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
No additional regulation required

Solution
UC3.2-SOL.9 - 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 (SRM) and evaluate effectiveness of mitigation actions
Description
Covered with UC3.2-SOL.7 – Development of best-practices on how to ease integration and governance of safety and training department cooperation, but complemented with the monitoring and effectives of the mitigation actions
Limitation(s):
UC3.2-ORG.1 – Need for strengthening the integration between the training and safety departments
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130, GM4 ORO.GEN.200(a)(3)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Amend ORO.GEN.200 to include text encouraging the sharing of data with industry. Also recommend amending ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.

Solution
UC3.2-SOL.10 - 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
Description
Covered with UC3.2-SOL.1 - Development of best-practices to map FDM event definition and EBT competencies and training topics, but complemented with the required transmission channels
Limitation(s):
UC3.2-ORG.1 – Need for strengthening the integration between the training and safety departments
EU AMC, GM & Standards (applicable, but not to be amended)
No current regulation.
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
ORO.AOC.130 contains extensive requirements and guidance for FDM programmes but does not include identification of competencies in analysis of events. Enhance ORO.AOC.130 AMC and GM to include relevant guidance.

3.2.5 Solution Package UC3.2-PS.5 - Regulatory initiative regarding the customisation of the programmes and contextualisation of scenarios

Solution
UC3.2-SOL.14 – Development of Guidance Material for a proper EBT programme adaptation including realistic training scenarios
Description
Develop guidelines for assisting operators in adapting the programmes and the training scenarios for creating an environment that properly mimics the real operations.
Limitation(s):
UC3.2-ORG.7 – Difficulty in creating an environment similar to actual operations
EU AMC, GM & Standards (applicable, but not to be amended)
Covered under customisation and contextualisation in UC3.2-SOL.8
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
None

Solution
UC3.2-SOL.15 - Publication of additional or alternative tables for training topics and scenarios selection
Description
Currently, EBT programmes are designed based on the selection and adaptation of the training topics and scenarios defined in Appendices 2 to 6 ICAO Doc 9995 or AMC2 to AMC6 ORO.FC.232, which include a mapping of the involved competencies for each defined training topic and scenario. In that regard, for all those operators starting to implement a mapping between FDM events and the training competencies or behaviours, it would be very useful to have tables that allow operators to select training topics and scenarios for the competencies to be trained.
Limitation(s):
UC3.2-OPS.3 – Adapting the mapping between training topics and competencies
EU AMC, GM & Standards (applicable, but not to be amended)
ORO.FC.32
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations

None - ORO.FC.32 contains adequate options and amount of information mapping competencies and training topics.

3.2.6 Solution Package UC3.2-PS.6 - Initiatives to support the adoption of digital tools and capabilities for assisting on the customisation of the programmes

Solution
UC3.2-SOL.3 - Initiatives for promoting collaborative data sharing programmes
Description
Incentivise the promotion of collaborative data programmes (e.g., Data4Safety) that could potentially provide data for the operators' programmes at national or European level, enabling a better customisation of the programmes, even filling data gaps that may be present in some operators' data (e.g., airports or routes for which not information is available since an operator does not operate there). Aviation stakeholders, including operators, regulatory authorities, industry associations, and safety organisations, should be encouraged to collaborate in establishing and supporting data-sharing programs aiming to collect, analyse, and disseminate data regarding different areas of the EBT programmes
Limitation(s):
UC3.2-TEC.3 – Limited interest from airlines in sharing their data
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130, GM4 ORO.GEN.200(a)(3)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Amend ORO.GEN.200 to include text encouraging the sharing of data with industry. Also recommend amending ARO.GEN.200 to encourage CAs to facilitate liaison meetings / groups within industry with the aim of sharing data.

Solution
UC3.2-SOL.5 - Regulatory requirements / Guidance Material explicitly capturing desirable capabilities for EBT software regarding programmes' customisation
Description
In the scenario in which digital tools are introduced to support operators in the process of customising the EBT programmes (e.g., selecting specific training topics and scenarios, structuring the programmes considering provided and required frequencies for the training topics…), guidelines should be developed defining the requirements to be met by the software to be implemented
Limitation(s):
UC3.2-TEC.5 – Basic tools used for the customisation of programme
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.FC.231(a); GM3 ORO.FC.231(a); GM1 ORO.FC.231(a)(2); AMC1 ORO.FC.231(i)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Regulatory gap - additional GM recommended to ORO.FC.231(a).

Solution
UC3.1-SOL.6 - Regulatory requirements / Guidance Material explicitly capturing desirable capabilities for EBT software regarding the contextualisation of scenarios
Description
Guidelines should be developed defining the requirements to be met by the software to be implemented
Limitation(s):
UC3.2-TEC.6 – Potential need for tools to assist in the scenario contextualisation
EU AMC, GM & Standards (applicable, but not to be amended)
GM1 ARO.OPS.226(a); GM1 ARO.OPS.226(a); AMC1 ORO.FC.145(a); AMC1 ORO.FC.231(a)(1), GM1 ORO.FC.231(a)(2), GM3 ORO.FC.231(a)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Regulatory gap. Recommend additional GM added to ORO.FC.131(a)

3.3 Use Case 3.3: Authorities support and role within EBT programmes

3.3.1 Solution Package UC3.3-PS.1 - Safety promotion for the improvement of authorities' visibility on EBT programmes and the proper bi-directional sharing of data between authorities and operators

Solution
UC3.3-SOL.1 - Development of best-practices for sharing authority data with operators
Description
Publication and promotion by industry bodies or relevant regulatory working groups of guidelines and industry best-practices to encourage an effective and efficient sharing of data from the authority to the operators, enabling an enhanced customisation of the programmes
Limitation(s):
UC3.3-TEC.1 – Lack of input for programme definition
EU AMC, GM & Standards (applicable, but not to be amended)
ORO.GEN.140, ARO.GEN.305, Regulation 376/2014
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Consider amending 376/2014 to encourage CAs to collate, analyse and share safety data with operators.

Solution
UC3.3-SOL.2 – Development of initiatives to facilitate access to safety data by the authority
Description
Initiatives should be implemented to facilitate access to operators' safety data by the authority, which is necessary for both the approval process and the monitoring and oversight of the programmes.
Limitation(s):
UC3.3-TEC.2 – Limited access to safety data and to data-sharing platform, UC3.3-ORG.4 – Authority's limited access to operators' safety data,
EU AMC, GM & Standards (applicable, but not to be amended)
m
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
None

3.3.2 Solution Package UC3.3-PS.2 - Safety promotion for the monitoring of EBT programmes' effectiveness and consistency

Solution
UC3.3-SOL.11 – Definition of safety management process to identify risks from operators' training data
Description
Considering the framework defined in the solution "UC3.3-SOL.8 - Regulatory requirements / Guidance Material defining a recommended framework of KPIs for oversight of EBT programmes by Authorities", safety management process should be defined at state level to be able to identify potential risks from pilots training data shared by the operators in the context of EBT oversight.
Limitation(s):
UC3.3-OPS.1 – Lack of safety promotion driven by EBT programmes
EU AMC, GM & Standards (applicable, but not to be amended)
ARO.OPS.226, ICAO Doc 9859, "Safety Management Manual"
Is the solution covered by the existing EU requirements, AMC and GM?
Yes
Gaps in Regulation vs Recommendations
None. KPIs covered in UC3.3-SOL.8. Identification and sharing of potential risks are closely linked to Ref. line 48. Articles 5, 6, 7 and 8 of the Basic Regulation define an authority's responsibilities to establish and maintain a State Safety programme in line with international standards and recommended practices, (ICAO Doc 9859, "Safety Management Manual"). The State Safety Plan and the State Plan for Aviation Safety shall identify the main safety risks affecting its national aviation system.

3.3.3 Solution Package UC3.3-PS.3 - Regulatory initiative regarding the oversight of EBT programmes'

Solution
UC3.3-SOL.8 - Regulatory requirements / Guidance Material defining a recommended framework of KPIs for oversight of EBT programmes by Authorities
Description
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 (e.g., GM to ARO.OPS.226-d).
Limitation(s):
UC3.3-TEC.8 – Undefined framework for monitoring EBT programmes, UC3.3-TEC.9 – Lack of reporting framework for concordance, UC3.3-OPS.1 – Lack of safety promotion driven by EBT programmes, UC3.1-OPS.6 – Need for further transparency and benchmarking capabilities,
EU AMC, GM & Standards (applicable, but not to be amended)
No existing regulation beyond the requirements of ARO.OPS.226.
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Add GM to ARO.OPS.226 detailing KPIs - "what does good look like?"

Solution
UC3.3-SOL.12 - Regulatory requirements / Guidance Material defining the requirements for the reporting of simulator hours
Description
Require operators to report simulator hours, especially the hours needed for tailored or remedial training, so that authorities can detect potential deviations between their operators or between data from different countries. These data could be included as one of the indicators or metrics to be reported within a defined data reporting framework of the programmes, as explained for other limitations, through which operators should share data with the authority.
Limitation(s):
UC3.3-OPS.3 – Lack of visibility on remedial training hours
EU AMC, GM & Standards (applicable, but not to be amended)
No specific regulation, however, AMC1 ARO.OPS.226(d) includes a requirement to monitor the effectiveness of the operator's EBT programme to improve pilot competencies
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
No regulation required

4. Case Study 4: Digital fuel management

4.1 Use Case 4.1: Leveraging aircraft-specific fuel data for fuel performance-based schemes:

4.1.1 Solution Package UC4.1-PS.3 – Regulatory initiatives for fuel-related data collection and validation

Solution
UC4.1-SOL.6 - Development of GM/AMC accounting for specificities in regard with validation of fuel data through the adoption of standards
Description
Select a set of existing standards (e.g., EUROCAE ED-76(A) standards or similar standards) that ensure a coherent approach to data validation for the implementation of fuel reductions and that cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices
Limitation(s):
UC4.1-TEC.4 - Duplicated parameters coming from different sources
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC6 CAT.OP.MPA.181, AMC7 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181,
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation focuses on the flight planning and reducing the contingency fuel based upon the data derived from the fuel monitoring system. The regulations mention that the flight should be planned by using the most accurate information available, however there are no references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices. It only states that the fuel consumption monitoring system should include data transparency and verification, however there is no guidance of what this should look like.

Solution
UC4.1-SOL.8 – Development of GM/AMC accounting for specificities in regard with validation of fuel data through the adoption of standards
Description
Select a set of existing standards (e.g., EUROCAE ED-76(A) standards or similar standards) that ensure a coherent approach to data validation for the implementation of fuel reductions and that cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices.
Limitation(s):
UC4.1-TEC.5 – Lack of guidance to address data quality problems.
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC6 CAT.OP.MPA.181, AMC7 CAT.OP.MPA.181, AMC 8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation focuses on the flight planning and reducing the contingency fuel based upon the data derived from the fuel monitoring system. The regulations mention that the flight should be planned by using the most accurate information available, however there are no references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices. It only states that the fuel consumption monitoring system should include data transparency and verification, however there is no guidance of what this should look like.

Solution
UC4.1-SOL.9 - Development of GM/AMC for minimum requirements and selection criteria of fuel-related data sources
Description
Develop guidelines for data source integration to mitigate compatibility issues and ensure data accuracy and completeness. The guidelines should include best practices regarding: • Compatibility of different data sources, considering factors such as data formats, protocols, and frequencies. • Mapping data fields between different sources. • Integration protocols and standards that operators can follow when combining data from diverse sources. • Strategies to identify and address data gaps, ensuring data completeness.
Limitation(s):
UC4.1-TEC.6 - Integration of data sources
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, GM1 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially. The EU requirements don’t also cover other than basic fuel schemes
Gaps in Regulation vs Recommendations
The regulations mention that the flight should be planned by using the most accurate information available, however there are no references to ensuring the data is compatible when it's derived from the different sources. It also doesn't cover other fuel schemes except the basic fuel one and it doesn't mention helicopters. The regulations require to collect statistically relevant data for period at least of two years. The ICAO Doc 9976 in Appendix 7 to Chapter 5 lists in additional notes for the approving Authority that f) Data for analysis should be presented in the following format: Flight #/Date/Origin/Destination/Equipment/Scheduled Time/Actual Time/Planned Burn/Actual Burn/Arrival Fuel/Diversions/Reason/Fuel Emergencies/Low Fuel. However, this part of document isn't mentioned in the EASA document, because the regulations don't mention data formatting, standardisation of the data records or the level of the details of the fuel data

Solution
UC4.1-SOL.11 - Development of GM/AMC accounting for specificities in regard with validation of fuel data through the adoption of standards
Description
Select a set of existing standards (e.g., EUROCAE ED-76(A) standards or similar standards) that ensure a coherent approach to data validation for the implementation of fuel reductions and that cover a wide range of aspects, including data quality assurance practices (e.g., data completeness assurance)
Limitation(s):
UC4.1-TEC.6 - Integration of data sources
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC6 CAT.OP.MPA 181, AMC7 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181,
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation focuses on the flight planning and reducing the contingency fuel based upon the data derived from the fuel monitoring system. The regulations mention that the flight should be planned by using the most accurate information available, however there are no references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices

Solution
UC4.1-SOL.20 - Development of GM/AMC for minimum requirements regarding fuel-related parameters that are manually collected
Description
Develop guidelines that include specific procedures for manual data collection, data entry, and quality control to minimize errors. The guidelines should provide operators with strategies for mitigating errors associated with manual data collection (e.g., regular data validation checks, error detection mechanisms, etc) and validation processes for all manually collected data.
Limitation(s):
UC4.1-ORG.3 - Reliance on manual data collection
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, GM1 CAT.OP.MPA.181,
Is the solution covered by the existing EU requirements, AMC and GM?
Partially. EU requirements also don’t cover Basic Fuel Scheme with Variations or Individual Fuel Scheme
Gaps in Regulation vs Recommendations
EASA regulations allow for manual recording of fuel-related data, but they fall short on providing procedures for data collection, maintenance, and quality control.

Solution
UC4.1-SOL.22 - Development of GM/AMC accounting for specificities in regard with validation of fuel data through the adoption of standards
Description
Select a set of existing standards (e.g., EUROCAE ED-76(A) standards or similar standards) that ensure a coherent approach to data validation for the implementation of fuel reductions and that cover a wide range of aspects, including data quality assurance practices for manually collected data.
Limitation(s):
UC4.1-ORG.3 - Reliance on manual data collection
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC6 CAT.OP.MPA.181, AMC7 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation focuses on the flight planning and reducing the contingency fuel based upon the data derived from the fuel monitoring system. It allows the manual data recording. The regulations mention that the flight should be planned by using the most accurate information available, however there are no references to existing standards that would help to ensure a coherent approach to data validation for the implementation of fuel reductions and that will cover a wide range of aspects, including data quality assurance practices for manually collected data

Solution
UC4.1-SOL.24 - Alignment of FDM and fuel schemes guidelines regarding relevant parameters to be collected under performance
Description
Define flight parameters needed to support the fuel scheme and the minimum performance needed, enabling operators to fully capitalize on FDM data for fuel optimisation and participation in fuel performance-based schemes. This solution involves engaging with regulatory authorities to revise FDM regulations guidelines to include fuel scheme-relevant parameters
Limitation(s):
UC4.1-ORG.4 - Misalignment of available flight data parameters and fuel-related parameters
EU AMC, GM & Standards (applicable, but not to be amended)
ORO.AOC.130, AMC1 to ORO.AOC.130, GM3 ORO.AOC.130, AMC1 ORO.AOC.130(h)4, AMC2 ORO.AOC.130, GM2 ORO.AOC.130
Is the solution covered by the existing EU requirements, AMC and GM?
Yes, if NPA adopted

Gaps in Regulation vs Recommendations
N/A

Solution
UC4.1-SOL.25 - Development of GM/AMC for FDM data governance agreements
Description
Collaborate with industry experts, regulatory bodies, and relevant stakeholders to adapt FDM data governance frameworks and make them compatible with FDM data use for fuel planning and management. These frameworks should address data sharing protocols, privacy protection, and the cultivation of a 'just culture' within the context of fuel management.
Limitation(s):
UC4.1-ORG.5 - Establishment of FDM data governance agreements
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 ORO.AOC.130 parts J and K (2), GM1 ORO.AOC.130 part D, The General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679, **NPA**: AMC1 ORO.AOC.130 parts J and K, GM1 ORO.AOC.130 part F, AMC1 ORO.GEN.200(a)(6)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Current EASA policy covers some aspect of FDM data access under GMC and AMC with the NPA adding to these requirements., GDPR will need to be consider in any form of data access (outside the scope of EASA), Addition of further guidance on GDPR and best practice required.

4.1.2 Solution Package UC4.1-PS.4 – Regulatory initiatives for fuel consumption estimation models

Solution
UC4.1-SOL.12 - Development of GM/AMC that establish a standardised framework for generalising statistical models
Description
Develop regulatory requirements or guidance material explicitly establishing a standardised framework for generalizing statistical models across different aircraft or operational contexts, as well as defining the limits of models' generalization for each operational context. The requirements or guidance should include the principles and methodologies for generalizing statistical fuel consumption models and guidelines on how to apply statistical models to different aircraft or operational scenarios. Additionally, definitions of the limits of model generalization for each operational context should be included (i.e., when and to what extent statistical models can be applied).
Limitation(s):
UC4.1-TEC.7 - Generalization of fuel consumption models
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180, AMC5 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181, AMC6 CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation describes in a high-level what requirements shall be met to have a fuel/energy scheme and that the scientific principles should be applied when analysing gathered data (CAT.OP.MPA.180). The regulation also states that the collecting statistically relevant data is required for establishing baseline for safety performance (SPIs) prior to submitting an individual fuel scheme for approval (AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180). it is also specified that this data should be collected over a defined period of time, e.g., minimum of 2 years. The data then should be used in reviewing safety performance of the operator's processes (GM2 CAT.OP.MPA.180). The statistical data covering taxi fuel can be used to calculate the taxi fuel for the basic scheme (AMC5 CAT.OP.MPA.181). GM2 CAT.OP.MPA.181 also provides an example of statistical contingency fuel method as per AMC6.CAT.OP.MPA.181 that allows usage of the statistical fuel method. The condition to use this method is a continuous 2-year operation is required during which statistical contingency fuel (SCF) data is recorded. It also valid that to use SCF on a particular city pair/aeroplane combination, sufficient data is required to be statistically significant. This method can be used by the operator to monitor the fuel consumption on each city pair/aeroplane combination, and to carry out a statistical analysis to calculate the required contingency fuel.

Solution
UC4.1-SOL.13- Development of GM/AMC specifying what constitutes statistically relevant data
Description
Develop regulatory requirements or guidance material explicitly capturing what constitutes statistically relevant data, considering factors like representativeness, completeness, and timeliness. Industry bodies and regulatory working groups should define what qualifies as statistically relevant data by including minimum data requirements
Limitation(s):
UC4.1-TEC.8 - Limited regulatory details regarding the set of statistically relevant data
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180, AMC5 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181, AMC6 CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation describes in a high-level what requirements shall be met to have a fuel/energy scheme and that the scientific principles should be applied when analysing gathered data. The regulation also states that the collecting statistically relevant data is required for establishing baseline for safety performance (SPIs) prior to submitting an individual fuel scheme for approval. it is also specified that this data should be collected over a defined period of time, e.g., minimum of 2 years. There is no specific guidance material explicitly capturing what constitutes statistically relevant data, considering factors like representativeness, completeness, and timeliness. ICAO Doc 9976 mentions in Appendix 4 to Chapter 5 what data should be used in SCF process and data integrity, however EASA regulations don't refer to it.

Solution
UC4.1-SOL.14 - Development of GM/AMC specifying criteria for assessing the adequacy of data for statistical analysis
Description
Develop guidelines that offer specific provisions to assist operators, particularly those with limited datasets or operating irregular routes, in ensuring that their fuel planning is based on statistically significant data. The guidelines should: • Establish criteria for assessing the adequacy of data for statistical analysis while considering operational variations. • Provide a detailed approach and methodology, similar to other specific regulations already in place such as passenger and baggage weight surveys for mass and balance (CAT.POL.MAB.100). • Provide recommendations on effective data sampling techniques. • Guidance on how to revalidate datasets over time.
Limitation(s):
UC4.1-TEC.9 - Limited availability of representative data
EU AMC,GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180, AMC5 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181, AMC6 CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM2 CAT.OP.MPA.181,
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The regulation specifies that statistical data can be used when calculating fuel variations, however it doesn't differentiate operations between high volume operations or the operators with limited datasets r operating irregular routes. The regulations don't cover criteria for assessing the adequacy of data for statistical analysis while considering operational variations. The regulations also don't provide detailed approach and methodology, similar to other specific regulations already in place such as passenger and baggage weight surveys for mass and balance (CAT.POL.MAB.100), or recommendations on effective data sampling techniques and guidance on how to revalidate datasets over time.

Solution
UC4.1-SOL.17 - Development of GM/AMC capturing the need for transparency in algorithm details provided by vendors
Description
Develop regulatory requirements or 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. These requirements should specify the level of detail and documentation that vendors must provide regarding the algorithms used in their tools.
Limitation(s):
UC4.1-TEC.11
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC1 CAT.OP.MPA.180
Is the solution covered by the existing EU requirements, AMC and GM?
Partially. The EU requirements don't cover other-than-complex motor-powered aircraft operations and local operations
Gaps in Regulation vs Recommendations
EASA regulations mandate that airlines document the functionalities of their computerized flight planning systems within their OMs. Additionally, the regulations require airlines to verify the continued suitability of the system after any updates. However, these regulations are silent on the transparency of the algorithms used within these computerised flight planning systems.

Solution
UC4.1-SOL.18 - Development of GM/AMC that allow for more flexibility regarding fuel consumption monitoring systems
Description
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.
Limitation(s):
UC4.1-TEC.16 - Limited capitalisation of knowledge regarding statistical estimations
EU AMC, GM & Standards (applicable, but not to be amended)
AMC6 CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181, GM3 CAT.OP.MPA.181, ICAO Doc 9976 Appendix 5 - Chapter 5
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
EASA regulations reference ICAO Doc 9976, Appendix 5 to Chapter 5, as a resource for detailed information on fuel consumption monitoring systems. This ICAO document emphasizes that airlines should establish processes and controls to ensure safe operations while accommodating variations in individual aircraft performance. This approach allows flexibility for airlines to tailor their fuel management practices to their specific operations and fuel-saving initiatives.

Solution
UC4.1-SOL.27 - Development of GM/AMC that enhance the modification of the Operation Manual to provide pilots with insights on models
Description
Development of Appendixes to OM to provide pilots with insights on statistical/predictive models (i.e., data used, algorithm details and insights, factors considered, etc.).
Limitation(s):
UC4.1-ORG.8 - Lack of visibility by pilots on fuel planning
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180, AMC5 CAT.OP.MPA.181, AMC6 CAT.OP.MPA.181
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
EASA regulations encourage the use of statistical data in fuel-reduction models, but they don't establish standardized statistical methods for these models. While EASA regulations don't directly reference ICAO Doc 9976, Appendix 6 to Chapter 5 of this document provides some examples of statistical methodologies that could be applied to address this gap in the EASA regulations.

4.2 Use Case 4.2: Characterising the safety performance indicators for fuel schemes

4.2.1 Solution Package UC4.2-PS.2 - Regulatory initiatives for the definition and monitoring of safety performance

Solution
UC4.2-SOL.2 - Development of GM/AMC for standardised lists of SPIs
Description
Develop regulatory requirements explicitly capturing standardised lists of fuel and safety-related parameters to streamline and enhance the monitoring of fuel reductions, making the process more efficient and effective for both operators and regulatory authorities. The guidelines should include comprehensive lists of parameters relevant to both fuel management and safety monitoring to allow for a holistic assessment of fuel management initiatives while maintaining a clear distinction between fuel performance metrics and safety events monitoring.
Limitation(s):
UC4.2-TEC.1 - Mixed nature of proposed safety indicators
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.180, GM2 CAT.OP.MPA.180,
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
While EASA regulations mention Safety Performance Indicators (SPIs), they lack the detailed approach outlined in the proposed solution. ICAO Doc 9976, specifically Chapter 5 on Safety Assurance by Operators, might offer more comprehensive SPI guidance to address this gap

Solution
UC4.2-SOL.8 - Development of GM/AMC for the alignment of fuel initiatives with Safety Management System (SMS)
Description
Develop guidelines to provide operators with a structured framework for aligning fuel-related initiatives within their existing SMS processes. The guidelines should address a set of key topics, described below. • The fuel department must monitor fuel-related safety performance indicators, but any fuel initiatives affecting safety should also be monitored by Safety Risk Management (SRM), which is part of the SMS. Thus, the guidelines should address how to establish clear communication channels and protocols for monitoring safety performance indicators related to fuel initiatives. This ensures that both departments are aware of safety-related issues arising from fuel schemes. • Guidelines on how to address the complexities of accessing data that may not be controlled by a single department (e.g., FDM data is controlled and distributed by the safety department and the fuel department might need it to monitor specific SPIs). Thus, the guidelines should recommend mechanisms for seamless data sharing and collaboration between departments to monitor safety levels effectively. • Guidelines for regulatory authorities to conduct independent audits of safety monitoring processes within both the fuel department and the safety department to ensure that safety aspects of fuel initiatives are rigorously assessed.
Limitation(s):
UC4.2-ORG.5 - Absence of guidelines for the alignment of fuel initiatives and the SMS
EU AMC,GM & Standards (applicable, but not to be amended)
AMC2 ARO.GEN.300(a), GM1 ARO.GEN.300(a)(b)(c), ORO.GEN.200, AMC1 ORO.GEN.200(a)(1)(2)(3)(5), AMC1 ORO.GEN.200(a)(3)
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
In order to guarantee safe operations, EASA regulations mandate that regulators oversee airlines and their safety procedures. This oversight includes checking the airlines' risk management practices. EASA requires aviation authorities to develop a method for evaluating how well airlines assess risks within their safety management systems. While this might address part of the third solution point, it depends on how it's interpreted. EASA regulations do require airlines to track their performance, but this focus isn't necessarily on fuel management or the fuel department itself.

Solution
UC4.2-SOL.9 - Development of GM/AMC for the de-identification of fuel-related data
Description
Develop guidelines for the de-identification of fuel-related data, enabling safe sharing and collaboration across departments while ensuring the confidentiality and privacy of sensitive information. The GM/AMC should establish potential approaches to remove sensitive information from datasets while retaining their analytical value. The GM/AMC should: • Provide a framework for classifying fuel-related data based on sensitivity to assist operators in the identification of information that requires de-identification (e.g., aircraft-specific details, crew information, or operational parameters). • Provide potential de-identification techniques (e.g., anonymisation or aggregation) that ensure that sensitive information cannot be traced back to individuals or other operational characteristics. • Provide specific guidelines regarding access controls and data sharing protocols within the organisation. • Establish mechanisms for monitoring and auditing compliance with de-identification guidelines.
Limitation(s):
UC4.2-ORG.6 - Lack of detailed guidelines regarding the de-identification of data when shared with other departments within an organization
EU AMC,GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181, GM3 CAT.OP.MPA.181, GM1 CAT.OP.MPA.185, AMC1 CAT.OP.MPA.185(a), AMC2 ARO.OPS.225(c), GM3 CAT.OP.181, ICAO Doc 9976 Appendix 5 - Chapter 5
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
Both AMC1 CAT.OP.MPA.180(d)(2) and AMC8 CAT.OP.MPA.181(e) emphasize the importance of the operator demonstrating their capability to handle fuel consumption data. This implies some level of classification to identify sensitive information. There's no mention in regulations of specific de-identification methods like anonymisation or aggregation. While AMC1 CAT.OP.MPA.181(b) highlights the importance of using current aircraft-specific data, there's no guidance on access control within the organisation for de-identified data or protocols for secure data sharing across departments also there's no specific requirement for monitoring and auditing compliance with de-identification procedures.

Solution
UC4.2-SOL.10 - Development of GM/AMC for the continuous reporting of fuel-related safety performance
Description
Further develop current guidelines (e.g., EASA's AMC1 CAT.OP.MPA.180 b) regarding the reporting to the competent authority regarding the safety performance and regulatory compliance of fuel schemes. The GM/AMC should specifically address reporting requirements, frequency, format, and content. In this regard, the GM/AMC should, at least: • Specify reporting frequencies that align with regulatory expectations and industry best practices and provide clarity on how often operators should submit reports to the competent authority, ensuring a consistent approach across the industry. • Define standardised report formats to facilitate efficient and uniform reporting (e.g., types of data and information that must be included in the reports).
Limitation(s):
UC4.2-OPS.1 - Continuous reporting of fuel and safety performance
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.180
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
While AMC1 CAT.OP.MPA.180 lays the groundwork for reporting on individual fuel schemes, it lacks specifics on frequency, format, and content.

4.3 Use Case 4.3: Using operating conditions data to support performance-based fuel schemes:

4.3.1 Solution Package UC4.3-PS.2 - Regulatory initiatives for the collection, validation, and communication of operating conditions data

Solution
UC4.3-SOL.1 - Development of GM/AMC for the definition of minimum set of operating conditions data sources
Description
Develop guidelines that establish minimum set of operating conditions data sources required for specific fuel reduction applications and fuel scheme.
Limitation(s):
UC4.3-TEC.1 - Collecting all necessary operating conditions data sources
EU AMC, GM & Standards (applicable, but not to be amended)
AMC1 CAT.OP.MPA.175(a), AMC1 CAT.OP.MPA.180
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
AMC1 CAT.OP.MPA.175(a) Focuses on operational flight plan data, including fuel calculations and in-flight replanning. However, it doesn't specify data sources for fuel reduction applicationsAMC1 CAT.OP.MPA.180(e)(1) mandates using a suitable computerized flight-planning system, but it doesn't specify the data this system should utilise for fuel reduction purposes. The regulations lack specific requirements for the type and source of operating conditions data needed for fuel reduction applications. There's no mention of guidelines defining minimum data sets for various fuel schemes.

Solution
UC4.3-SOL.3 - Development of GM/AMC for the definition of minimum requirements for operating conditions data sources
Description
Develop guidelines that establish minimum requirements for operating conditions data sources in collaboration with authorities and stakeholders for specific fuel reduction applications. The key components of these guidelines should include: • Quality assurance: Quality assurance measures to ensure the accuracy and reliability of collected data (e.g., guidelines on data validation and verification processes). • Methodologies to regularly assess the data collection processes and quality.
Limitation(s):
UC4.3-ORG.1 - Assessment of operating conditions data quality
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181, GM3 CAT.OP.MPA.181, GM1 CAT.OP.MPA.185, AMC1 CAT.OP.MPA.185(a), AMC2 ARO.OPS.225(c), GM3 CAT.OP.MPA.181, ICAO Doc 9976 Appendix 5 - Chapter 5.
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The EASA regulations mandate a fuel/energy scheme for airlines, with options for basic, variations, or individual schemes based on safety and operational data. they focus on scheme existence, not data quality. They also recommend using large-scale industry data for basic schemes and individual operator data for variations/individual schemes., however, don't specify data collection methods or quality control. The Regulations require flight planning to consider current aircraft-specific data (derived from fuel consumption monitoring) or manufacturer data if unavailable. They focus on data use, not data quality or collection methods. The detailed guidance on FCM programs, including data collection methods, analysis, and record-keeping is provided in ICAO Doc 9976. the information is highly detailed but not mandatory under current regulations.

Solution
UC4.3-SOL.4 - Development of GM/AMC accounting for specificities in regard with validation of operating conditions data
Description
Select a set of existing standards (e.g., EUROCAE ED-76(A) or similar standards) accounting for specificities in regard with validation of operating conditions data (data reliability) that cover a wide range of aspects, including data collection procedures, accuracy checks, error identification, and quality assurance practices. The regulatory initiative should: • Develop comprehensive GM/AMC that outlines the specific requirements and procedures for validating operating conditions data according to the adopted standards. • Define clear and standardised criteria for evaluating the quality and reliability of different types of operating conditions data (e.g., criteria related to accuracy, completeness, timeliness, etc.).
Limitation(s):
UC4.3-ORG.1 - Assessment of operating conditions data quality
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181, GM3 CAT.OP.MPA.181, GM1 CAT.OP.MPA.185, AMC1 CAT.OP.MPA.185(a), AMC2 ARO.OPS.225(c), GM3 CAT.OP.MPA.181, ICAO Doc 9976 Appendix 5 - Chapter 5.
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The Regulations mandate fuel/energy schemes but don’t specify data quality or collection methods. They also recommend using large-scale industry data and individual operator data but lack specifics on data collection or verification. EASA Regulations require using current aircraft-specific data, but don't specify data quality or collection methods. ICAO Doc 9976 provides detailed guidance on FCM programs (data collection, analysis, record-keeping) but is not referenced under these regulations. This document cold cover some gaps.

Solution
UC4.2-SOL.5 - Development of GM/AMC for the integration of operating conditions data
Description
Develop guidelines for data source integration to mitigate compatibility issues and ensure data accuracy and completeness. The guidelines should address compatibility of different data sources, considering factors such as data formats, protocols, and frequencies, and should include integration protocols and standards that operators can follow when combining data from diverse sources
Limitation(s):
UC4.3-ORG.2 - Integration of parameters coming from diverse data sources
EU AMC, GM & Standards (applicable, but not to be amended)
CAT.OP.MPA.180, AMC1 CAT.OP.MPA.180, CAT.OP.MPA.181, AMC8 CAT.OP.MPA.181, GM1 CAT.OP.MPA.181, GM3 CAT.OP.MPA.181, GM1 CAT.OP.MPA.185, AMC1 CAT.OP.MPA.185(a), AMC2 ARO.OPS.225(c), GM3 CAT.OP.MPA.181, ICAO Doc 9976 Appendix 5 - Chapter 5.
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
EASA Regulations mandates fuel/energy schemes but lack specifics on data collection methods or quality. They also require using current aircraft-specific data but again lack specifics on data quality or collection. ICAO Doc 9976 complements the Solution: ICAO Doc 9976 provides detailed guidance on FCM programs (data collection, analysis, record-keeping), however it's not referenced in EASA regulations.

Solution
UC4.3-SOL.7 - Development of GM/AMC for the definition of communication channels / OCCs to share operating conditions data seamlessly
Description
Develop guidelines specifically aimed at addressing the challenges associated with the existence of segregated Operational Control Capabilities within organizations. The GM/AMC should: • Define clear communication channels and protocols for seamless sharing of operating conditions data (e.g., types of data that should be shared, format in which it should be exchanged, etc). • Promote data standardization across OCCs to ensure that all stakeholders work with consistent data formats and structures. • Establish procedures for granting access and authorization to OCCs, ensuring that all authorized personnel can access and use operating conditions data. • Encourage real-time or near-real-time data sharing to enable timely decision-making for fuel planning, flight dispatch, and crew members.
Limitation(s):
UC4.3-ORG.8 - Operating under a segregated ecosystem of OCCs
EU AMC, GM & Standards (applicable, but not to be amended)
No Regulations available
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
No regulations available that would cover this solution.

5. Case Study 5: Flight data models for safety

5.1 Use Case 5.1: Identification, decoding and processing of flight data for an FDM programme

5.1.1 Solution Package UC5.1-PS.1 - Promotion of industry best-practices and technologies among industry stakeholders

Solution
UC5.1-SOL.5 - Install WQAR equipment on newly-manufactured smaller aircraft
Description
Installation of WQAR equipment in small aircraft from the factory line, to enable the conduction of FDM programmes. The action should distribute information on the benefits of enabling flight data use and the limitations that exist in using the FDR for the same functions.
Limitation(s):
UC5.1-TEC.4 - Specific limitations for operators of small aircraft
EU AMC, GM & Standards (applicable, but not to be amended)
EUROCAE ED-203A (June 2018)- Airworthiness security methods and consideration • Section 2.1 Intentional unauthorised electronic interaction   ○ Relates to the wireless connectivity of the QAR and the potential security risk from that interaction, and the design considerations for any such device (This also applies if the equipment is physically connected to enable download of the data at a whilst on the ground e.g., via USB port)) • Section 3.1 Security Scope EUROCAE ED-12C Software considerations in airborne systems and equipment certification • The ability to record digital data whilst airborne, and potential transmit that data 'live' may impact on the operational safety of the aircraft. ORO.AOC.130 Flight data monitoring – aeroplanes • GM2 ORO.AOC.130 Flight data monitoring – aeroplanes
Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
ORO.AOC.130 Flight Data monitoring – aeroplanes • Currently states "The operator shall establish and maintain a flight data monitoring programme, which shall be integrated in its management system, for aeroplanes with *a maximum certificated take-off mass of more than 27 000 kg." (regulation (EU) 2015/1329)*   ○ To encourage operators of smaller aircraft GM may need to be created encompassing the MCTOM of all aircraft that would benefit from inclusion in a FDM programme GM2 ORO.AOC.130 Flight data monitoring – aeroplanes • The current guidance material provides examples of events to be recorded, which may need to be reconsidered for applicability to smaller aircraft

- Communications
- Licensing of radio spectrum may need to be confirmed to ensure use of 4/5G networks or other means are approved and able to support secure data transfer for operators working at airports that do not have the capability for data collection at the gates, or for future 'in flight' data collection

5.1.2 Solution Package UC5.1-PS.3 Development of regulatory initiatives for performance of FDM programmes

Solution
UC5.1-SOL.2 - Set an objective for minimum data recovery
Description
• Define the minimum performance that operator data recovery processes should achieve by establishing the proportion of data or flights for which data should be recovered, and the time frame to do so. This should include objective evaluation criteria while including provisions for exceptional situations where compliance is not possible. • By defining guidelines on minimum data analysis recovery, the operator will have to consider the de-risking of its operation. Such considerations will impact their cost-benefit analysis of hardware solution for data transmission and, ultimately, push them towards solutions with wireless capabilities that lower the risk of data loss due to memory overflow. • By defining these guidelines, an incentive is created for operators to properly structure the tasks and responsibilities concerned with monitoring of data recovery, identification of issues and implementation of mitigation measures. • By defining these guidelines, an additional incentive is created for operators to ensure the proper execution of the data retrieval and transmission process, while affecting the cost-benefit calculus of upgrading to new equipment that is either not impacted by transmission delays thanks to higher memory capacity or can minimise delays by automatically transmitting data at low cost. • By defining these guidelines, an additional incentive is created for operators to ensure the proper execution of the data retrieval and transmission process, which ultimately affects the cost-benefit calculus of upgrading to new equipment that does not require usage of maintenance service providers or certified technicians (reducing the cost) and that does not face the constrain of being charged per data transfer and not per volume of data transferred (reducing the delay).
Limitation(s):
UC5.1-TEC.2 - Limited recording capacity in older equipment UC5.1-TEC.7 - Risk of data loss when recovering data from non-WQARs UC5.1-ORG.6 - Data loss or corruption due to lack of monitoring UC5.1-OPS.1 - Data loss due to transmission delays UC5.1-OPS.2 - Cost of and delays to data transmission from non-WQARs
EU AMC, GM & Standards (applicable, but not to be amended)

• ORO.AOC.130 Flight data monitoring – aeroplanes (Regulation (EU) 965/2012, amended by Regulation (EU) 2015/1329);
  ○ AMC1 ORO.AOC.130 - Flight data monitoring - aeroplanes;
  ▪ h) The data recovery strategy should ensure a sufficiently representative capture of flight information to maintain an overview of operations. Data analysis should be performed sufficiently frequently to enable action to be taken on significant safety issues.
• **NPA** - AMC to ORO.AOC.130, conditions that specify minimum performance objectives for the main steps of an FDM programme, including flight data recovery: the conditions address the functioning of the airborne system, the set of flight parameters to be collected, the flight collection rate, the time to identify a failure to collect data from an individual aircraft, and the time to process the collected data.

Is the solution covered by the existing EU requirements, AMC and GM?
Fully if NPA adopted
Gaps in Regulation vs Recommendations
• The NPA covers all aspects of the recommendations on this point.

- ○

Solution
UC5.1-SOL.7 - Conditions for minimum data analysis capabilities
Description
Define the minimum performance that operator data analysis processes should achieve by establishing the proportion of data or flights for which data should be processed after transmission to a computer server, and the time frame to do so. This should include the objective evaluation criteria of the minimum performance while including provisions for exceptional situations where compliance is not possible. By defining these guidelines on minimum data analysis capabilities, the operator will have to consider the need to ensure scalability of its software solution, which will impact their cost-benefit analysis when choosing software solutions and, ultimately, push them towards better scalable solutions.
Limitation(s):
UC5.1-TEC.9 - Limitations to computational resources for flight data decoding UC5.1-TEC.12 - Limitations to computational resources for flight data processing
EU AMC, GM & Standards (applicable, but not to be amended)
• ORO.AOC.130 Flight data monitoring – aeroplanes (Regulation (EU) 965/2012, amended by Regulation (EU) 2015/1329); ○ AMC1 ORO.AOC.130 Flight data monitoring – aeroplanes – part h ▪ The NPA proposes the addition of 5 sub bullets to the section ▪ These additions identify timelines on frequency of analysis
Is the solution covered by the existing EU requirements, AMC and GM?
Fully if NPA adopted
Gaps in Regulation vs Recommendations

Solution
UC5.1-SOL.8 - Minimum list of risk areas to be monitored through FDM
Description
Minimum list of risk areas that should be monitoring within the FDM programme. The guidelines should provide references on how these risk areas can be monitored and include provisions for exceptional situations where compliance is not possible (particularly due to lack of available data). By standardising the logics and algorithms used across software vendors, the impact of changing between vendors and being subject to some degree to the software vendor-defined algorithms can be mitigated. The minimum list of risk areas to be monitored, coupled with the information on standardised FDM-based indicators and the logics, algorithms and thresholds used in the Data4Safety programme can support the regulator with limitation “UC5.1-ORG.13B – Difficulties in assessing the selection and definition of FDM events by operators”. They also serve to partially address “UC5.1-ORG.13A - Limitations to standardisation of events and flight parameters by authorities”, as these standardised indicators and industry-agreed algorithms are not directly sanctioned by the authority but instead presented as potential alternatives to be adapted.
Limitation(s):
UC5.1-TEC.10 - Lack of standardisation of FDM events definitions UC5.1-ORG.12 - Insufficient operator control over the definitions of FDM events and measurements UC5.1-ORG.13 - Limitations to the role of the authority in FDM programmes
EU AMC, GM & Standards (applicable, but not to be amended)

• ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ GM2 ORO.AOC.130 Flight data monitoring — aeroplanes – Examples of FDM events, but is illustrative and not exhaustive or mandatory
• CAP739 – Appendix B – Typical FDM Exceedance Detection and Routine Parameter Analysis
• The NPA proposes following changes
  ○ AMC2 ORO.AOC.130 Flight data monitoring – aeroplanes
  ▪ There is no specification in AMC1 ORO.AOC.130 regarding the risk areas that should be monitored by the FDM programme. As a result, compliance with AMC1 ORO.AOC.130 does not guarantee that the operator uses its FDM programme to monitor the risk areas that are relevant for all large aeroplane operators.
  ○ GM2 ORO.AOC.130 Flight data monitoring — aeroplanes
  ▪ Provide industry best practices on monitoring precursors of incidents related to the key risk areas that are specified in AMC2 ORO.AOC.130 with FDM. The new Table 1 of GM2 ORO.AOC.130 contains examples of such precursors that could be monitored by means of FDM events or FDM measurements.

Is the solution covered by the existing EU requirements, AMC and GM?
Fully, if NPA adopted
Gaps in Regulation vs Recommendations
• The updates proposed increase the scope of FDM and definitions, and address the minimum set of risk areas to be monitored.

Solution
UC5.1-SOL.13 - Maintaining knowledge and documentation on flight data and DFLs
Description
Ensure that a minimum set of knowledge and documentation is maintained by the operator on the flight data used for the FDM programme and on the DFLs of their aircraft. Among these, it should include: • Documentation on the flight parameters collected or used for the FDM programme, including nomenclature and performance. • The DFL documentation in both paper (i.e., pdf file) and electronic versions (i.e., FRED file or equivalent open format), linked to each aircraft tail number and including its time period of applicability. Should the operator customise its DFL by themselves or through a vendor, such customisation should be captured in the DFL documentation. • The data quality process followed to clean flight data before further processing. This solution is partially dependent on the application of solution "**UC5.1-SOL.6 - Create the conditions for open access to DFL electronic documentation**", as access to the electronic version of the DFL documentation will otherwise not be possible for many operators.
Limitation(s):
UC5.1-ORG.9 - Lack of operator knowledge management of DFLs
EU AMC, GM & Standards (applicable, but not to be amended)

• ORO.AOC.130 Flight data monitoring – aeroplanes
• GM1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ (e) Implementing an FDM programme (3) The FDM team (part ii)
• NPA -GM1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ (d) Preconditions for an effective FDM programme
  ▪ part 4 Integration with the operator's management system
  ▪ part 5 Up-to-date flight parameter decoding documentation

Is the solution covered by the existing EU requirements, AMC and GM?
Fully, if NPA Adopted
Gaps in Regulation vs Recommendations
None

Solution
UC5.1-SOL.14 - Maintaining knowledge and documentation on FDM events and algorithms
Description
Ensure that a minimum set of knowledge and documentation is maintained by the operator on the FDM events and algorithms covered within the FDM programme. It should include: • A description of the logic of algorithms related to flight splitting, flight phase identification, FDM events and FDM measurements, including thresholds when relevant. The description should be sufficiently detailed to enable evaluation against the SOPs and flight manual limitations of the operator. • Flight parameters used and their performance.
Limitation(s):
UC5.1-ORG.15 - Lack of operator knowledge management of FDM events
EU AMC, GM & Standards (applicable, but not to be amended)

• ORO.AOC.130 Flight data monitoring – aeroplanes
• GM1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ (e) Implementing an FDM programme (3) The FDM team (part ii)
NPA
• GM1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ (d) Preconditions for an effective FDM programme
  ▪ part 4 Integration with the operator's management system
  ▪ part 5 Up-to-date flight parameter decoding documentation
• AMC1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ (l) Maintaining knowledge about data and algorithms:

Is the solution covered by the existing EU requirements, AMC and GM?
Fully, if NPA Adopted
Gaps in Regulation vs Recommendations

5.1.3 Solution Package UC5.1 - PS.4- Development of regulatory initiatives for DFL documentation

Solution
UC5.1-SOL.3 -Develop a Flight Parameter Reference document for FDM
Description
1. Develop a Flight Parameter Reference (FPR) document containing a comprehensive list of flight parameters to serve as a common baseline for Data Frame Layouts used in FDM. 2. It should be ensured that DFL documentation produced by manufacturers can be related to the Flight Parameter Reference document. 3. A gradual standardisation of DFLs within and across operators and establishing a baseline level of parameter performance. • By providing clear information over the capabilities in terms of parameters and performance of regional aircraft, when compared with those values established in the FPR document. In addition, it nudges manufacturers, including those of regional aircraft, towards further standardisation of parameters and their performance as recorded by their aircraft. • By enabling a platform, the Data4Safety programme, where manufacturers of regional aircraft can collaborate themselves in the definition of algorithms and logics, later shared and publicised across the wider FDM community. • By supporting manufacturers in communicating the specificities of their aircraft and operation, which should help software vendors and operators in defining higher quality events, measurements, and algorithms, better adapted to regional aircraft.
Limitation(s):
UC5.1-TEC.3 - Need to use multiple DFLs UC5.1-TEC.4 - Specific limitations for operators of smaller aircraft UC5.1-TEC.5 - Lack of standardisation of flight parameters UC5.1-ORG.4 - Lack of information for operator-requested DFL customisation UC5.1-OPS.5 - Lower quality of FDM events and measurements in the case of regional aircraft
EU AMC, GM & Standards (applicable, but not to be amended)
• ORO.AOC.130 Flight data monitoring – aeroplanes (Regulation (EU) 965/2012, amended by Regulation (EU) 2015/1329) • GM3 ORO.AOC.130 Flight data monitoring – aeroplanes list additional guidance (ICAO Doc 1000 and UK CAP 739) and industry good practice (EOFDM) for aeroplanes' FDM programmes. **NPA** • updateAMC2 ORO.AOC.130 Flight data monitoring – aeroplanes   ○ There is no specification in AMC1 ORO.AOC.130 regarding the risk areas that should be monitored by the FDM programme. As a result, compliance with AMC1 ORO.AOC.130 does not guarantee that the operator uses its FDM programme to monitor the risk areas that are relevant for all large aeroplane operators. • GM2 ORO.AOC.130 Flight data monitoring — aeroplanes • Provide industry best practices on monitoring precursors of incidents related to the key risk areas that are specified in AMC2 ORO.AOC.130 with FDM. The new Table 1 of GM2 ORO.AOC.130 contains examples of such precursors that could be monitored by means of FDM events or FDM measurements.
Is the solution covered by the existing EU requirements, AMC and GM?
Partial – if NPA adopted

Gaps in Regulation vs Recommendations
• To enable this solution an agreed layout by all manufacturers will be required/or a standardised data frame layout will need to be establish applicable for all classes of aircraft requiring FDM

Solution
UC5.1-SOL.6 - Create the conditions for open access to DFL electronic documentation
Description
Create conditions to ensure availability and access to DFL electronic documentation in an open format. • Aircraft and equipment manufacturers providing operators with the DFL electronic documentation in an open format (such as the FRED format) for newly-manufactured aeroplanes. • DFL electronic documentation should be included as part of the required aircraft documentation, delivered at the same time and with the same level of detail and completeness as the DFL paper document contained in the Aircraft Maintenance Manual (AMM). It shall also be delivered to an operator leasing an aircraft. • Operators converting their DFL paper documentation into electronic documentation, by themselves or through a service provider. With manufacturers providing the DFL electronic documentation, and software vendors using it, the production of DFL decoding files is simplified and the cost can be significantly reduced. Ultimately, the need to use proprietary formats is indirectly addressed, as it is no longer capable of dissuading operators from changing between service providers given the reduction in the cost of producing the decoding file. By requiring manufacturers to produce and deliver the DFL electronic documentation, and software vendors to share it as well, this limitation is fully addressed: • The production of DFL decoding files is simplified by removing the data entry process, which significantly reduces the cost of production, addressing limitations "**UC5.1-ORG.7A - Cost of producing the DFL decoding file for operators**" and "**UC5.1-ORG.7B - Cost of updating the DFL decoding file after a change to the DFL by the manufacturer**". As the DFL electronic documentation is now fully in control of the operator, its freedom to share it with different vendors is ensured. In parallel, the leverage that the software vendor has to prevent sharing of flight data is reduced, as the cost for the operator to request a new decoding from another vendor is lower than currently. The combination of factors can, in contrast, enable further centralisation of decoding by reducing the risk and cost for the operator. Thus, the solution addresses limitation "**UC5.1-ORG.7C - Dependence on the software vendor to produce the DFL decoding file**". By requiring manufacturers to produce and deliver the DFL electronic documentation, the production of DFL decoding files is simplified and the cost can be significantly reduced, mitigating the overall impact that modifications of the DFL by the manufacturer cause on operators and software vendors. By decreasing the cost of producing the DFL decoding file, it can be more easily incorporated into the subscription cost of the service. Additionally, given that software vendors are required to share the DFL electronic documentation but not their DFL decoding files, absorbing the cost, and capitalising on past developments remains an option for vendors. By eliminating the manual labour required for data entry of the paper DFL documentation into a computer and validation of this process, the overall cost of production is reduced, and the process is simplified. This result can help software vendors minimise invested resources to maintain their decoding capabilities.
Limitation(s):
UC5.1-TEC.8 - Usage of proprietary formats in DFL decoding files UC5.1-ORG.5 - Modification of the DFL by the manufacturer UC5.1-ORG.7 - Operators losing ownership of their DFL decoding file

UC5.1-ORG.10 - SaaS business model not adapted to the production of DFL decoding files UC5.1-OPS.4 - Cost and complexity of producing a DFL decoding file for software vendors
EU AMC, GM & Standards (applicable, but not to be amended)
ARINC647A-1 - Flight recorder electronic documentation (FRED) - This specification is an international standard defining the content and format of electronic files which document Flight Data Recording systems. The FRED specification is an expansion of the Flight Recorder Configuration Standard (FRCS) and is intended to provide guidelines for software systems designers and developers of ground support equipment for flight data recorders. The FRED specification has been developed to facilitate the exchange of Flight Data Recorder (FDR) documentation between aircraft manufacturers, operators, and government agencies.
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
To enable this solution an agreed layout by all manufacturers will be required/or a standardised data frame layout will need to be establish applicable for all classes of aircraft requiring FDM. FDM vendors would also be required to enable the export of the DFL in this standard format within their software solutions.

Solution
UC5.1-SOL.12 - Addressing Intellectual Property Rights in FDM
Description
Develop guidelines on Intellectual Property Rights in the context of FDM, flight data decoding and DFL documentation. The guidelines should be preceded by a legal evaluation of the different claims to IPRs in this context and should provide industry stakeholders with a clear understanding of what can be considered IPR and what cannot. Data quality requirements of the different domains utilising flight data, serving as a base from which different teams within the operator can agree on a common data quality framework.
Limitation(s):
UC5.1-ORG.8 - Intellectual Property Rights in flight data decoding
EU AMC, GM & Standards (applicable, but not to be amended)
No applicable regulation
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
The EU has guidance and information on IPR https://single-market-economy.ec.europa.eu/industry/strategy/intellectual-property_en IPR is outside the scope of the regulatory analysis. Legal and specialist advice would be required to understand the effects of IPR.

5.1.4 Solution Package UC5.1-PS.5 - Initiatives to develop technical solutions to the collection of flight data

Solution
UC5.1-SOL.4 - Definition by manufacturers of DFLs with a wide selection of parameters
Description

• Development by manufacturers of Data Frame Layouts with an extensive number of flight parameters usable for a multitude of purposes and for most operators, addressing the data needs of FDM, fuel management, continuing airworthiness and others. By increasing the utility of the standard DFL, the need to adapt and customise can be minimised and the number of DFLs reduced.
• Development of this solution should be coordinated with solution "UC5.1-SOL.3 - Develop a Flight Parameter Reference document for FDM" to ensure the standardisation of these extensive DFLs.
• Increasing the overall number of parameters captured in the aircraft, thus removing the issue of missing parameters or them being inadequate for specific uses (beyond very specific parameters not included in the standard DFL).
• Addresses this limitation by increasing the number of parameters captured, ultimately removing the need to customise the DFL for most operators.
  ○ By minimising the need of operators to customise DFLs, which should further simplify the production process of the DFL decoding file and allow software vendors to re-use previously produced decoding files more easily.
  ○ By eliminating the manual labour required for data entry of the paper DFL documentation into a computer and validation of this process, the overall cost of production is reduced, and the process is simplified. This result can help software vendors minimise invested resources to maintain their decoding capabilities.
• Minimising the need of operators to customise their DFLs which should further simplify the production process of the DFL decoding file and allow software vendors to re-use previously produced decoding files more easily.

Limitation(s):
UC5.1-TEC.3 - Requirement to use multiple DFLs UC5.1-TEC.4 - Specific limitations for operators of smaller aircraft UC5.1-TEC.5 - Lack of standardisation of flight parameters UC5.1-ORG.1 - Limitations to the customisation of DFLs UC5.1-ORG.2 - Limitations to increasing the recording capacity of DFLs UC5.1-ORG.4 - Lack of information for operator-requested DFL customisation UC5.1-OPS.4 – Cost and complexity of producing a DFL decoding file for software vendors
EU AMC, GM & Standards (applicable, but not to be amended)
• ARINC647A-1 - Flight recorder electronic documentation (FRED) - This specification is an international standard defining the content and format of electronic files which document the data frame layout of a Flight Data Recording system. The FRED specification is an expansion of the Flight Recorder Configuration Standard (FRCS) and is intended to provide guidelines for software systems designers and developers of ground support equipment for flight data recorders. The FRED specification has been developed to facilitate the exchange of data frame layout documentation between aircraft manufacturers, operators, and government agencies. • CAP731 Approval, Operational Serviceability and Readout of Aircraft Flight recorder provides guidance on DFLs • Proposed amendment to AMC1 ORO.AOC.130 in NPA 2024-02 introduces a minimum list of parameters to be recorded for the purpose of FDM, based on standards applicable to a flight data recorder.
Is the solution covered by the existing EU requirements, AMC and GM?

Partial if NPA adopted
Gaps in Regulation vs Recommendations
To enable this solution, an agreed layout by all manufacturers will be required, or a standardised data frame layout will need to be establish which would be applicable for all classes of aircraft within the scope of a FDM programme.

5.1.5 Solution Package UC5.1-PS.6- Initiatives adopt digital capabilities on FDM events and fusion

Solution
UC5.1-SOL.9 - Development of industry-agreed FDM algorithms and logics
Description

• As part of the normal functioning of the Data4Safety programme, different approaches, algorithms and logics to identify and measure safety occurrences from flight data are tested and validated and published (see "Guidance for identifying unstable approach with flight data", published on DATA4SAFETY | EASA (europa.eu)). Such an approach already allows for benchmarking of events across operators, and logics and algorithms can be shared and promoted across software vendors, operators, and other users of flight data.
• By standardising the logics and algorithms used across software vendors, the impact of changing between vendors and being subject to some degree to the software vendor-defined algorithms can be mitigated
• The minimum list of risk areas to be monitored, coupled with the information on standardised FDM-based indicators and the logics, algorithms and thresholds used in the Data4Safety programme can support the regulator with limitation "UC5.1-ORG.13B – Difficulties in assessing the selection and definition of FDM events by operators".
• They also serve to partially address "UC5.1-ORG.13A - Limitations to standardisation of events and flight parameters by authorities", as these standardised indicators and industry-agreed algorithms are not directly sanctioned by the authority but instead presented as potential alternatives to be adapted.
  ○ By providing clear information over the capabilities in terms of parameters and performance of regional aircraft, when compared with those values established in the FPR document. In addition, it nudges manufacturers, including those of regional aircraft, towards further standardisation of parameters and their performance as recorded by their aircraft.
  ○ By enabling a platform, the Data4Safety programme, where manufacturers of regional aircraft can collaborate themselves in the definition of algorithms and logics, later shared and publicised across the wider FDM community.
  ○ By supporting manufacturers in communicating the specificities of their aircraft and operation, which should help software vendors and operators in defining higher quality events, measurements, and algorithms, better adapted to regional aircraft.

Limitation(s):
UC5.1-TEC.10 - Lack of standardisation of FDM events definitions UC5.1-ORG.12 - Insufficient operator control over the definitions of FDM events and measurements UC5.1-ORG.13 - Limitations to the role of the authority in FDM programmes UC5.1-OPS.5 - Lower quality of FDM events and measurements in the case of regional aircraft
EU AMC, GM & Standards (applicable, but not to be amended)
• ORO.AOC.130 Flight data monitoring – aeroplanes   ○ GM2 ORO.AOC.130 Flight data monitoring — aeroplanes – Examples of FDM events, but is illustrative and not exhaustive or mandatory

- CAP739 – Appendix B – Typical FDM Exceedance Detection and Routine Parameter Analysis - Examples of FDM events, but is illustrative and not exhaustive or mandatory

NPA

- AMC1 ORO.AOC.130 Flight data monitoring – aeroplanes
  - Includes amendments with regards to; FDM analysis software, Safety information and promotion, Data recovery and analysis, Data retention, maintenance of knowledge, Airborne systems and equipment
- AMC2.ORO.AOC.130 Flight data monitoring – aeroplanes
  - Scope of flight data monitoring (FDM) programme
- GM2 ORO.AOC.130 Flight data monitoring — aeroplanes - Examples of FDM events, but is illustrative and not exhaustive or mandatory

Is the solution covered by the existing EU requirements, AMC and GM?
Partially
Gaps in Regulation vs Recommendations
The need for a standardised list of logics and algorithms to be used across industry would be required if this was to be enforced.

5.2 Use Case 5.2: Usage of flight data for FDM and other safety-relevant activities

5.2.1 Solution Package UC5.2-PS.1 - Development of industry best-practices on cross-system and cross domain usage of flight data

Solution
UC5.2-SOL.5 - Define cross-domain data formatting standards
Description

• Develop cross-domain data formatting standards, ensuring cross-interoperability of data in software solutions for different safety-relevant activities. These set of documents should include:
  ○ Standardised data formats for the main data outcomes in each domain, encompassing data structure, attributes, and naming conventions.
  ○ Insights into mapping data attributes across different data sources. Other potential components such as aligning data granularity across sources to ensure different sources can be merged without loss of essential details.
  ○ Producing documentation and knowledge that can be accessed by teams other than the FDM, giving them more independence and their own platforms for knowledge sharing.
  ○ Democratising access to FDM knowledge. With an external certification to pass, it is not necessary to be part or have experience in an FDM team in order to acquire knowledge on flight data and FDM. While the depth of expertise between a practicing expert and a certified analyst without experience will be wide, it represents a base on which to build.
• Production of documentation and knowledge that can be accessed by teams other than the FDM, giving them more independence and their own platforms for knowledge sharing.
• Data quality requirements of the different domains utilising flight data, serving as a base from which different teams within the operator can agree on a common data quality framework.

Limitation(s):
UC5.2-TEC.5 - Lack of integration of software solutions across uses of flight data UC5.2-ORG.5 - Limitations to maintaining the FDM team in a central role for any use of flight data UC5.2-OPS.4 - Duplication of flight data decoding activities for other uses
EU AMC, GM & Standards (applicable, but not to be amended)
None
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
No identifiable standards have been identified, best practice may exist, however, to enable this solution, industry and regulators would have to agree what should be written into minimum standards, and where this should sit (i.e. EASA, industry body etc)

5.2.2 Solution Package UC5.2-PS.4 - Development of industry best-practices on cross-system and cross domain usage of flight data

Solution
UC5.2-SOL.1 - Define minimum FDM software capabilities
Description

• Define the minimum capabilities that an FDM software should have to fulfil its purpose as a flight data processing and safety analysis tool. Given the current lack of certification process of FDM software, the guidelines should provide a list of capabilities that would be advantageous for the software. These capabilities could include, among others:
  ○ Capacity to export FDM events and measurements in an open format.
  ○ Capacity to replay flight data in a flight animation.
  ○ Capacity to display aggregated and individual information on summary reports or dashboards.
  ○ Capacity to exchange information with the SMS software in an open format.[2]
• The objective is that software vendors incorporate such capabilities into their FDM software. They may either decide to develop this capability internally (which voids the need to interoperate in the context of this limitation) or to supplement their software with solutions offered by a different provider (which will require enabling interoperability between solutions by technological means that can be reused with many other vendors, decreasing the unit cost of enabling each connection).
• Helping software vendors to facilitate the exchange of data between their FDM software and the SMS software of the operator.
• Enabling and facilitating the use of technological means to improve the execution of analysis, eliminating the need to use multiple independent systems.

Limitation(s):
UC5.2-TEC.1 - Lack of interoperability with complementary software solutions for FDM analysis UC5.2-TEC.2 - Lack of integration of FDM software with SMS software UC5.2-OPS.1 - Usage of multiple software solutions for the SRM process
EU AMC, GM & Standards (applicable, but not to be amended)

EUROCAE ED-12C Software consideration in airborne systems and equipment – Only applicable if there is a direct data link from the FDM recorder to a ground station during flight
EUROCAE ED203A Airworthiness security methods and consideration - Only applicable if there is a direct data link from the FDM recorder to a ground station during flight
NPA
• AMC1 ORO.AOC.130 Flight data monitoring – aeroplanes
  ○ Part (d)
  ○ Part (e)
  ○ Other parts e.g. Part (i) Data retention strategy, part (j) data access and security policy, may impact requirements for minimum FDM software capabilities
• GM1 ORO.AOC.130 Flight data monitoring – aeroplanes

[2] There is currently no standardised data format for SMS software. Solving this issue goes beyond the scope of FDM programmes.

Is the solution covered by the existing EU requirements, AMC and GM?
Partially – if NPA adopted
Gaps in Regulation vs Recommendations
No regulation exists for FDM software capabilities, this is dependent on the desire to regulate for minimum data sets in FDM which would be a factor or if industry is best placed to build on best practice e.g., through the EOFDM forum. Potential requirement for guidance on approaches to assured software development could be included, such as NASA-STD-8739.8 (09/08/2022) Software Assurance and Software Safety Standard if operators wish to stream live in flight data to a ground station.

Solution
UC5.2-SOL.2 - Technical standards for FDM-SMS integration
Description
• Produce technical standards on how to exchange data between FDM and SMS software. The initiative shall determine which information should be transferred between both software solutions (e.g., monitoring targets from SMS to FDM, event rates from FDM to SMS), the format of the data and the protocols to be used in the data exchange. • By developing such standards, the technical limitation on integration will be significantly mitigated, as software vendors will not have to develop custom integrations for each other's software. • Enabling and facilitating the use of technological means to improve the execution of analysis, eliminating the need to use multiple independent systems.
Limitation(s):
UC5.2-TEC.2 - Lack of integration of FDM software with SMS software UC5.2-OPS.1 - Usage of multiple software solutions for the SRM process
EU AMC, GM & Standards (applicable, but not to be amended)
EUROCAE ED-12C Software consideration in airborne systems and equipment – Only applicable if there is a direct data link from the FDM recorder to a ground station during flight EUROCAE ED203A Airworthiness security methods and consideration - Only applicable if there is a direct data link from the FDM recorder to a ground station during flight
Is the solution covered by the existing EU requirements, AMC and GM?
No
Gaps in Regulation vs Recommendations
No standardised data format or data sharing agreements between different vendors, opportunity to develop best practice through EOFDM forum for example Guidance on approaches to assured software development could be included, such as NASA-STD-8739.8 (09/08/2022) Software Assurance and Software Safety Standard

5.2.3 Solution Package UC5.2-PS.5 - Development of regulatory initiative for certification of FDM analysts

Solution
UC5.2-SOL.7 - Certification of FDM analyst competency
Description

• Develop a system of evaluation and certification of FDM analyst competency, establishing a curriculum and an examination process through a collaborative process with relevant industry stakeholders. Topics should include:
  ○ Knowledge on the data collection, decoding and quality assurance processes.
  ○ Flight data characteristics and limitations.
  ○ Flight phase, event and measurement definition, implementation, and computation.
  ○ Analysis of individual events and trends, including identification of causal factors.
  ○ SMS implementation and the SRM process.
• This solution addresses limitation “UC5.2-ORG.1A - Variability in the level of competency of FDM analysts” by ensuring that the body of analysts across the industry achieves a shared level of understanding on best practices and minimum knowledge.
• Democratising access to FDM knowledge. With an external certification to pass, it is not necessary to be part or have experience in an FDM team in order to acquire knowledge on flight data and FDM. While the depth of expertise between a practicing expert and a certified analyst without experience will be wide, it represents a base on which to build.

Limitation(s):
UC5.2-ORG.1 - Factors hindering the build-up of FDM knowledge at operators UC5.2-ORG.5 - Limitations to maintaining the FDM team in a central role for any use of flight data
EU AMC, GM & Standards (applicable, but not to be amended)
GM1 ORO.AOC.130 (e) - Implementing an FDM programme – (3) The FDM team - part (ii) **NPA** GM1 ORO.AOC.130 (e) - Implementing an FDM programme – (3) The FDM team - part (i)F – provides guidance on the person requirements for the FDM analyst
Is the solution covered by the existing EU requirements, AMC and GM?
Partial, if NPA adopted
Gaps in Regulation vs Recommendations
The level of competency or training required is not specified within AMC, which could lead to differences or discrepancies between operators FDM teams

6. Conclusions

The review of the current requirements, AMC and GM within the regulations has identified that for the solutions proposed in "D-2.1 Development of the case studies" they fall into 5 main categories:

1. New Requirements, AMC or GM (or combination thereof) to enable them to be implemented
2. Modifications to existing requirements, AMC or GM (or combination thereof) to enable them to be implemented
3. Industry led working groups to establish best practice and agree collaborative ways of working (not covered in this document)
4. A broader understanding of existing industry standards or EU regulation (such as GDPR) to enable the solutions
5. Training and competency development for people involved with the functions identified in the case studies.

For case study 3: flight training data for EBT/CBTA most of the proposed solutions are Non-regulatory (36/55), however guidance and development of best practice has been flagged as a need. Where modifications have been identified as required in the regulatory documents, these predominantly sit within guidance material.

For case study 4: Digital fuel management, 19 out of the 56 proposed solutions require some form of update or modification. This includes:

- Standardised Lists and Fuel Safety Parameters
- Fuel-Related SPIs
- Data integration and compatibility
- De-identification of fuel-related data
- Fuel performance modelling
- Data sharing and collaboration
- Operating conditions data sources
- Operating conditions data platform (Optional)
- Safety Monitoring Systems
- Unified approach to monitor SPIs
- Reporting to competent authority.

For case study 5: Flight data models for safety, four require modifications of existing regulations / AMC/ GM and six require new requirements, AMC or GM. A decision will need to be taken on the scope of aircraft that must be included within a FDM programme and those which should be encouraged to operate a voluntary FDM programme.

The review has considered all solutions, and there are some interdependencies between these. These interdependencies will need to be understood, as the implementation of one solution may predicate the implementation of another solution. It may also be the case that be implementation of one solution with the required changes to regulations, that a second solution can be automatically implemented for no additional work. This is further considered in 'D3.2 Proposed roadmaps for changes'.

7. References

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- D3.2 Proposed roadmaps for changes - Digital transformation - Case studies for aviation safety standards – Data Science Applications (DATAPP), Research project EASA.2022.HVP.01
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