European Union Aviation Safety Agency

EPAS preparation – October 2025

Light BIS – BIS 43 "SI-9001 Inadequate management of repetitive defects"

Summary of the Safety Issue Assessment

1	Problem	The inadequate management of repetitive defects was identified as a contributing factor to a number of fatal and non-fatal accidents of large aeroplanes in commercial air transport and classified as one of the upper-end medium priority safety issues of the airworthiness safety risk portfolio. While deferred defects and carried forward defects are defined in the continuing airworthiness regulation, the current regulations do not clearly define repetitive defects. Repetitive defects (examples in Annex A chapter 7) can furthermore be difficult to identify and rectify, and root causes thereof have the potential to remain latent over long periods of time. They may eventually affect the safe operation of aircraft, particularly when combined with other defects, or when they occur on highly integrated systems, potentially impacting on automation and/or on flight crew workload.
2	Criticality	**SIPI** 5.79 in 2024 — **Category**: Mitigate/Define — **TST**: No
3	Stakeholders	Competent Authorities, Continuing Airworthiness Maintenance Organisation (CAMO), Maintenance Organisation (MO), Combined Airworthiness Organisation (CAO), Aircraft Operators (Flight crew)

Summary of the Impact Assessment (Options and their impacts)

4 a. The option "No policy change" is not recommended due to the identified safety risks

b. Proposed actions

Impact between -10 (very negative) and +10 (very positive)

	Action #01		Action #02		Action #03	
		Guidance material for repetitive defects		***Oversight of CAMOs and AMOs on the management of repetitive defects***		***Good practices on managing repetitive defects***
	RMT	*Comment*	*MST*	*Comment*	*SPT*	*Comment*
Affected stakeholders						
Primary target	*CAMOs, CAs*		*CA inspectors*		*CAMOs, MOs, pilots*	
Final outreach	*Maintenance licence staff*		*CAMOs, MOs, CAOs*		*Maintenance licence staff, NCA staff, airline pilot*	
Impact per criteria and overall impact per action						
Safety impact	5	It will provide clarification on repetitive defects, identification, and management thereof (not limited to reliability programme as it is today)	5	It will raise the focus of competent authorities oversight activities to ensure repetitive defects are effectively managed. This focus is expected for the next oversight cycle.	3	It will enable to share good practices from industry and regulatory stakeholders on how repetitive defects are identified, monitored, resolved, and documented as a key safety risk, as part of their SMS.
	Medium postive		Medium postive		Low postive	
Economic impact - overall	0	Extremely low resources impact at EASA level and potential benefits to be materialised at a later stage for CAMOs and MOs.	0	Oversight focus integrated in the current oversight workload	-0.5	Minor workload impact on EASA side, neutral impact on stakeholders
EASA resources	*Negligible*	*1 to 2 weeks to develop the GM requirements*	*Negligible*	*Oversight focus integrated in the current oversight workload*	*Very low*	*EASA SPT team with few hours from CAW experts contribution*
Stakeholders resources	*Negligible*	*The GM may create very minor additional work with its implementation in the CAMOs and MOs. This will be compensated by potential efficiency benefits (versus an inefficient management of repetitive defect).*	*Negligible*	*Oversight focus integrated in the current oversight workload*	*Neutral*	*It is a safety promotion material to be used when beneficial by the stakeholders*
Overall score	**5**	**Medium positive impact**	**5**	**Medium positive impact**	**2.5**	**Low positive impact**

Indicative timeline

Years	Up to end 2025	2026	2027	2028	2029
SPT	SAFE 360 2024	Creation of EASA webpage	n/a (but SP material remain available)		SI monitoring to assess improvement or new issues
MST	n/a	Start of oversight focus	Continuation and end of oversight focus	n/a	
	Feedack from CAs and stakeholders from SPT and MST				
RMT (GM)	Draft GM in NPA 2025-XX (Q4) RMT.0735	Consultation (stakeholders comments)	Final GM update (also based on MST feedback) and EDD publication	GM implementation	

Decisions			
5	**BIS team proposal**	**Best Intervention Strategy:** the 3 combined actions are proposed to mitigate the “repetitive defects” safety risks. Action 2 and 3 would pave the way to the Action 1. Indeed the focused oversight and the best practices promoted will be key enabler for the subsequent implementation of the necessary Guidance Material providing the missing definition on management of repetitive defect (Action 1, rulemaking in progress in 2025). The combination of these actions will maximise the impacts of the individual actions.	
6	**ESC before AB**	5.1	BIS consultation for Advisory Bodies: Yes (ESC 7/11/2025)
		5.2	ExCom to arbitrate on resources before BIS consultation: No
7	**AB feedback**	Positive or negative feedback? Which BIS actions are amended?	
8	**ESC decision**		

Table of contents

Annex A: SIA SI-9001 Inadequate management of repetitive defects

Executive Summary

1. Why intervene?

The inadequate management of repetitive defects was identified as a contributing factor to a number of fatal and non-fatal accidents of large aeroplanes in commercial air transport and classified as one of the top medium priority safety issues of the airworthiness safety risk portfolio.
While deferred defects and carried forward defects are defined in the continuing airworthiness regulation, the current regulations do not clearly define repetitive defects. Repetitive defects can furthermore be difficult to identify and rectify, and root causes thereof have the potential to remain latent over long periods of time. They may eventually affect the safe operation of aircraft, particularly when combined with other defects, or when they occur on highly integrated systems, potentially impacting on automation and/ or on flight crew workload.
The assessment of this safety issue was launched to review the current European regulation and industry practices regarding repetitive defects, with the overall aim at identifying actions to improve the management of repetitive defects at European level, thereby mitigating the associated risk.
It is important to note that the scope of this safety issue specifically focuses on identification, monitoring and resolution of repetitive defects on a daily basis.

1 Safety issue assessment

1.1 Introduction and purpose

The management of repetitive defects has been identified as one of the top medium priority safety issues of the airworthiness safety risk portfolio (safety issue transferred from the commercial air transport large aeroplanes safety risk portfolio in 2023). Investigation reports of fatal and non-fatal accidents of large aeroplanes in commercial air transport identified repetitive defects as contributing factors.
While deferred defects and carried forward defects are defined in the continuing airworthiness regulation, the current regulations do not clearly define repetitive defects. Repetitive defects can furthermore be difficult to identify and rectify, and root causes thereof have the potential to remain latent over long periods of time. They may eventually affect the safe operation of aircraft, particularly when combined with other defects, or when they occur on highly integrated systems, potentially impacting on automation and/ or on flight crew workload.
The management of repetitive defects involves multiple domains including continuing airworthiness management, aircraft maintenance, flight operations, and design. This translates into additional challenges, such as information sharing, communication, or interpretation issues, which can ultimately impact how well repetitive defects are managed and hence potentially threaten flight safety.
The purpose of this safety issue assessment (SIA) was threefold:

- identifying and reviewing the current regulatory requirements, industry standards and any guidance material related to repetitive defects in the EU, as well as some of other ICAO member states around the world;
- capturing the experience of industry stakeholders to better understand if the current practices sufficiently mitigate the safety risks posed by the repetitive defects and management thereof;
- proposing mitigating actions derived from the assessment of plausible threats and consequences associated with repetitive defects impacting on flight safety.

1.2 Definition of the safety issue

The safety issue addresses repetitive defects of aircraft systems/ structure which may adversely affect aircraft operations and airworthiness if not managed properly.
Managing repetitive defects requires a multi-dimensional and collaborative approach between all stakeholders in the airworthiness domain, including operators, design approval holders, continuing airworthiness management and maintenance organisations.
Continuing Airworthiness Management Organisations (CAMO) hold the main responsibility in managing such defects. Their role, as prescribed by Regulation (EU) No 1321/2014, is to ensure the airworthiness of the aircraft and arrange the rectification of defects. Identification of repetitive defects is a challenge, as well as their technical assessment and resolution. The CAMO interfaces with all other involved organisations.
Aircraft Maintenance Organisations (AMO) are tasked by the CAMOs to perform the necessary maintenance resulting from the Aircraft Maintenance Programme (AMP) or from defect identification. Reporting information from AMO to CAMO may be essential in the management of repetitive defects.
Aircraft Operators and flight crews operate the aircraft and are exposed to defects. The flight crew is expected to report them through the aircraft technical log to inform the CAMO. On the other hand, the CAMO should ensure that the flight crew has all information necessary to perform the flight, which may include informing the flight crew of specific defects that could occur in a repetitive manner.

Design Approval Holders (DAH) are responsible for the design of the aircraft. Once informed by the CAMO, they should support the investigation with a view to solve the issue and/ or propose mitigating actions (ref. section 8 on reporting among organisations of AMC 20-8A on occurrence reporting).
The current EU regulatory materials identify the *‘rectification of any defect or damage affecting safe operation’* as one of the continuing airworthiness tasks, refer to Regulation (EU) No 1321/2014 Annex I (Part-M) Subpart C (continuing airworthiness) M.A.301 on continuing airworthiness tasks. Therefore, continuing airworthiness management organisations are expected to implement an effective defect control system to ensure that all defects affecting the safe operation of the aircraft are either rectified or deferred in accordance with minimum equipment list (MEL) or configuration deviation list (CDL). However, sometimes the rectification action taken may not necessarily resolve the defect in the first attempt and the same or similar defect may occur during the subsequent days and flights.
In addition to the above requirement, the EU regulatory materials also require the CAMOs to implement a reliability programme to monitor the effectiveness of the aircraft maintenance programme. Such a reliability programme considers wide range of perspectives and the analysis of different types of data including the evaluation of repetitive defects, refer to Regulation (EU) No 1321/2014 Annex I (Part-M) Appendix I to AMC M.A.302 and AMC M.B.301(b) on the content of the maintenance programme. Some CAMOs have performance metrics related to repetitive defects as part of their reliability programme to demonstrate that repetitive defects are controlled and managed proactively, e.g., ‘last three-/ six-/ 12-month trend’, ‘top repetitive defects per ATA chapter’, ‘repetitive defects on critical systems’.
Nevertheless, repetitive defects and potential consequences thereof on flight safety cannot be solely mitigated by relying on the reliability programme which requires taking corrective actions when adverse trends are identified. CAMOs must also identify and monitor repetitive defects on a daily basis so that they can be resolved without waiting for the next reliability report to be produced.
It is important to note that the scope of this safety issue specifically focuses on identification, monitoring and resolution of repetitive defects on a daily basis.

1.3 Who is affected?

The key stakeholders affected by this safety issue are the operators, the continuing airworthiness management organisations, the approved maintenance organisations and the design approval holders.

1.4 Assessment methodology

A working group was established to conduct an in-depth assessment of this safety issue, consisting of EASA, International Federation of Airworthiness (IFA), Avioscribe, Airbus, EasyJet, Luxair, Wizz Air, Cargolux Airlines, Pegasus Airlines, KLM.

The representatives contributed to the assessment by reviewing instrumental accident and serious incident reports, responding to a ‘Delphi Study’ about key questions on the management of repetitive defects, sharing their views during several online meetings, as well as reviewing the final draft of this document.

The safety issue assessment was approached through the collection of safety intelligence (section 1.5), that combined multiple sources of data ranging from occurrence data to industry stakeholders’ practices and experience. The safety intelligence part of the assessment is reflected in the hereafter listed activities, from a) to c).
The collected safety intelligence was then fed into the risk assessment part (section 1.6) to:

- define the most significant scenario to address inadequate management of repetitive defects,
- identify causes and contributing factors,
- assess the barriers (incl. existence and effectiveness), and

– propose actions in accordance, to mitigate the risk.

This second part of the safety issue assessment is reflected in the hereafter listed activity d).

Type of activities	*Objective*
a) Review of literature	– Review of **regulations** to identify differences in some of the comparable ICAO member states (section 1.5.1 and **APPENDIX A - Regulatory materials review**). – Review of **accidents/ serious incidents investigation reports** to better understand how repetitive defects played a contributing role (section 1.5.2 and **SIA APPENDIX B - Accidents and serious incidents investigation reports review**).
b) Analysis of European Central Repository data	– Review of relevant **occurrences** to identify any potential trends (section 1.5.3 and SIA APPENDIX C - Repetitive defects ECR dashboard (dated 20.09.2023)).
c) Collection of data from industry stakeholders	– **Delphi Study** limited to the working group members (section 1.5.4 and SIA APPENDIX D - Delphi study results) to capture their views and reach a consensus on four key questions about: 1. Whether there should be a clearer guidance on the definition of repetitive defects in EU regulatory materials. 2. Whether repetitive defects should be subject to a risk assessment collectively conducted by CAMOs and flight operations. 3. Whether the flight crews should be notified of repetitive defects before the flight. 4. Whether repetitive defects should be sometimes considered and recorded as deferred defects based on the risk assessment. – **SenseMaker Engagement** to collect data from the wider industry about their lived experiences on how they dealt with repetitive defects (section 1.5.5 and SIA APPENDIX E - SenseMaker engagement results).
d) Bow-tie development	– Identify all the existing threats and barriers as well as the escalation factors (i.e., regulatory requirements and industry practices) (section 1.6 and **Error! Not a valid result for table.**)

1.5 Safety intelligence

1.5.1 Review of regulatory status, incl. foreign authorities

One of the key activities carried out was the brief review of the international standards developed by ICAO and IATA, as well as regulatory materials (incl. guidance materials) published related to repetitive defects by different ICAO member states.
The results of the review are detailed in **APPENDIX A - Regulatory materials review**. They clearly highlighted the following observations:

– ICAO Annex 8 Airworthiness of Aircraft and ICAO Doc 9760 Airworthiness Manual: management of repetitive defects vaguely referred to in the ICAO Doc 9760 only.

- IATA IOSA Standards and Recommended Practices (ISAPRs): Operators are required to have a defect recording and control including the management of repetitive defects. While the communication of repetitive defects to flight crew was required in previous versions of the IOSA standards manual (ISM), it was removed in the Edition 6 of the ISM published in 2012.
- TCCA maintenance related regulations: Regulatory requirements published by Transport Canada include the most prescriptive definition of recurring defects (i.e., three occurrences in 15 flights) and the most restrictive requirements about how they should be treated/ managed (i.e., removing the aircraft from service to investigate into the root cause of the defect)
- FAA maintenance related regulations: FAA website was searched to specifically focusing on Part 43 on maintenance, preventive maintenance, rebuilding, and alteration; Part 121 on operating requirements: domestic, flag, and supplemental operations; Part 145 on repair stations; any of the phrases such as 'repetitive defects', 'recurring defects', 'repeating defects' was however not found in any of the Federal Aviation Regulations. FAA AC 120-17B on reliability program methods/ standards for determining time limitations refers to the evaluation of repetitive defects as an example of analytical techniques and tools for root cause analysis of variations from performance standard.
- European continuing airworthiness regulation, reg. (EU) 1321/ 2014: While there are no published specific criteria in EU regulations or guidance material about what constitutes a 'repetitive defect', the regulation requires all operators to establish an effective defect control system including the management of repetitive defects.

1.5.2 Review of accidents and serious incidents investigation reports

Accidents and serious incidents investigation reports, where repetitive defects and management thereof were identified as contributing factors, were selected for review by the working group members. The query in the European Central Repository of Safety Recommendations (SRIS2) did not provide any conclusive evidence, therefore the hereafter ten (10) accidents and serious incidents were collectively identified by the working group members based on their knowledge and sensitivity to the subject safety issue.
The safety recommendations related to the management of repetitive defects are hereafter extracted from the investigation reports. Note however that the complete review of each investigation report is detailed in **SIA APPENDIX B - Accidents and serious incidents investigation reports review**, and records key elements in addition to the safety recommendations. For the fatal accidents, it was felt that safety recommendations fell short of addressing key issues related to the management of repetitive defects (e.g., Boeing 737-500, PK-CLC, PT Sriwijaya Air, Indonesia, 09 January 2021).
For each accident/ serious incident, the following elements were documented in the appendix, when applicable:

- event summary,
- key elements of the report related to the management of repetitive defects,
- safety gap analysis towards the identification of repetitive defects, the notification/ communication of repetitive defects, the repetitive defects as hazards to flight safety, and the resolution of the repetitive defects,
- proposed mitigating actions for the identified safety gaps,
- already existing mitigating action that may need enhancement.

Hereafter is the list of the accidents and serious incidents reviewed within the frame of this SIA, along with the safety recommendations related to repetitive defects.
For a deeper understanding of the key elements of these accidents and serious incidents that contributed to the shaping of the risk assessment in section 1.6, the reader is strongly invited to refer to the **SIA APPENDIX B - Accidents and serious incidents investigation reports review.**

- **Airbus A319, G-EZAC, easyJet, France, 15 November 2006**

Generator Control Units repeatedly rejected from service due to repetition of the same intermittent fault, serious incident, commercial air transport of passengers, no fatalities/ no injuries.
Safety recommendation 2008-088: It is recommended that Hamilton Sundstrand modifies its repair and overhaul procedures as necessary, to ensure that a unit with an excessive service rejection rate or a recurrent fault is not repeatedly released back to service.
Safety recommendation 2008-089: It is recommended that the EASA and the FAA review their measures for monitoring and approving component repair organisations to ensure they have systems in place to identify units with an excessive service rejection rate of recurrent faults.

– **Boeing 737-800, TC-JGE, Turkish Airlines, Netherlands, 25 February 2009**

Repetitive malfunctions of the radio altimeter, aircraft crashed during approach near Amsterdam Schiphol airport, Netherlands, commercial air transport of passengers, with 9 fatalities and 120 injuries.
Safety recommendation 6: FAA, EASA and DGCA should make (renewed) efforts to make airlines aware of the importance of reporting and ensure that reporting procedures are adhered to.
Safety recommendation 7: Boeing should make (renewed) efforts to ensure that all airlines operating Boeing aircraft are aware of the importance of reporting.
Safety recommendation 8: Turkish Airlines should ensure that its pilots and maintenance technicians are aware of the importance of reporting.

– **Airbus A320, PK-AXC, Indonesia Air Asia, Indonesia, 28 December 2014**

Repetitive defects of the rudder travel limiter units, aircraft destroyed when it impacted the water of the Java Sea between Surabaya and Singapore, Indonesia, commercial air transport of passengers, with 162 fatalities.
Safety recommendation 3: The KNKT recommends that the Directorate General Civil Aviation ensures that air operator maintenance system has the ability to detect and address all repetitive faults appropriately.

– **Boeing 737-800, CN-ROJ, Royal Air Maroc, France, 30 December 2016**

Repetitive malfunctions of the radio altimeter, serious incident, commercial air transport of passenger, no fatalities/ no injuries.
Safety recommendation FRAN 2021-015: Systematic reporting of the faults and anomalies encountered by the flight crews is necessary for the maintenance personnel to correct the problems or in case of an intermittent fault, to monitor their evolution, as specified by the manufacturer’s procedures. Consequently, the BEA recommends that, whereas the non-systematic reporting of technical malfunctions by the crews does not facilitate the identification and processing of intermittent faults; Royal Air Maroc implement the necessary provisions in order that the technical malfunctions observed in flight are systematically reported in the documents provided for this purpose.
Safety recommendation FRAN 2021-026: Boeing has asked operators to implement a policy for processing intermittent faults, with these faults being specifically monitored on several consecutive flights. It is possible to access the faults recorded by the main computers through the CDU, after a flight, even if they are no longer active on the ground. Consequently, the BEA recommends that, whereas Boeing lets the operator choose the strategy for resolving intermittent faults; whereas the persistence of intermittent faults which contributed to this serious incident; Royal Air Maroc reinforce its policy with respect to the processing of intermittent faults.

– **Boeing 737-800, F-GZHO, Transavia, France, 08 February 2018**

Repetitive defects of the AoA sensor, incidents on two consecutive flights (one ferry flight, followed by one commercial air transport with passengers), dysfunction of AoA sensor indicated by alerts during take-off, and additional turn-around for the occurrence in France.

- **Airbus A320, ES-SAN, Smartlynx Airlines, Estonia, 28 February 2018**

  Repeated faults of the ELAC computers, nine ELAC resets performed in flight, accident, training flight, no fatalities/ no injuries.
  As a result of this accident, Airbus decided to totally forbid ELAC reset following a F/CTL ELAC 1(2) PITCH FAULT ECAM alert in flight and to restrict the number of ELAC reset to one if this alert triggers on ground with additional actions to ensure that the reset has been successful.

- **Boeing 737-8 (MAX), PK-LQP, PT. Lion Mentari Airlines, Indonesia, 29 October 2018**

  Repetitive defects of the AoA sensor, aircraft crashed into the sea shortly after take-off from Jakarta-Soekarno-Hatta International Airport, Indonesia, commercial air transport of passengers, with 189 fatalities.
  Safety recommendation 04.O-2018-35.8: The OMF [Onboard Maintenance Function] has the history page which contains record of the aircraft problems which can be utilized as a source for aircraft problem monitoring. The BAT [Batam Aero Technic] has not utilized the OMF information as the source of aircraft problem monitoring. Therefore, KNKT recommends that Batam Aero Technic establish policy and procedure of handling OMF.
  Safety recommendation 04.O-2018-35.10: After Xtra Aerospace repair of the accident AOA sensor in November of 2017, the sensor was installed on the PK-LQP aircraft on left side position during the maintenance activity in Denpasar on 28 October 2018. On the subsequent flight, a 21-degree difference between left and right AOA sensors was recorded on the DFDR, commencing shortly after the takeoff roll was initiated. This immediate 21- degree delta indicated that the AOA sensor was most likely improperly calibrated at Xtra. As noted, utilization of the Peak Model SRI-201B API by Xtra Aerospace for the test and calibration of the 0861FL1 AOA sensor should have required a written procedure to specify the proper position of the REL/ABS switch. Therefore, KNKT recommends emphasizing the implementation of a company manual including equivalency assessment, training and written procedure, to ensure component being repaired are properly maintained.
  Safety recommendation 04.R-2018-35.22: The absence of equivalency assessment required by Xtra Aerospace procedure and unavailability of procedure was not detected by the FAA. This indicated inadequacy of the FAA oversight. Therefore, KNKT recommends that the FAA improves the oversight to Approved Maintenance Organization (AMO) to ensure the processes within the AMO are conducted in accordance with the requirements.

- **Airbus A319, N521NK, Spirit Airlines, United States, 15 February 2020**

  Repetitive defects of the engine integrated drive generator (IDG), ram air turbine (RAT) automatic extension upon dual loss of electrical power while on approach to the Sacramento International Airport, Sacramento, California, commercial air transport of passengers, no fatalities/ no injuries.
  As a result of this incident, Airbus has improved their troubleshooting manual (TSM) by incorporating steps to direct maintenance towards a direct extraction of the post flight report (PFR) and troubleshooting data (TSD) from the GCUs.

- **Airbus A321, G-POWN, Titan Airways, United Kingdom, 26 February 2020**

  Repetitive malfunctions of the engines, incident, commercial air transport of passengers, no fatalities/ no injuries.
  The manufacturer’s recommended method of searching the troubleshooting manual was not used to find the engine stall applicable procedure. As a result of this serious incident, a safety and compliance notice was issued to disseminate the manufacturer’s training material on using the AirN@v TSM. This was also added to their Airbus engineer type training courses and equivalent material for airnavx.

- **Boeing 737-500, PK-CLC, PT Sriwijaya Air, Indonesia, 09 January 2021**

Repetitive defects of the autothrottle, aircraft crashed into the sea, shortly after departure from Jakarta-Soekarno-Hatta International Airport, Indonesia, commercial air transport of passengers, with 62 fatalities.
Safety recommendation 04.O-2021-01.05: The samples of the Sriwijaya Air hazard report in the period of 2020 showed that majority of the hazard were reported by ground personnel. Few hazards were reported by pilots and maintenance personnel and there was no hazard report by dispatchers. This unbalance composition of the hazard reporters indicated that hazard reporting program has not been emphasized to all employees which might result in hazards not being identified and mitigated. Therefore, KNKT recommends Sriwijaya Air to emphasize the hazard reporting program to all employees to encourage hazard reporting.

From the reports, the following key issues were identified:

- Components released back to service despite excessive rejection rate or recurrent faults (rogue[1] units),
- Either lack of or poor reporting of defects in the aircraft technical logbook so that repetitive defects are not identified as such;
- Incorrect or incomplete troubleshooting, clearing the flight deck effects or aircraft symptoms but not solving the root cause;
- Normalisation of aircraft system resets, exacerbating the above items of concern;
- Insufficient CAMO awareness and control of every aircraft repetitive defects;
- Repetitive defects and management thereof mostly addressed as a component/ equipment reliability issue only, with no hazard assessment on flight safety.

1.5.3 Review of occurrences from the European Central Repository

1.5.3.1 Aggregated overview

The European Central Repository (ECR) was queried on the 20th of September 2023. The initial dataset encompassed all occurrences (i.e., accidents, serious incidents, and incidents), for the period from 2017 onwards, where the value of the occurrence attribute ‘narrative text’ was containing the words ‘recurrent defect’ or ‘repetitive defect’ or ‘recurrent fault’ or ‘repetitive fault’ or ‘recurrent failure’ or ‘repetitive failure’. The dataset was further refined to remove duplicates, and occurrences found not applicable.
The full aggregated overview is provided in SIA APPENDIX C - Repetitive defects ECR dashboard (dated 20.09.2023).
During the period 2017-2023, 110 records of occurrences of repetitive defects were reported in the ECR. While 2023 is not complete, the yearly number of occurrence records of repetitive defects steadily increased over 2020-2023, with a higher number in 2022 (20) and 2023 (23) than in the pre-pandemic year 2019 (16). Note that Europe air traffic numbers in 2022 had returned to 83% of the 2019 traffic levels. By summer 2023, traffic had already rebounded to 93% of 2019 levels.

[1] A rogue unit is a single serialized line replaceable unit (LRU) which has demonstrated a history of identical system faults which may or may not result in an exceedance of an operator’s defined number of repetitive unscheduled removals within an associated short service life (FAA AC 120-17B).

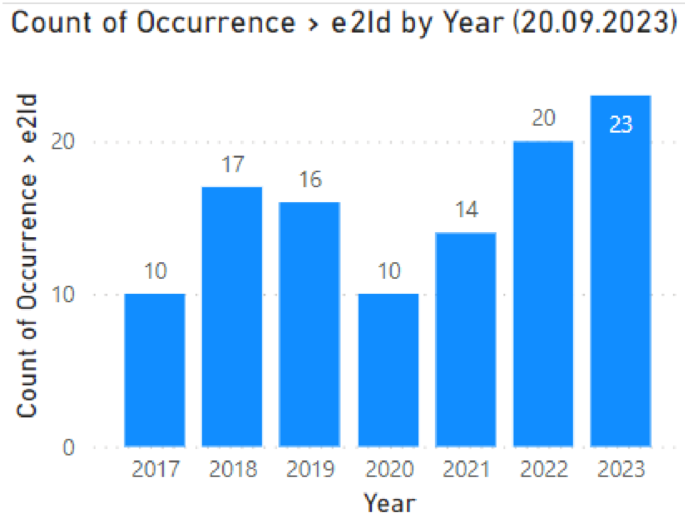


Figure 1 - Number of occurrence reports per year

The main affected aircraft systems are flight control system, autoflight system, air conditioning and pressurisation system, fuel system, landing gear system, and navigation system.

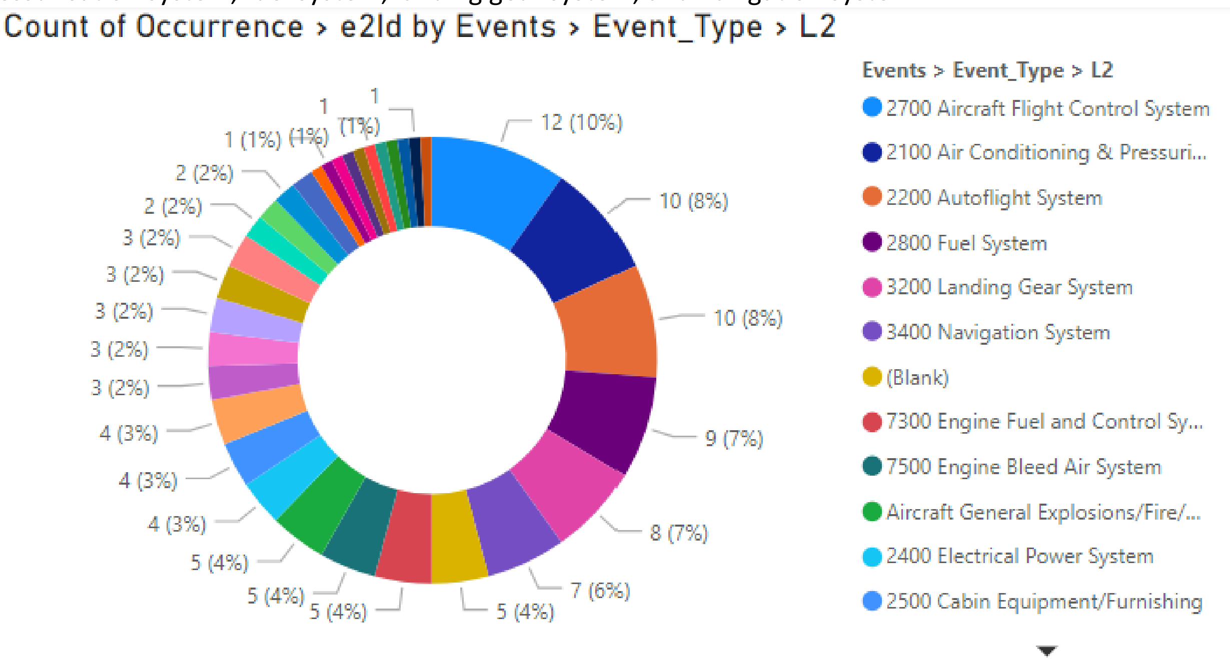


Figure 2 - Number of occurrence reports per ATA chapter

Three out of five occurrence records of repetitive defects (70) are classed as 'incident'. 17 occurrence records are classed as 'occurrence without safety effect', although four of them adversely affecting the flight control system.

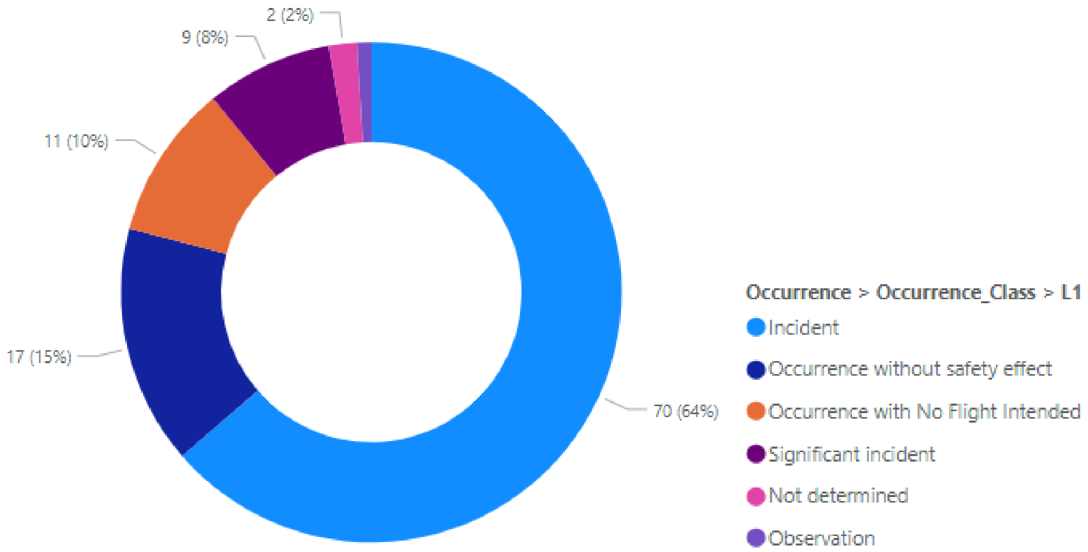


Figure 3 - Number of occurrence reports and distribution per occurrence class

1.5.3.2 Narrative text review

From the following five occurrence reports that are further detailed hereafter:

- three reports were selected from the refined dataset (2017 onwards), which aggregated overview is presented in the previous section;
- two were selected out of the refined dataset, they occurred in 2012 and 2016, but they are retained here because of the interest raised by their narrative.

These reports demonstrate not only potentially high-risk events as a result of repetitive defects, but also challenges faced by the flight deck and engineering crews during the identification, investigation and resolution of repetitive defects.

Report	***Summary of the investigation***
01	**OC-0000000002923694/ Incident/ GENOCC - RECURRENT PIREPS TCAS TRAFFIC NOT SHOWING CORRECTLY** Aircraft has experienced a recurrent pilot reports #TCAS TRAFFIC NOT SHOWING CORRECTLY#: As per technical logbook entries, it seems the TCAS does not detect traffic beyond 2700ft. T/S as per TSM Task 34-72-00-810-832-A - Incorrect Location of the TCAS Intruders on the NDs carried out with following outcomes: – 05 Nov. TCAS Bottom Antenna replaced – 01 Dec. TCAS replaced – 04 Dec. TCAS Top Antenna replaced – 09 Dec. On arrival from CCJ pilot reported "TCAS below scan is not showing even with mode selector on below' Short Term Action: TCAS System test as per AMM34-72-00 reported ok. ATC/ TCAS control panel replaced due to recurrent defect. Post replacement Test ok.

Report	*Summary of the investigation*
02	**OC-0000000001944520/ Incident/ Aileron control restriction fault isolation discrepancy** The aircraft had a repetitive defect related to control wheel restrictions. This commenced on the 27th of October 2019 and has occurred 4 further times, the most recent event being on the 11th of February 2020. Following the most recent event TLP[2], the aircraft was declared serviceable and offered for an Elective Check Flight, however before the Check Flight Paperwork was signed, the Technical Pilots contacted Reliability / Systems for further comment. A timeline of troubleshooting and a review of troubleshooting was performed, and following review, it was believed that all possible troubleshooting had been performed, particularly in light of the most recent finding of water on the aileron input quadrant bearings. It was mutually agreed that it would be beneficial to have the recorded control wheel forces, to serve as a benchmark, and as such an LMWR[3] was raised to perform an Aileron Control Wheel Test iaw AMM 27-11-00-700-805 and record the values. Note: FIM 27-11 Task 813 Step G, Para 4 includes Control Wheel Force Checks, which was cited as being completed on WO. During the completion of LMWR (AMM 27-11-00-700-805) on WO, it was noted that several of the values exceeded the limits. As such the aircraft was declared AOG and further troubleshooting was performed which resulted in the A System Flight Control Module Package Assembly. During review of previous maintenance actions carried out on the Captains Control Column, it could not be demonstrated that previous maintenance carried out on the captains control column was completed in accordance with appropriate maintenance data. The captains control column and control wheel assembly was replaced and routed to MRO for further investigation and Overhaul.
03	**OC-0000000001613443/ Incident/ Rejected take-off due red flag on P1 airspeed indicator (ASI) at 80kts** ASR/2182 07/01/2016: During the take-off roll at 80 kts it was noticed the P1 ASI was displaying a red flag and the red 'SPD' warning was displayed on the EFIS screen. The Take off was rejected at 85kts with minimal braking. The aircraft was taxied off the runway where the fault self-cleared. Abnormal checklists and LMC were consulted and after Brake Cooling a second departure was carried out with no further incident. ASR/2226 18/01/2016: Take off rejected at approximately 70 kts due to speed flag on left pilot ASI and EADI. Aircraft back to stand and Techlog entry made. ASR/2276 21/01/2016:

[2] Technical Log Page (TLP)
[3] Line Maintenance Work Request (LMWR)

Report	Summary of the investigation
	High Speed RTO detected by FDM- No ASR filed by Commander but it is annotated in log that Ops and LMC were made aware and the reported issue was fluctuating airspeed. On both the 18th January 2016 and the 21st January 2016 the fault reoccurred causing a further two rejected take-offs. The warning could no longer be considered to be spurious and further engineering investigation was carried out. It was observed that all three faults happened on the first flight of the day. Following the second rejected take off on 18th January, the engineers suspected the indication was due to a problem with the pitot static tube. Water drains were checked and operational test were completed that day. As well as this a pitot static check was completed with the aircraft at speed 180kts. Engineers were unable to reproduce fault. Fault diagnosis carried out by engineers and subsequently the decision was made to replace the P1 Air Speed Indicator (ASI). A fault with this system could have caused the indication described in both ASR/2182 and ASR/2226 as well as the fluctuating speed indication described in asr/2276 and in TLP 030445-4/02. On the 21st of Jan 2016 the Air Speed Indicator (ASI) P1 was replaced. The ASI P1 removed in this case, P/N 622-6728-011, was fitted to A/C on the 01 Jun 2010. This component completed 7401 unit hours and 10080 landings. A Repetitive Defect Investigation was raised on the 21st of Jan 2016 in order to track this fault further and any future reoccurrence. Tech log monitored and there has been no further fault reoccurrence since the ASI replacement on the 21st of January.
04	**OC-0000000002252963/ Incident/ Dual autopilot failure** FO was PF for departure phase and Capt. took control for the remainder of the flight. On swapping the autopilots from B to A, autopilot A did engage and then about 5 seconds later disengaged. All switches and CB's were checked and we completed QRH checklist for Autopilot failure. Autopilot B could not be engaged either. Informed ATC and stopped climb at FL270 and reviewed situation. Contacted Ops and Maintrol on VHF Box 2 and we all agreed that we could continue to Salzburg. Engineering cover met us in Salzburg. CWS was used to aid flight. Engineers could not fix problem and in fact further issues developed in that the FO's flight director was now inoperative and Mach Trim Fail and Speed Trim Fail were now operating single channel only. Capt. flew aircraft back to UK base for maintenance. No further faults developed. Root Cause information is stored in the safety system however is restricted. Corrective actions: DFCS MCP replaced. Further testing to be carried out. Instruction sent to *** from tech services to monitor autopilot issue due to long history of defects. **** raised for land verify test to be c/o before next flight sector 24/02/18, test c/o satis Autopilot failure occurred 24/02/18, trouble shooting and wiring checks carried out, confirmed pressure switch fault, component replaced. As per safety request response received from Reliability, the troubleshooting found that the repetitive defect was linked to the Autopilot Elevator Pressure Switch. Since its replacement the aircraft has not suffered any further defects. The Flight Control Computer was confirmed to be NFF by *****. Company have a policy where PN: ***** Pressure switches are not repaired and replaced with new units only.

Report	***Summary of the investigation***
05	**OC-0000000002725698/ Incident/ Spoiler elevator computer (SEC) failed on touchdown** On Tech Log review, it was discovered that SEC1 had failed at least nine times on preceding days, each time it had been reset on ground. Reporter is concerned that multiple resets have been allowed on critical flight control hardware. NAA Closure: The unit had been installed on the 24 Nov as part of a scheduled modification program. A couple of days after installation this unit became faulty and post flight reports showed 'F/CTL SEC 1' faults with six defect entries leading up to the day of the event. The investigation showed that although these defects had been reported, the incorrect ATA sub-chapter codes had been recorded in three of the events (27-96-00 & 27-00-00 instead of 27-94-00) thus rendering the defect outside the parameters of the repetitive defect monitoring system. On the 03 Dec the repeat resets were noticed by Engineering as part of their daily PIREP monitoring checks. Technical Services were informed and carried out a history check of all recently installed SEC units and their investigation revealed that the SEC had a previous fault history. Therefore, as a precaution this unit was removed and sent to the vendor for investigation. The SEC units have a known reliability issue, and a modification programme is currently on-going. A Tech Log page defect review was carried out and this revealed a repetitive SEC 2 faults. After two successful resets this defect was captured on the third event and a defect raised for rectification. SEC 1 and SEC 3 interchanged and SEC 3 subsequently replaced. A Quality Notice was issued regarding the need for correct recording of ATA chapters and sub-chapters for maintenance entries.

1.5.4 Conclusions of the Delphi study

Considering the findings and recommendations established by the accidents and serious incidents investigation bodies, and the results of the regulatory material review, four key questions were discussed by the working group members in a two-round Delphi Study[4]. These are:

- Q1. Do you think there should be a definition of repetitive defect in the regulations/ guidance material published by the regulators?
- Q2. Do you think repetitive defects should be subject to 'risk assessment' collectively conducted by flight operations and CAMO?
- Q3. Do you think the flight crews should be notified of repetitive defects before the flight so that they can consider the potential operational risks?
- Q4. Do you think repetitive defects should be recorded as 'deferred defects' based on the risk assessment conducted collectively by CAMO and flight ops teams?

[4] Delphi is a scientific method to organize and structure an expert discussion aiming to generate insights on controversial topics with limited information. (Source: https://www.sciencedirect.com/science/article/pii/S2215016121001941)

During the first round, working group members were asked to respond to the above 'closed questions' but they were also asked to clearly articulate their reasoning behind their choice. Unfortunately, consensus was not achieved in any of the questions.
In the second round, the members were asked to review all the responses and then share their thoughts and views about the same questions. Unfortunately, not only the number of responses were lower than first round, but again no clear agreement on these key questions. Nevertheless, it would be fair to conclude the following key points.

- Most of the group members believe that some clarification should be included in the European guidance material about the identification of repetitive defects. A prescriptive definition using specific numbers (e.g., three occurrences in ten days or five occurrences in 20 flights) may however not always be helpful to capture all repetitive defects that need to be controlled to mitigate all associated flight safety risks.
- Although it may not be possible for all repetitive defects, the second-round responses recognised that collectively conducting risks assessments, particularly for those systems contributing to critical functions or adversely affecting handling qualities and performances, would be beneficial.
- The communication of repetitive defects to flight crew was the most controversial topic which group members expressed diverse views. While many argued that trying to notify all repetitive defects would overload the flight crew and potentially create unnecessary confusion, there was also reasonable agreement for the need to have certain repetitive defects to be visible to flight crew, when critically important for situational awareness.
- There was finally reasonable agreement that certain repetitive defects based on risk assessments could/ should be recorded as deferred defects so that they are visible to flight crew and for their potential impact on flight planning (e.g., fuel planning or ETOPS/ EDTO flights etc.)

The details of all the responses of both rounds can be found SIA APPENDIX D - Delphi study results.

1.5.5 Conclusions of the SenseMaker engagement

In addition to the Delphi study, a SenseMaker[5] engagement was designed to capture industry professionals' 'lived experiences' about managing repetitive defects. The purpose of this survey was to better understand the specific scenarios how operators manage and control repetitive defects or perhaps also to capture scenarios that presented significant threat to flight safety.
Even though this survey was promoted by the EASA Safety Promotion team and the working group members, the participation was very low and only 34 responses were received. Nevertheless, the responses provided some interesting cases where aircraft with repetitive defects impacting on flight safety were allowed to continue in revenue service. At the other end of the spectrum, some operators clearly treat repetitive defects as 'deferred defects'. Two examples of shared scenarios are included in Figure 4; however, the entire dataset can be found in SIA APPENDIX E - SenseMaker engagement results.

5 SenseMaker® is an online platform and an original distributed ethnographic approach to sense-making which enables the participants to share their 'lived experiences' and subsequently by answering unique questions, it enables self-signification – allowing respondents to give meaning to their own experiences. (Source: https://thecynefin.co/about-sensemaker/)

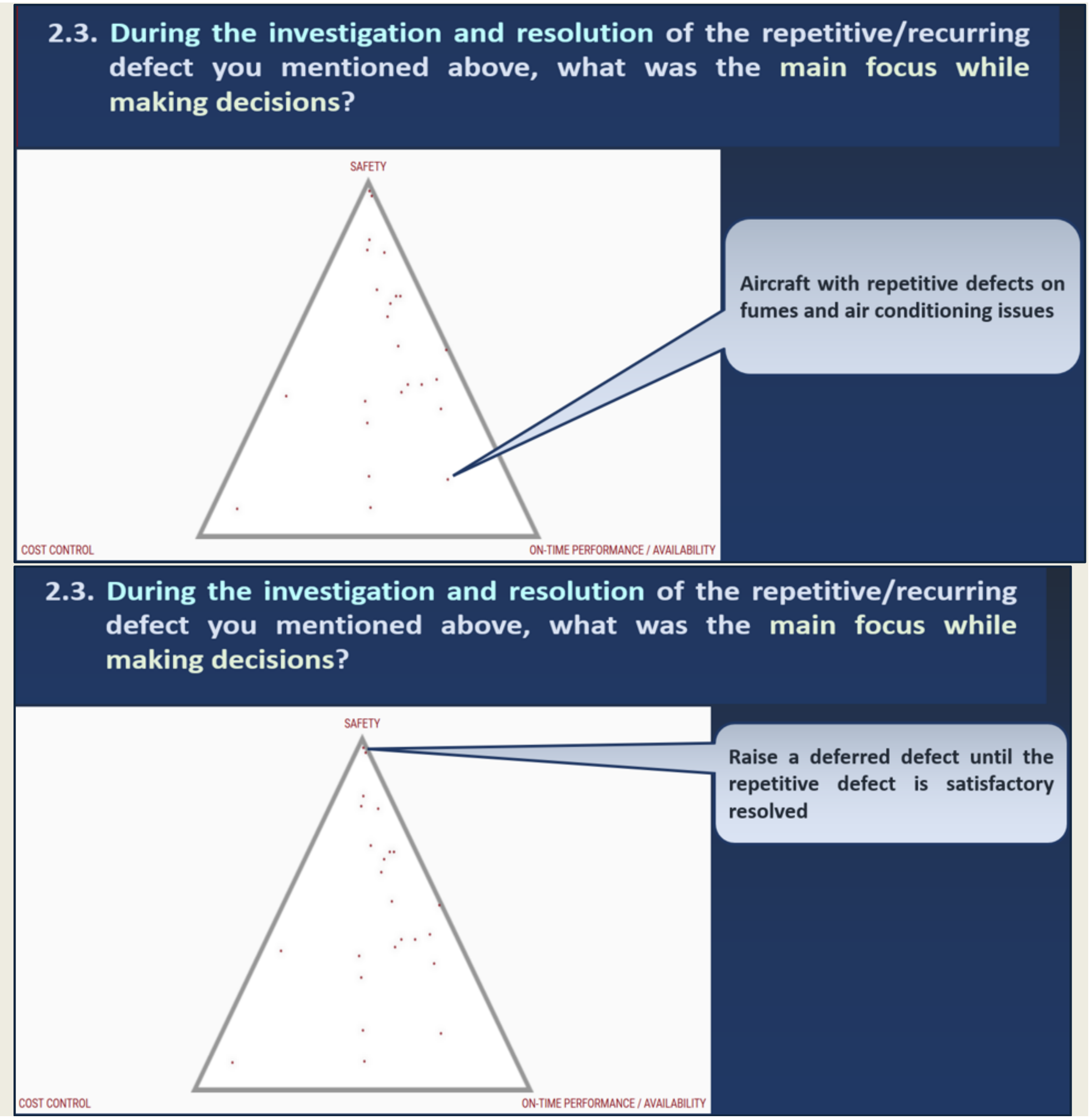


Figure 4 - Examples of shared scenarios on the management of repetitive defects considering competing goals

1.6 Risk assessment

2 Using the safety intelligence collected through the multiple activities described in section 1.5, a bowtie diagram was developed to support the assessment. The full diagram is to be found in

SIA APPENDIX F - Bowtie diagram.

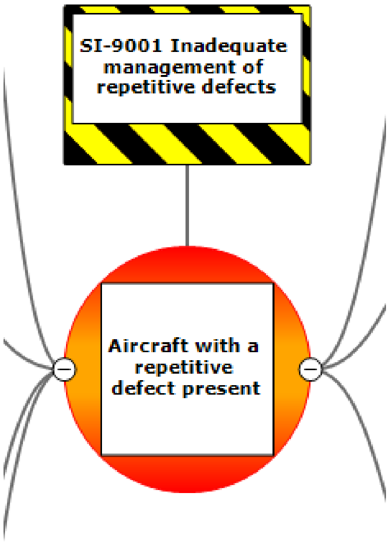


Figure 5 - Top event: Aircraft with a repetitive defect present

The diagram is organised around the top event 'aircraft with a repetitive defect present'. The threats and prevention barriers mainly address the identification of repetitive defects, while the consequences and mitigation barriers are about controlling the risk associated with dispatching an aircraft with repetitive defects.

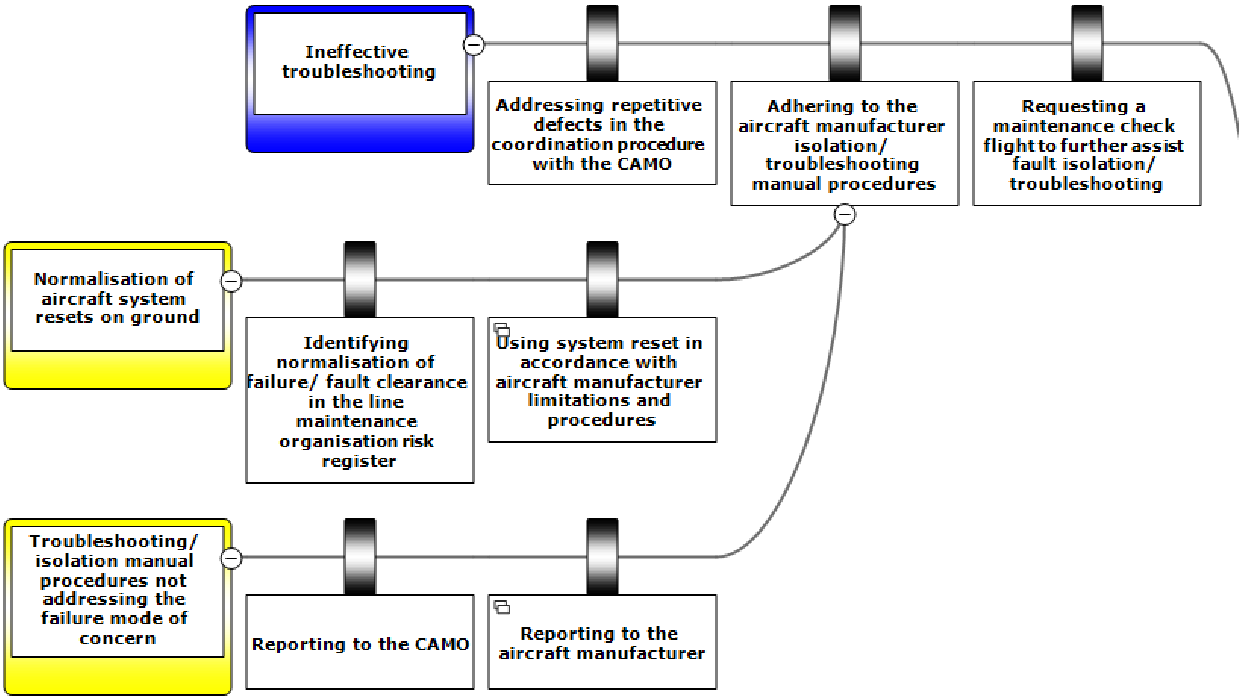


Figure 6 - Threat 1: Ineffective troubleshooting

Failure/ fault troubleshooting is one key element in the identification of repetitive defects. Ineffective troubleshooting addresses here incorrect or incomplete troubleshooting, as well as unsuccessful

troubleshooting, e.g., where the fault is eventually not confirmed/ not found having exhausted the likely root causes.
The safety intelligence collected, particularly within the review of the accidents and serious incidents reports, shows cases of incomplete or non-adherence to the aircraft manufacturer isolation/ troubleshooting manual procedures, mainly driven by the normalisation of failure/ fault clearance:

- aircraft systems are reset cycling circuit breakers to clear the fault messages instead of proper investigation of the root cause, or
- troubleshooting procedures are stopped after recurrent and successful BITE tests whereas the root remains unconfirmed.

A fault not confirmed/ not found may not mean that the aircraft is airworthy, it may just mean that the fault appears under specific conditions, especially if it had already happened. A proper system knowledge and understanding of the defect interpretation, together with a historical fault check, is therefore primordial.
Airbus developed safety promotion materials on intermittent repetitive failures and the use of system reset (ref. section 2.1). Airbus materials may however not reach all European operators, particularly the ones not operating Airbus aeroplanes. Plus, the philosophy of system resets may be quite different from one product to the other, or from one manufacturer to the other. It is therefore recommended to develop additional safety promotion materials at European level, that would be product-/ manufacturer-agnostic. It should equally encourage aeroplane manufacturers to develop specific materials for their operators.
Implementation of the management system is required per 145.A.200 'Management system'. The normalisation of fault/ failure clearance is therefore proposed to be identified in the hazard risk register of the line maintenance organisations.
The fact that the fault is not present on ground does not mean that the failure code cannot be found by interrogating the aircraft systems/ units. When all troubleshooting is performed in accordance with the approved manuals and no root cause is identified, a maintenance check flight may be requested to further assist the fault isolation as described GM M.A.301(i)(b)(3). The maintenance check flight is performed here in accordance with the standard operating procedures.
Finally reporting of occurrences among organisations (i.e., not only reporting to competent authorities) is paramount in the management of repetitive defects and should be improved. It is therefore recommended to stress out the consideration of reporting amongst organisations to address ineffective troubleshooting (e.g., misleading, incorrect, or insufficient applicable maintenance data or procedures)(ref. section 8 on reporting among organisations of AMC 20-8A on occurrence reporting, ORO.GEN.160 occurrence reporting, M.A.202 occurrence reporting, and 21.A.3A reporting system).

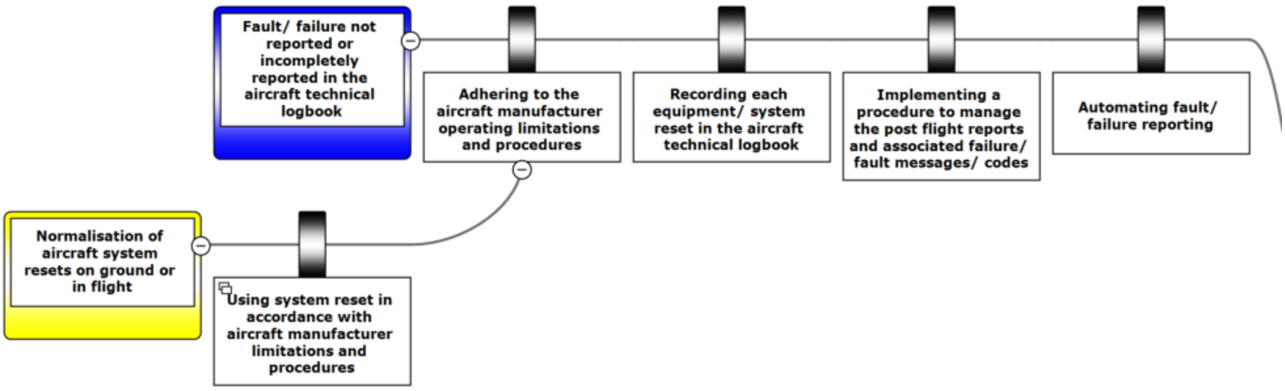


Figure 7 - Threat 2: Fault/ failure not reported or incompletely reported in the aircraft technical logbook

An incomplete or lack of fault/ failure reporting in the aircraft technical logbook directly affects the identification of the repetitive defects.
Like the previous threat focused on ineffective troubleshooting, the safety intelligence collected, particularly within the review of the accidents and serious incidents reports, shows cases of incomplete or non-adherence to the aircraft operating limitations and procedures, mainly driven by the normalisation of aircraft system resets by the flight crew on ground or in flight. The recommendation on the development of safety materials similar to the existing Airbus intermittent repetitive failures and use of system reset is therefore equally valid here.
As described in the threat related to ineffective troubleshooting, resetting systems may only clear the indication, while the failure remains latent. The failure may degrade over time or may escalate to serious consequences when combined with other system failures during the next flights. Repetitive resets of systems may actually indicate repetitive failures and should therefore be recorded in the aircraft technical logbook.
A couple of accidents and serious incidents investigation reports show that post flight reports and associated failure/ fault messages/ codes were not sufficiently considered, resulting in failures/ faults not reported, or incompletely reported so that the line maintenance engineer would entry the troubleshooting manual with incorrect input.
When the technology for an aircraft health monitoring system exists and data are produced, these data are not quite used today. Experience outlines also that the pilot may not report all the flight deck effects or aircraft behaviours experienced during the flight. Automation or semi-automation in the reporting of failures and faults based on monitored systems and computers would improve the completeness and correctness of the aircraft technical logbook, and actively support the next steps of the troubleshooting.

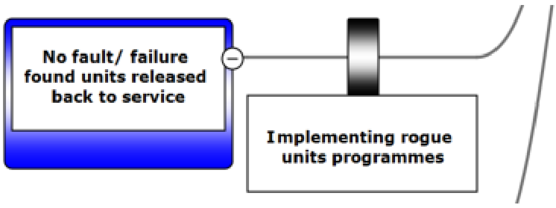


Figure 8 - Threat 3: No fault/ failure found units released back to service

Components released back to service despite excessive rejection rate or recurrent faults is a threat identified in the investigation report of one incident only. Oversight of component repair organisation should ensure organisations have a system in place to identify units/ components with excessive rejection rate or recurrent faults. There is no additional recommendation driven by this safety issue assessment.

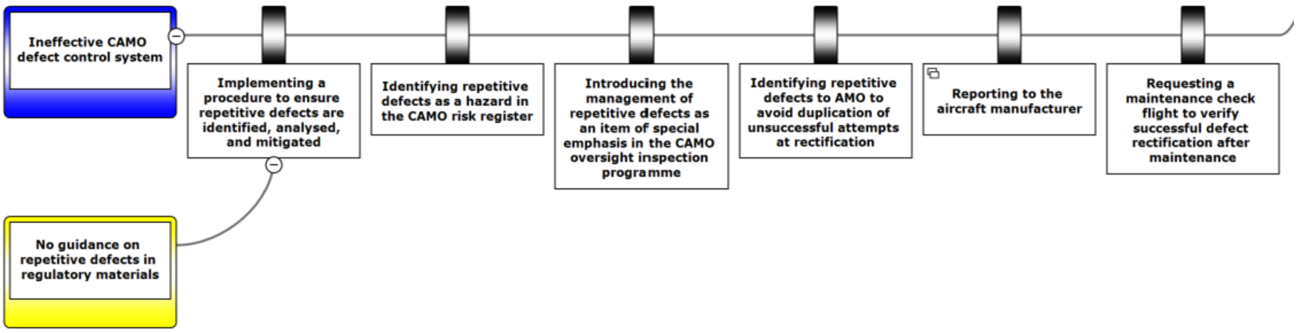


Figure 9 - Threat 4: Ineffective CAMO defect control system

As per AMC M.A.301(b) Continuing airworthiness tasks, the management of repetitive defects is part of the CAMO defect control system. Managing repetitive defects is a function of both the reliability programme within CAMOs (i.e., monthly/ quarterly reliability reports/ meetings) and the 'maintenance/ operations control centres' which are responsible for monitoring repetitive defects on a daily basis.

Regulatory requirements in some ICAO members states and some organisations in the industry use a clear definition of repetitive defects which includes a specific criterion (e.g., any defect occurring three times in 10 days or five times during 15 flights, etc.) However, use of such specific criteria may not always be helpful to identify and assess all the safety risks impacting on flight safety. Therefore, providing some guidance on which defects should be classified as repetitive but more importantly using engineering judgement is vital for the CAMOs to capture all repetitive defects which may potentially pose significant flight safety risks. Subsequently they can consider previous troubleshooting and rectification attempts and determine next actions to be taken, highlighting here the importance of communicating with the maintenance organisations to avoid duplication of unsuccessful attempts at rectification.

Having no clear guidance in regulatory documents on which defects operators should classify as repetitive defects sometimes may result in organisations including a definition with specific criteria in their procedures. For operators dealing with large number of flights every day, some level of automation can be introduced based on an algorithm to capture the repetitive defects which only meets the criteria defined in the ground monitoring system; however, some other repetitive defects which can still pose flight safety risks, may be potentially excluded/ missed (e.g., defects not monitored by aircraft systems), and not dealt with as required. Therefore, applying both specific criteria-based approach and using engineering judgement is crucially important.

Repetitive defects can be difficult to identify and rectify, and root causes thereof have the potential to remain latent over long periods of time. They may affect the safe operation of aircraft, particularly if combined with other defects, or when they occur on highly integrated systems, potentially impacting on automation and/ or on flight crew workload. While there is no intent to request for a strict definition of repetitive defects in the European continuing airworthiness regulation, it is recommended to provide guidance materials to the CAMOs, ensuring the repetitive defects and associated risks are well understood and addressed in their procedures.

Implementation of the management system is required per CAMO.A.200 'Management system'. Repetitive defects are therefore proposed to be identified as a hazard in the risk register of the CAMOs. In addition, at the level of the European competent authorities, it is recommended to introduce the management of repetitive defects as an item of emphasis in the CAMO oversight inspection program.

As highlighted in the previous threats, reporting among organisations is to be considered, here particularly the CAMO reporting to the aircraft manufacturer.

Finally, as needed, the CAMO may request a maintenance check flight to verify successful defect rectification after maintenance as described GM M.A.301(i)(b)(2). The maintenance check flight is performed here in accordance with the standard operating procedures.

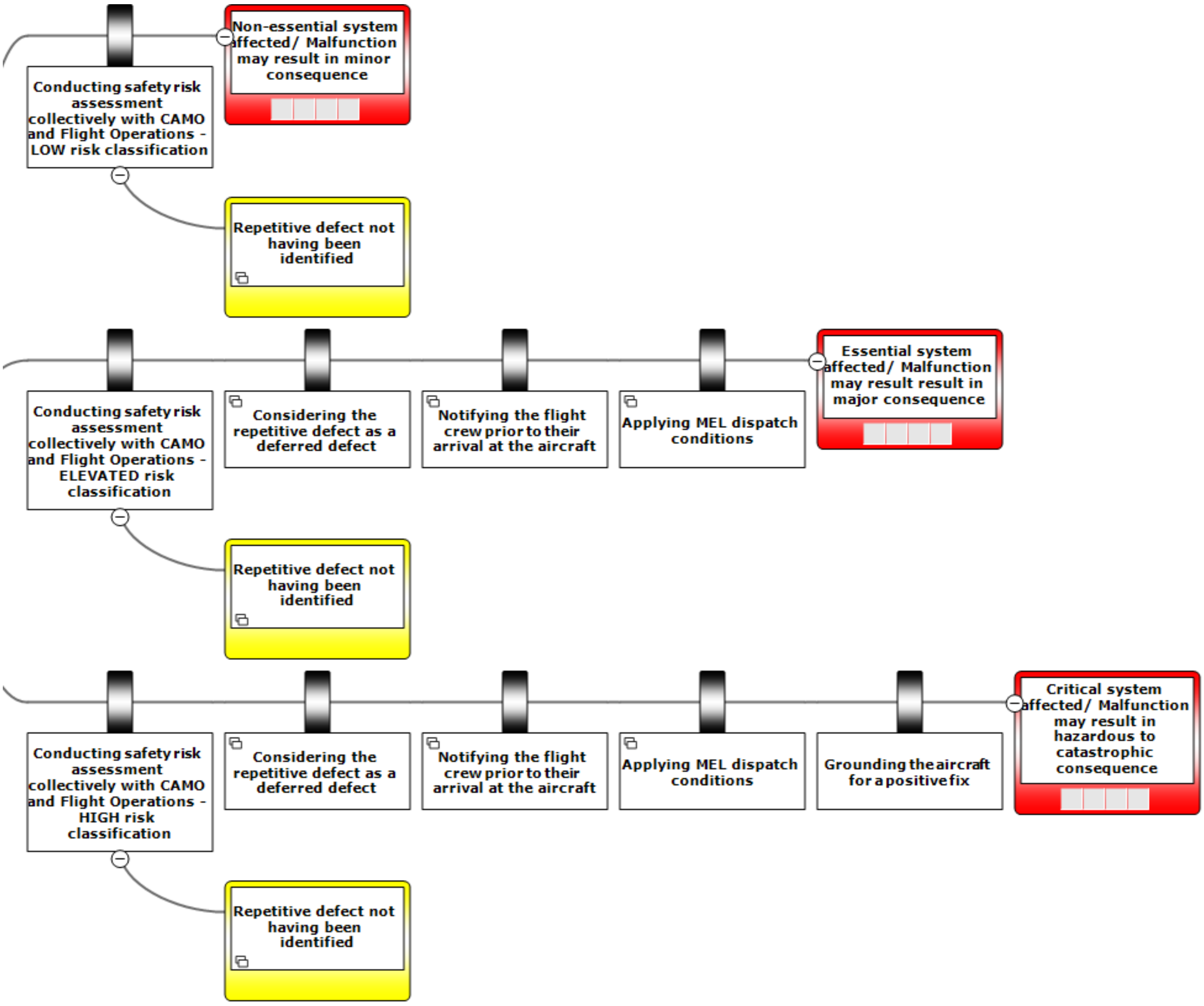


Figure 10 - Consequences: Mitigations adapted to the risk classification when dispatching the aircraft with repetitive defects

Once identified, repetitive defects are mainly regarded as an equipment/ component technical issue with an adverse reliability trend, rather than a hazard to flight safety. As particularly highlighted by the Turkish Airlines fatal accident in 2009, there is a need for a holistic approach to risk management within an airline i.e., both CAMOs and flight operations collectively risk assessing repetitive defects, and triggering mitigating actions commensurate with the risk classification.

CAMOs have to deal with repetitive defects every day, therefore, carrying out risk assessments for every single repetitive defect would not be possible for any organisation. Nevertheless, as clearly indicated by the reviewed accident investigation reports, considering repetitive defects only as a reliability trend and not viewing them through the lens of flight safety risks can potentially create huge challenges for the flight crew. A typical example was the reliability issues impacting on the autothrottle system resulting in the flight crew continuing reliance on automation during approach and unfortunately a controlled flight into terrain accident.

Repetitive defects on essential or critical systems particularly impacting on automation not being visible to flight crew would limit their ability to deal with the consequences of such defects in high workload situations during flight (e.g., the unreliable radio altimeter reading, resulting in autothrottle to command retard during final approach and ultimately causing the aircraft to stall).

Without proper risk assessment, a high-risk repetitive defect (e.g., a radio altimeter showing incorrect reading and feeding information to autothrottle) may not be seen as a threat to flight safety but just a reliability issue. Not recording such repetitive defects as 'deferred defects' enables the organisation to continue flying the aircraft in revenue service. Furthermore, it also makes such defects not clearly visible to the flight crew and limits their ability to be situationally aware when such defects reoccur during critical phases of the flight.

2.1 Existing actions

There are no specific actions related to inadequate management of repetitive defects included in the current EPAS 2023-2026.
Safety promotion materials were published by Airbus and EASA in the past couple of years:

- Airbus safety first magazine, System reset: use with caution, July 2021

  https://safetyfirst.airbus.com/system-reset-use-with-caution/

- Airbus FAST magazine, Intermittent repetitive failure (find it, fix it!), December 2022

  https://aircraft.airbus.com/en/newsroom/stories/2022-12-intermittent-repetitive-failure

- Conversation aviation magazine, System reset: use with caution, March 2023, article developed by Airbus

3 Baseline scenario – What would happen if there is no additional action?

Without additional mitigations measures, the safety risks identified in the Chapter 1 will remain.

4 Intervention objectives

The overall objectives of the EASA system are defined in Article 2 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in Chapters 1 and 2.

5 List of proposed actions

5.1 List of proposed actions with identification of EPAS action type and link to bowtie

Action number	*Action title*	*Issue*	*Objective*	*Action type*	*Bowtie diagram*
1	Development of guidance material on repetitive defects	Repetitive defects mainly considered as a reliability issue	Provide clarification on repetitive defects, identification, and management thereof, not limited to reliability programme	RMT	Threat 4/ consequences
2	Oversight of CAMOs and AMOs on the management of repetitive defects	Ineffective defect control system	Focus competent authorities oversight activities to ensure repetitive defects are effectively managed	MST	Threat 1/ threat 4
3	Promotion of good practices on managing repetitive defects		Sharing good practices from industry and regulatory stakeholders on how repetitive defects are identified, monitored, resolved, and documented as a key safety risk, as part of their SMS.	SPT	Threat 1/ threat 2/ threat 4/ consequences

5.2 Detailed definition of proposed actions

5.2.1 Development of guidance material for repetitive defects

The discussions within the working group and the results of the Delphi study clearly indicated that not necessarily a very prescriptive definition such as the statements in the TCCA regulations but a guidance on how CAMOs should consider repetitive defects would be beneficial for all stakeholders, incl. identification, coordination AMO, CAMO, and aircraft manufacturer, risk assessment collectively conducted by CAMO and flight operations, etc.
The guidance should highlight that repetitive defects may present hazard to flight safety and should not be solely addressed by reliability programmes.

5.2.2 Oversight of CAMOs and AMOs to ensure repetitive defects are effectively managed

The competent authorities can and should give sufficient focus on this safety issue during their oversight activities.

Considering the recently implemented Part CAMO regulations, the hazards and risks associated with repetitive defects which may impact on flight safety should be well documented as part of CAMOs SMS. Equally the hazards and risks associated with the normalisation of failure/ fault clearance should be documented as part of AMOs SMS.
Coordination between CAMOs and AMOs is paramount, and coordination procedures should address repetitive defects.
Reporting amongst organisations is to be stressed out, and implementation reviewed, when addressing repetitive defects.

5.2.3 Promotion of good practices on managing repetitive defects

There are many organisations which implemented robust processes to manage repetitive defects effectively. Nevertheless, the discussions within the working group and the results of the Delphi study have revealed sometimes contrasting views and practices particularly about whether flight crews should be informed about some of the repetitive defects, whether some repetitive defects should be subject to a collective risk assessment and finally, whether sometimes repetitive defects should be treated as deferred defects or not. It can be argued that the differences in opinion on these topics was due to the context and the surrounding circumstances each organisation operates. Therefore, a safety promotion task which aims to explore these differences and share good and innovative ideas would be beneficial for all the other organisations.
Example of practices:

- Communicating that a fault not confirmed/ not found does not mean that the aircraft is airworthy. A proper system knowledge and understanding of the defect interpretation, together with an historical fault check, is primordial.
- Using system resets with caution.
- Recording each equipment/ system reset in the aircraft technical logbook, even when seemingly or perceived as successful.
- Reporting any defect observed by the flight crew, including those that self-clear.
- Adopting common wording between flight crews and maintenance engineers when recording failures/ faults or other events in the aircraft technical logbook.
- Using not only the aircraft technical logbook but also aircraft data through digital tools to monitor and identify repetitions.
- Systematic recording of any troubleshooting manual step performed with results.
- Introducing automation or semi-automation in the reporting of failures and faults based on monitored systems and computers.
- Developing and implementing risk-based approach and procedures to repetitive defects.
- Developing procedures coordinating the different organisations contributing to the management of repetitive defects.
- Timely sharing of information related to aircraft defects, and coordination between the competent authorities for the different domains, e.g., the CAMO competent authority, the Part 145 competent authority and the state of registry competent authority.

5.3 Discarded actions

No discarded actions.

6 Conclusion

The global assessment of the proposed actions can be found in the first page of the BIS report and the details are in Annexes B, C and D of the BIS report.

7 SIA APPENDIX A - Regulatory materials review

Review of international standards, regulatory requirements, and guidance material in some of the ICAO member states:

SOURCE DOCUMENT	REFERENCE	REQUIREMENT/ GUIDANCE
ICAO Annex 8 Airworthiness of Aircraft	The entire document	No mention of any of the following words/ phrases: '**recurrent defects**', '**repetitive defects**', '**repeating defects**'
ICAO Doc 9760 Airworthiness Manual	Part III State of Registry, Attachment A to Chapter 10 (III-10-A-3)	CONTENT OF A MAINTENANCE ORGANIZATION'S PROCEDURES MANUAL Annex 8, Part II, 6.3, provides that the following information be included in the manual: a. b. ... m. Notwithstanding the above requirements, consideration should be given to including the following in the procedures manual: a) Management b) Maintenance procedures c) Line maintenance procedures (when applicable) i. ii. iii. line maintenance control of defects and **repetitive defects**;
European continuing airworthiness regulation	Regulation (EU) 1321/ 2014	There is no definition of 'repetitive defect' in the European continuing airworthiness regulation. The CAMO is basically expected to ensure that the **repetitive defects** are identified, analysed, and mitigated (e.g., adjustment of the maintenance programme, decision to implement a non-mandatory service bulletin, etc.)
	AMC M.A.301(b)	**'continuing airworthiness tasks'** for addressing the rectification of defect and damage affecting safe operation recommends, in case of aircraft used by licensed air carriers and of complex motor-powered aircraft, the implementation of a system in order to assess the effectiveness of the CAMO defect control system in use. This system should provide for -amongst other- **repetitive incidents and defects**: monitor on a continuous basis defects

SOURCE DOCUMENT	REFERENCE	REQUIREMENT/ GUIDANCE
		occurring in flight and defects found during maintenance and overhaul, highlighting any that are repetitive.
	Appendix I to AMC M.A.302 and AMC M.B.301(b)	**'aircraft maintenance programme'** provides detailed information on the content of an approved maintenance programme (AMP). Aircraft maintenance programmes of complex motor-powered aircraft, based upon maintenance steering group (MSG) logic or those that include condition monitored components or that do not contain overhaul time periods for all significant system components, shall include a reliability programme. The purpose of a reliability programme is to ensure that the aircraft maintenance programme tasks are effective and their periodicity is adequate. As per this appendix section 6.5.6.2, the reliability programme should involve evaluation of **repetitive defects**.
	Appendix II to AMC1 CAMO.A.125(d)(3)	**'terms of approval and privileges of the organisation'** addresses subcontracting of continuing airworthiness management tasks. The section 2.13 'defect control' specifies that where the CAMO has subcontracted the day-to-day control of technical log deferred defects, this should be specified in the contract and should be adequately described in the appropriate procedures. These procedures should include the responsibilities and actions to be taken for **repetitive defects**.
	AMC 145.A.70(a)	**'maintenance organisation exposition'** provides the information to be included in the maintenance organisation exposition of a part-145 organisation. The exposition should include a chapter L2.3 'Line maintenance control of defects and **repetitive defects**'.
FAA maintenance regulation	FAR 43 FAR 121	No mention of any of the following words/phrases: '**recurrent defects**', '**repetitive defects**', '**repeating defects**'
	AC 120-17B	Subject: Reliability Program Methods—Standards for Determining Time Limitations, Date: 19/12/2018 The chapter 5 on analysis and recommendation refers to the **evaluation of repetitive defects** as an example of analytical techniques and tools for root cause analysis of variations from performance standard. Parag. 5.1.1 Techniques and Tools. Examples of analytical techniques and tools that may be used include: [...] **Evaluation of repetitive defects**, including: – No Fault Found (NFF). NFF occurs when a system is tested after a fault is reported but the fault is not replicated during the test. – Rogue Units. A rogue unit is a single serialized line replaceable unit (LRU) which has demonstrated a

SOURCE DOCUMENT	REFERENCE	REQUIREMENT/ GUIDANCE
		history of identical system faults which may or may not result in an exceedance of an operator's defined number of repetitive unscheduled removals within an associated short service life. – Chronic Units. A chronic unit is a single serialized LRU which has demonstrated a history of different system faults resulting in an exceedance of an operator's defined number of repetitive unscheduled removals within an associated short service life. – Chronic Systems/Aircraft. A chronic system or aircraft is identified by a specific aircraft serial number which has demonstrated a history of repetitive unscheduled maintenance defects within the same system/subsystem during an operator-defined period of time. […]
TCCA maintenance regulation	CAR 706.05	**'defect recording, rectification, and control procedures'**, from subpart 6 'aircraft maintenance requirements for air operators' of part VII 'commercial air services', requires an air operator to include in its maintenance control system the procedure referred to in the commercial air service standards for detecting **defects that recur** and identifying these defects as **recurring defects**. https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433
	STD 726.05	'defect recording and control' describes that: – the defect recording system has to include a method to highlight **defects that recur**, so that they are readily identifiable by flight crews and the maintenance organization at all bases where the aircraft is operated. The air operator is responsible for identifying defects as **recurring defects** to maintenance personnel in order to avoid the duplication of unsuccessful attempts at rectification. – the defect control system has to ensure that the rectification of a defect identified as a **recurring defect** will take into account the methodology used in previous repair attempts. – defects are **recurring defects** if a failure mode is repeated three times, on a particular aircraft, within 15 flight segments of a previous repair made in respect of that failure mode. https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433/standards/standard-726-air-operator-maintenance-canadian-aviation-regulations-cars#726_05

SOURCE DOCUMENT	REFERENCE	REQUIREMENT/ GUIDANCE
	STD 726.08(1)(o)	**'maintenance control manual'** requires that the maintenance control manual of an air operator shall contain a description of the defect rectification and control procedures, including the methods used to detect and report **recurring defects**. https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433/standards/standard-726-air-operator-maintenance-canadian-aviation-regulations-cars#726_08
	TP14408 'TCCA guidelines:	**'maintenance control manuals'** provides explanatory narrative in section 15 'defect control and rectification', along with an example for handling **recurring defects**: '*A recurring defect is one that reoccurs 3 times in 15 flight segments. Once a defect has been identified as a recurring defect the Maintenance Manager will remove the aircraft from service in order to conduct an investigation into the root cause of the defect. The aircraft will remain off-line until the Maintenance Manager is satisfied that the source of the defect has been permanently fixed. The Maintenance Manager will review the last 15 flight segments in the Journey Log for any signs of a recurring defect.*' https://tc.canada.ca/en/aviation/publications/transport-canada-civil-aviation-guidelines-maintenance-control-manuals-tp-14408/tp-14408-transport-canada-civil-aviation-guidelines-maintenance-control-manuals-1

8 SIA APPENDIX B - Accidents and serious incidents investigation reports review

8.1 Airbus A319, G-EZAC, easyJet, 15.09.2006

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
AAIB 4/2009	France	15.09.2006	Incident	Airbus A319/ G-EZAC/ easyJet
Event summary/ Key elements	**Event summary:** – **Previous flight -2**: • Elec gen1 fault twice during flight. GCU 1 replaced tested ok but tripped again during ground run, reset, A/C released for service. – **Previous flight -1:** • After 20 min in flight ELEC GEN 1 fault, GEN 1 tripped off, ECAM proc: one attempt reset, failed. Selection OFF, APU ON. Mx contacted for a later MEL possibility. – **Incident flight**: • MEL applied**,** GEN 1 off, APU to be active throughout the flight. Entry made in aircraft TLB. When changing over, the pilots shared about the Gen 1 issue. • In cruise Cpt PFD, ND, upper ECAM, MCDU became inoperative, AP, A/THR disconnected. No radio communication. no Transponder, ALT law, ELEC AC ESS BUS FAULT => Procedures reported followed by capt but no reconfiguration of the electrical system. GEN 1 OFF/ON no change, back OFF. • Aircraft could only be controlled manually, performed by the FO as his displays were ok but w/o flight director. • Restart of the APU, by the capt, had no effect on the electrical system. Crew decided that the best course of action was to continue to Bristol. • Emergency gear extension system used to extend the landing gear by gravity. **Key elements of the report related to the management of repetitive defects:** MEL applied after 2 occurrences, but corrective actions applied after flight - 2, so could be considered as independent (i.e., not repetitive)			
Safety gap analysis towards	**Identification of repetitive defects:** – Failures during previous flights -2 & -1 recorded in TLB, – Maintenance contacted for a later MEL possibility, – Crew aware of MEL applied, dispatch GEN 1 off, APU active. Uncertain if considered as "repetitive" – Fault addressed by application of MEL – **Notification/ communication of repetitive defects:** – When changing over, the pilots shared about the Gen 1 issue **Repetitive defects as hazards to flight safety:** – None – Significant effects of fault combined with reported unsuccessful transfer of AC ESS BUS via ALTN procedure caused by specific GCU failure. – GCU 1 replaced after flight -2, showed when investigated an history of similar fault (inexplicit Rogue unit) **Resolution of the repetitive defects:** n/a **Other:** n/a			

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
AAIB 4/2009	France	15.09.2006	Incident	Airbus A319/ G-EZAC/ easyJet
Proposed mitigating actions for the identified safety gaps	– Traceability of repetitive faults at component level “Rogue units”, response to SR 2008-089 does not appear to cover rogue units, it focuses on issues at airframe level. Was the SIB planned for 2016 released? As per the SRIS database, what started with a RMT (response June 2010) transposed into the issuance of a SIB (response April 2016) that was eventually replaced by a safety promotion action (response April 2021).			
Already existing mitigating actions that may need enhancement	– For info in FCOM clearly defined reset procedure + record in log book. – No limitation of reset, but each reset to be recorded in logbook to allow identification of repetitive faults.			

8.2 Boeing 737-800, TC-JGE, Turkish Airlines, 25.02.2009

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
M2009LV0225_01	Netherlands	25.02.2009	Accident	Boeing 737-800/ TC-JGE/ Turkish Airlines
Event summary/ Key elements	**Event summary:** – A Boeing 737-800 (flight TK1951) operated by Turkish Airlines was flying from Istanbul Atatürk Airport in Turkey to Amsterdam Schiphol Airport, on 25 February 2009. As this was a ‘Line Flight Under Supervision’, there were three crew members in the cockpit, namely the captain, who was also acting as instructor, the first officer who had to gain experience on the route of the flight and who was accordingly flying under supervision, and a safety pilot who was observing the flight. – There were also four cabin crew members and 128 passengers on board. During the approach to runway 18 Right (18R) at Schiphol airport, the aircraft crashed into a field at a distance of about 1.5 kilometres from the threshold of the runway. This accident cost the lives of four crew members, including the three pilots, and five passengers, with a further three crew members and 117 passengers sustaining injuries. – During the approach, and using the instrument landing system, it appeared that the left radio altimeter system suddenly indicated an erroneous height of -8 feet on the left primary flight display. In reality the height -8 cannot occur, however, the value itself is within the (design) height range of the radio altimeter system. As the erroneous radio height was lower than the required limit of 27 feet for the autothrottle to enter into the ‘retard flare’ mode and other conditions (described in paragraph 2.2.4) were being met, the autothrottle reduced the engine thrust to idle during the approach. This was in anticipation of the ‘touchdown’ (wheels on the runway), where the thrust levers are pulled fully aft by the autothrottle. This was possible because the left radio altimeter system had characterised the measured heights (including the -8 value) as ‘normal’ (usable). Under this condition the autothrottle, just like other systems on board, can use this height value. The ‘retard flare’ mode was indicated on the primary flight display as ‘RETARD’. At the same time the right-hand side autopilot (which used data from the right-hand side radio altimeter system) followed the glide slope signal. The aircraft was trimmed nose up in order to follow the glide slope and the airspeed decreased. **Key elements of the report related to the management of repetitive defects:** – The maintenance documents of the aircraft did not contain any defects or technical complaints that still had to be resolved. (Crews’ awareness – Communication of repetitive defects) – The only indication for a defect in the left radio altimeter system was the - 8 feet indication on the left primary flight display (Symptoms of the defect misleading crew) – The crews involved in previous flights had stated that these irregularities had proved not to be reproducible on the ground and/ or had not recurred during their return flights. For this reason, the crews did not report the incident (The challenge about repetitive defects i.e., mainly/ purely relying on engineering to monitor unless crews are requested to report if a defect repeated or not) – The radio altimeter system issues were discussed seven times during the six-weekly Operations meetings with pilots, fleet management and Engineering, Maintenance and Quality managers. These meetings did not result in informing pilots about the issues and the possible consequences of this for flight operations because the problems were not deemed to be a threat to safety. Turkish Technic Inc. representatives believed both radio altimeter systems were a backup for the other if either one failed. In their view there was a lack of information in the system documentation to comprehend the actual system autothrottle and radio altimeter system interaction. (Responses to repetitive defects short term i.e., MCC vs. long term i.e., reliability programme) – Technical reliability issues were discussed during the Reliability Control Board Meeting chaired by the Turkish Airlines Technical management and also attended by the Turkish Airlines Flight Operations management. The Turkish Airlines Flight Safety and Quality Assurance department attended the meetings until October 2008. Between 16 February 2007 and 11 February 2009 the radio altimeter system issues were discussed four times, especially on TC-JGE, during these meetings. (Effectiveness of Reliability Programme i.e., taking corrective action such as planning downtime for troubleshooting or even grounding the aircraft or test flying before the defect is completely resolved) – A complete overview of the regular maintenance performed on TC-JGE was available for the investigation. In accordance with the manufacturer specifications regular maintenance is not performed on radio altimeter systems. Maintenance will only be performed after a complaint from a crew member or when during maintenance it becomes evident that something is not working correctly. The aircraft underwent its last C-check on 20 October 2008 when all antennas were fitted with gaskets. The last A-check was carried out on 19 and 20 February 2009 just before the accident. Work was not performed on the radio altimeter system during these maintenance overhauls because complaints about the radio altimeter systems had not been written down in the maintenance documentation. (MSG-3 Should it consider developing tasks i.e., functional checks for those safety critical systems impacting on automation?) – Several airlines, including Turkish Airlines, regarded the problems with radio altimeter systems as a technical problem rather than a hazard to flight safety. As a result, the pilots were not informed of this issue. (Risk assessment of repetitive defects)			

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
M2009LV0225_01	Netherlands	25.02.2009	Accident	Boeing 737-800/ TC-JGE/ Turkish Airlines
Safety gap analysis towards	**Identification of repetitive defects:** – The radio altimeter system issues were discussed seven times during the six-weekly Operations meetings with pilots, fleet management and Engineering, Maintenance and Quality managers. These meetings did not result in informing pilots about the issues and the possible consequences of this for flight operations because the problems were not deemed to be a threat to safety. Turkish Technic Inc. representatives believed both radio altimeter systems were a backup for the other if either one failed. In their view there was a lack of information in the system documentation to comprehend the actual system autothrottle and radio altimeter system interaction. This demonstrates the need for repetitive defects to be robustly monitored on a daily basis without relying on the reliability programme. – A complete overview of the regular maintenance performed on TC-JGE was available for the investigation. In accordance with the manufacturer specifications regular maintenance is not performed on radio altimeter systems. Maintenance will only be performed after a complaint from a crew member or when during maintenance it becomes evident that something is not working correctly. The aircraft underwent its last C-check106 on 20 October 2008 when all antennas were fitted with gaskets. The last A-check107 was carried out on 19 and 20 February 2009 just before the accident. Work was not performed on the radio altimeter system during these maintenance overhauls because complaints about the radio altimeter systems had not been written down in the maintenance documentation. (MSG-3 Should it consider developing tasks i.e., functional checks for those safety critical systems impacting on automation?) **Notification/ communication of repetitive defects:** – Since the maintenance documents of the aircraft did not contain any defects or technical complaints that still had to be resolved, the situational awareness of the flight deck crew was significantly reduced due to repetitive defects on a critical system not being visible to them. **Repetitive defects as hazards to flight safety:** – Several airlines, including Turkish Airlines, regarded the problems with radio altimeter systems as a technical problem rather than a hazard to flight safety. Clearly, Turkish Airlines was not the only airline treating such adverse reliability trends only as technical issues but not considering the associated flight safety risks. This demonstrates the need for a holistic approach to risk management within an airline i.e., both flight operations departments and CAMOs collectively risk assessing such repetitive defects and when they potentially impact on automation and crew workload, consider taking swift action including planning downtime or removing aircraft from service. **Resolution of the repetitive defects:** – Technical reliability issues were discussed during the Reliability Control Board Meeting chaired by the Turkish Airlines Technical management and also attended by the Turkish Airlines Flight Operations management. The Turkish Airlines Flight Safety and Quality Assurance department attended the meetings until October 2008. Between 16 February 2007 and 11 February 2009 the radio altimeter system issues were discussed four times, especially on TC-JGE, during these meetings. This clearly demonstrates the importance of taking corrective actions following the identification of adverse reliability trends to achieve an effective reliability programme. **Other:** n/a			
Proposed mitigating actions for the identified safety gaps	– TBC			
Already existing mitigating actions that may need enhancement	– TBC			

8.3 Airbus A320, PK-AXC, Indonesia Air Asia, 28.12.2014

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.14.12.29.04	Indonesia	28.12.2014	Accident	Airbus A320/ PK-AXC/ Indonesia Air Asia
Event summary/ Key elements	**Event summary:** Loss of control in flight. 4 occurrences of master caution “AUTO FLT RUD TRV LIM SYS”, ECAM procedure followed for the 3 first instances. Then after the 4th, pilot actions recorded show FAC CBs pulled off. Resulting in EW AUTO FLT FAC 1 FAULT & AUTO FLIGHT FAC 2 FAULT, consequently auto pilot and auto thrust disengaged and the flight control system reverts to Alternate law (protection lost). First officer actions led to Aircraft entering an upset condition, stall warning activating until end of recording **Key elements of the report related to the management of repetitive defects:** Failure to have a global view of the repetitive nature of the fault.			
Safety gap analysis towards	**Identification of repetitive defects:** loss of RTLU, rudder travel limiter failures (either or both channels) occurred 23 times in the preceding year. Maintenance report 1 (tech log book) shows 5 pilot’s reports related to RTLU in November, and 9 in December. Maintenance report 2 (deferred defect log book) notes an RLTLU defect inserted on Dec 19th, then closed after scheduled flight, as PFR showed no fault recorded. ops test, no faults. **Notification/ communication of repetitive defects:** MR1 shows records of the instances of the failure condition but does not mention its “repetitive” nature. **Repetitive defects as hazards to flight safety:** Normalisation of resets be it on ground or in flight, on same system computers **Resolution of the repetitive defects:** n/a, treated as individual defect **Other:** n/a			
Proposed mitigating actions for the identified safety gaps	Identification (and record as such) of the repetitive nature of the failure is key to trigger fault isolation as early as possible. This in order to reduce exposure time.			
Already existing mitigating actions that may need enhancement	Clarification of allowable resets for flight crew vs. maintenance			

8.4 Boeing 737-800, CN-ROJ, Royal Air Maroc, 30.12.2016

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
BEA2017-0003	France	30.12.2016	Serious Incident	Boeing 737-800/ CN-ROJ/ Royal Air Maroc

Event summary/ Key elements

Event summary:
The aircraft was being vectored to the ILS of runway 06 at Paris-Orly (Val-de-Marne). The meteorological conditions required a category 3 instrument approach (CAT III ILS). After receiving the approach clearance, the crew twice tried to engage the second autopilot (A/P B). The non-reception of radio-altimeter (RA) 2 data by the flight control computer (FCC B) prevented the engagement of A/P B and caused the disengagement of A/P A. The crew re-engaged A/P A and the aircraft was diverted to Lyon-Saint Exupery airport, where conditions permitted a CAT I ILS approach, which could be carried out with only one A/P functioning. During the approach, an untimely right turn was commanded by the A/P due to the erroneous data from the IRS module of the left Air Data Inertial Reference Unit (ADIRU). The invalidity of the data supplied by the left ADIRU then led to the disengagement of A/P A. The captain then flew manually with the Flight Directors (F/D) displayed on the Primary Flight Display (PFD). The crew first tried to return to the path. As the deviation from the path compromised continuing the approach, they flew a missed approach and then engaged A/P B. The aeroplane had just been transferred to the Approach again when the L IRS FAULT warning was activated causing the disengagement of A/P B, and the disappearance of the pitch, roll and heading data along with the F/D bars from the left PFD. The captain again flew manually while carrying out from memory, one of the actions of the IRS FAULT checklist, namely, IRS Transfer Switch - BOTH ON R. The two FCC thus used the data supplied by the right ADIRU. The pitch, roll and heading were displayed again on the left PFD and the F/D bars reappeared. During the second approach and the interception with the localizer, and after re-engaging A/P B and transferring the controls to the co-pilot, the captain informed the controller that he had positioning problems. The controller continued the radar vectoring. On capturing the Glide, A/P B automatically disengaged due to FCC B not receiving data from RA 2. The F/D disappeared from both sides. The co-pilot then transferred the controls to the captain. The latter informed the Approach controller that he was continuing in manual flight. The flight was transferred to the Tower controller. The approach, in manual and without the F/D, was not stabilized with respect to either the path and slope or the aeroplane's speed and configuration. Several EGPWS "SINK RATE", "GLIDE SLOPE" and "TOO LOW TERRAIN" warnings were activated on final.

Key elements of the report related to the management of repetitive defects:
- The investigation showed that the malfunctions linked to RA 2, observed during the incident flight, were intermittent faults and that they had existed on CN-ROJ for at least six months (as recorded by the non-volatile memories (BITE) of the FCC). In the six months up until the day before the occurrence, this fault linked to RA 2 was recorded 35 times, including 16 times since 9 December. During the occurrence flight, this same fault, RADIO ALT-2 (J1B-B04, A04) was recorded seven times in FCC B.
- The analysis of the QAR data and fault messages recorded in the FCC BITE brought to light that the RAM crews did not systematically report the technical malfunctions in the CN-ROJ TLB.

Safety gap analysis towards

Identification of repetitive defects:
- The RAM's Operations Manual specifies that the captain must make a detailed entry in the TLB about any fault likely to affect airworthiness or operating safety, including the safety systems. This principle was not sufficiently complied with by the RAM pilots over the period analysed by the BEA. Disappearance of the F/D, the ADIRU malfunctions and the A/P automatically disconnecting were not systematically reported. Systematic reporting of the faults and anomalies encountered by the crew gives the maintenance department the possibility of correcting the problems or in the case of intermittent faults, of monitoring their evolution. It would have permitted the RAM maintenance department to be better prepared for resolving the problems encountered on this plane. In particular, it would have probably been able to identify the communication problem between RA 2 and FCC B sooner and to replace the left ADIRU more quickly.
- The tests carried out indicated that the fault associated with RA 2 was not confirmed on the ground and that as a consequence, it was an intermittent type fault. This fault could be systematically found by the maintenance personnel in the fault history of the Control Display Unit (CDU) (DFCS BITE procedure).

Notification/ communication of repetitive defects:
- The reading of the maintenance documents suggests that the RA 2/ FCC B fault did not reappear during the ground tests, thereby indicating, in accordance with the fault isolation manual, that either it was intermittent, or it only appeared in flight conditions. The Boeing procedure indicates that, in this case, the maintenance technicians must comply with the operator's policy for processing intermittent faults, use their judgement and the operator's maintenance history and specifically monitor the aeroplane in question.

Repetitive defects as hazards to flight safety:

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
BEA2017-0003	France	30.12.2016	Serious Incident	Boeing 737-800/ CN-ROJ/ Royal Air Maroc

	– Although it appeared on several occasions and its consequences were notified by the crews, the base maintenance centre was not able to solve this fault, resulting, on the day of the event, in a degraded aircraft, presenting **automated system problems mainly in the approach phase**. – During the flight, the crew were confronted with various malfunctions either linked to technical failures or of an operational nature (left ADIRU and RA 2). Confronted with **malfunctions which they could not explain, foresee, or interconnect, their confidence in the plane progressively decreased**, their attention being particularly focused on the fuel level which they believed insufficient. Each instant delaying the landing risked seeing new faults appear. The crew had thus progressively passed from conventional management in normal mode, at the beginning of the flight, to "emergency" mode management with them wanting to land as quickly as possible. **Resolution of the repetitive defects:** – Following the crew's report of a problem linked to RA 2 on 10 December 2016, RAM replaced it. However, the fault occurred again on 12 December 2016. The cause of the fault was therefore not removed. It then reoccurred on 25 December 2016 after 54 problem-free flights. FCC B was replaced three days after the occurrence, on 2 January 2017, without the problem disappearing. It was therefore highly likely that the malfunction was due to neither RA 2 nor FCC B, but due to the connection between the two systems. **Other:** Other factors that contributed to the escalation to that serious incident besides the presence of repetitive defects: – The concomitance of two independent failures within two separate systems where the cause of the failures, the absence of any link and the consequences were difficult for the crew to determine, without appropriate information in the operational documentation or sufficiently salient warnings emitted by the aircraft systems. – The operating logic of the FCC which does not monitor the inertial data provided by the ADIRU, except for approaches with the two A/P engaged. The FCC was not designed to, nor was it required for certification, to monitor the ADIRU inputs. – The ADIRU internal monitoring logic with respect to the validity of the inertial data transmitted to other systems. The activation criteria of the "Drift Angle" fault, which in turn activates the IRS FAULT warning, can cause the latter to appear at a late stage with respect to the start of the ADIRU IR module malfunction.
Proposed mitigating actions for the identified safety gaps	– The crew reports play an essential role in the maintenance actions that will be carried out on the aircraft a posteriori. If a fault which occurs in flight is not reported, it will not be the subject of a corrective maintenance action or specific monitoring by the department responsible for monitoring and managing faults. Systematic reporting of the faults and anomalies encountered by the crew is paramount. [related to safety recommendation FRAN 2021-015] – Operators were asked to implement a policy for processing intermittent faults, with these faults being specifically monitored on several consecutive flights, reminding that it is possible to access the faults recorded by the main computers through the Cockpit Display Unit, after a flight, even if they are no longer active on the ground. [related safety recommendation FRAN 2021-016]
Already existing mitigating actions that may need enhancement	

8.5 Boeing 737-800, F-GZHO, Transavia, 08.02.2018

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
BEA2018-0071	France	08.02.2018	Incident	Boeing 737-800/ F-GZHO/ Transavia France
Event summary/ Key elements	**Event summary:** On the first two flights after base maintenance event, IAS DISAGREE, ALT DISAGREE and AOA DISAGREE fault messages were triggered. First flight continued to destination with ALT and AOA disagree between left and fight PFD. On the second flight, after initial climb captain decided to return to original airport. Investigation revealed RH AOA sensor failure. Sensor chemical contamination was found (epoxy), which most probably occurred during the manufacturing process. QAR data showed that RH AOA sensor was not performing well since aircraft first flight (sensor was installed in the aircraft at factory). However, no fault message was triggered in cockpit during the three years of aircraft operation till the base maintenance event. However, it is possible that the handling of the sensor during base maintenance task exacerbated the dysfunction of the sensor without the technicians realising this. The technician working on the aeroplane between the two flights not using the FIM. Its use would have ensured that a more complete check was carried out, the failure would have probably been detected and the sensor replaced. **Key elements of the report related to the management of repetitive defects:** This event is not related to inadequate management of repetitive defect, as the faults were only triggered in two consecutive flights. It is more related to wrong/incomplete trouble shooting, not identifying the cause of the defect and releasing to service the aircraft.			
Safety gap analysis towards	**Identification of repetitive defects:** The technician working on the aeroplane between the two flights not using the FIM. Its use would have ensured that a more complete check was carried out, the failure would have probably been detected and the sensor replaced. **Notification/ communication of repetitive defects:** N/A **Repetitive defects as hazards to flight safety:** N/A **Resolution of the repetitive defects:** N/A **Other:** N/A			
Proposed mitigating actions for the identified safety gaps	N/A			
Already existing mitigating actions that may need enhancement	Following trouble shooting manual for defect rectification.			

8.6 Airbus A320, ES-SAN, Smartlynx Airlines, 28.02.2018

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
A2802118	Estonia	28.02.2018	Accident	Airbus A320/ ES-SAN/ Smartlynx Airlines Estonia

Event summary/ Key elements

Event summary:

- Runway excursion during training flight program: 5 touch & go cycles, 1 go around, then full stop landing for each of several successive trainees.
- Crew members: Instructor in pilot seat, trainee in first officer seat & safety pilot in jump seat
- During several touch & go, EW "F/CTL ELAC 1 PITCH FAULT" and/or "F/CTL ELAC2 PITCH FAULT" triggered when the instructor stopped the pitch trim wheel close to the trim take off position.
- When both EW triggered at same time, it led to a reversion from normal to pitch alternate law (EW: "F/CTL ALTN LAW"). Repeated faults were handled using ELAC resets (in line with current QRH). in total 9.
- While the 4th trainee performed his third touch & go, ELAC2 pitch fault re-occurred. Yet, as during the previous cycle, ELAC1 pitch fault triggered and was not reset, this induced a reversion in alt law.

Additionally, due to a bounce, the ground condition was not exactly sensed simultaneously in the COM and MON units of the SEC computers, leading to loose pitch control also by the SECs.

- Then, with thrust levers in TOGA detent, the A/C approached the rotation speed, pitch up sidestick orders had no effect. EW "F/CTL L+R ELEV FAULT" "MAN PITCH TRIM …USE" triggered. The A/C speed increase led to slightly lift off with pitch control available only with trim wheel, roll control available in direct law using sidesticks…..Idle thrust, conf 2 to conf 1, gear up ordered, A/C flew down from 48 ft, hit the runway (engine, LG damaged) then got airborne again in very degraded condition, manual pitch trim only was used… aircraft both engines failed during return leading to final landing 150m before runway threshold.

Key elements of the report related to the management of repetitive defects:

- The aircraft had no known technical issues before the flight. Potentially out of scope of this study.
- Continued training program despite repeated NoGo E/W

Safety gap analysis towards

Identification of repetitive defects:

- In real time during training, same trainer & safety pilot
- The crew made 5 ELAC1 resets and 4 ELAC2 resets.

Notification/ communication of repetitive defects:

- None

Repetitive defects as hazards to flight safety:

- Normalisation of resets in flight on same system or computer (9 occurrences of resets)
- Same failure, on a critical function repeating steadily.
- No step back for considering/assessing criticality of function losses and possible detrimental combination(s) E1+E2, and E1+E2 + other by referring to MEL for instance.

Resolution of the repetitive defects:

n/a, because occurred during flight

Other:

n/a

Proposed mitigating actions for the identified safety gaps

n/a

Best Intervention Strategy with Safety Issue Assessment
SI-9001 - Inadequate management of repetitive defects

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
A2802118	Estonia	28.02.2018	Accident	Airbus A320/ ES-SAN/ Smartlynx Airlines Estonia
Already existing mitigating actions that may need enhancement	– Clarification of allowable resets for flight crew (QRH). – Clarification of MEL for consideration in training flight context (FCTM). – Make safety pilot awareness about repetitive defect handling during training flights.			

8.7 Boeing 737-8 (MAX), PK-LQP, PT. Lion Mentari Airlines, 29.10.2018

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.18.10.35.04	Republic of Indonesia	29.10.2018	Accident	Boeing 737-8/ PK-LQP / PT. Lion Mentari Airlines
Event summary/ Key elements	**Event summary:** – On 29 October 2018, at about 0632 Local Time (23:32 UTC 28 October 2018), a PT Lion Mentari Airlines (Lion Air) Boeing 737-8 (MAX) aircraft registered PK-LQP, was being operated as a scheduled passenger flight from Soekarno-Hatta International Airport (WIII), Jakarta with intended destination of Depati Amir Airport (WIPK), Pangkal Pinang, when the aircraft disappeared from radar after informing Air Traffic Controller (ATCo) that they had flight control, altitude and airspeed issues. The aircraft impacted the water in Tanjung Karawang, West Java, all person on board perished and the aircraft destroyed. – On 26 October 2018, the SPD (speed) and ALT (altimeter) flags on the Captain's primary flight display first occurred on the flight from Tianjin, China to Manado, Indonesia. Following reoccurrence of these problems, the left angle of attack (AOA) sensor was replaced in Denpasar on 28 October 2018. – The installed left AOA sensor had a 21° bias which was undetected during the installation test in Denpasar. The erroneous AOA resulted in different indications during the flight from Denpasar to Jakarta, including IAS (indicated airspeed) DISAGREE, ALT (altitude) DISAGREE, FEEL DIFF PRESS (feel differential pressure) light, activations of Maneuvering Characteristics Augmentation System (MCAS) and left control column stick shaker which were active throughout the flight. The flight crew was able to stop the repetitive MCAS activation by switched the stabilizer trim to cut out. – After landed in Jakarta, the flight crew reported some malfunctions, but did not include the activation of stick shaker and STAB TRIM to CUT OUT. The AOA DISAGREE alert was not available on the aircraft therefore, the flight crew did not report it. The reported problem would only be able to rectify by performing tasks of AOA Disagree. – The following morning on 29 October 2018, the aircraft was operated from Jakarta with intended destination of Depati Amir Airport, Pangkal Pinang. According to the DFDR and the CVR, the flight had same problems as previous flight from Denpasar to Jakarta. – The flight crew started the IAS DISAGREE Non-Normal Checklist (NNC) but did not identify the runaway stabilizer. The multiple alerts, repetitive MCAS activations, and distractions related to numerous ATC communications contributed to the flight crew difficulties to control the aircraft. **Key elements of the report related to the management of repetitive defects:** – The AOA DISAGREE alert was not correctly enabled during Boeing 737-8 (MAX) development. As a result, it did not appear during flight with the mis-calibrated AOA sensor, could not be documented by the flight crew and was therefore not available to help maintenance identify the mis-calibrated AOA sensor. – The replacement AOA sensor that was installed on the accident aircraft had been mis-calibrated during an earlier repair. This mis-calibration was not detected during the repair. The investigation could not determine that the installation test of the AOA sensor was performed properly. The mis-calibration was not detected. – After LNI043 was airborne, the left control column stick shaker was active and several messages appeared. The Captain of LNI043 was aware to the aircraft condition after discussion with the engineer in Denpasar. This awareness helped the Captain to make proper problem identification. – Lack of documentation in the aircraft flight and maintenance log about the continuous stick shaker and use of the Runaway Stabilizer NNC meant that information was not available to the maintenance crew in Jakarta nor was it available to the accident crew, making it more difficult for each to take the appropriate actions. – The investigation found that the engineers were prone to entering the problem symptom reported by the flight crew in the Interactive Fault Isolation Manual (IFIM) first instead of reviewing the Onboard Maintenance Function (OMF) maintenance message. Conducting this method might lead the engineers into the inappropriate rectification task. – The investigation found that all Aircraft Flight Maintenance Log (AFML) pages received by the investigation did not contain fault codes. The absence of the fault code reported by the flight crew may increase the workload of the engineer and prolong the rectification process. – The OMF has the history page which contains record of the aircraft problems which can be utilised as a source for aircraft problem monitoring. Batam Aero Technic (BAT), the approved maintenance organisation, has not utilised the OMF information as the source of aircraft problem monitoring.			
Safety gap analysis towards	**Identification of repetitive defects:** – The definition of an aircraft repetitive problem was different between Lion Air CMM and BAT AMOQSM. The Lion Air CMM described that the aircraft problem categorized as the repetitive problem if discrepancy twice recurs on the same aircraft during 30 consecutive days of operation, while BAT AMOQSM stated three times within 30 consecutive days. This difference indicated that the Lion Air did not monitor the repetitive problem policy of the BAT as a subcontracted entity. – Incomplete report of the mechanical irregularities experienced during previous flight LNI043, where the flight crew was able to successfully land the accident aircraft while experiencing the same conditions as the accident flight. The Captain did not mention the activation of the stick shaker, and did not report the stabilizer runaway and the use of the			

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.18.10.35.04	Republic of Indonesia	29.10.2018	Accident	Boeing 737-8/ PK-LQP / PT. Lion Mentari Airlines

STAB TRIM CUTOUT guarded switches or that he had to use manual trim for the majority of the flight and the landing. The requirement to report all known and suspected defects is very critical for engineering to be able to maintain the airworthiness of the aircraft.

- There was no requirement to perform AOA value test. The IAS and ALT disagree reported which occurred on the LNI043 flight which was caused by AOA sensor bias, would not be able to solve by both IFIM tasks of 'ALT DISAGREE shows on PFD - Captain's' and 'IAS DISAGREE shows on PFD - Captain's'. The AOA DISAGREE message was not enabled and was inhibited; therefore, it did not appear on the LNI043 flight. The inhibited AOA DISAGREE message contributed to the inability of the engineer to rectify the failure of the AOA sensor.
- The AFML is the only source of the daily aircraft problem monitoring in which the problem may be identified by the flight crew or engineer. If the aircraft problem is not stated in the AFML, the repetitive problem may not be detected. The investigation found that the SPD and ALT flags problem was reported twice in the AFML on 26 and 27 October 2018 while the DFDR recorded the problems occurred three times. The SPD and ALT flags problem during the flight from Manado to Denpasar on 27 October 2018 was recorded on the DFDR but was not reported in the AFML. The absence of aircraft problem report affected the repetitive problem identification.
- The OMF and Interactive Fault Isolation Manual (IFIM) provide trouble shooting guidance for the engineer. The investigation found that the engineers were prone to entering the problem symptom reported by the flight crew in the IFIM first instead of reviewing the OMF maintenance message. Conducting this method might lead the engineers into the inappropriate rectification task.
- The Fault Reporting Manual (FRM) helps to directly appoint the proper IFIM task by fault code for particular problem entered by the flight crew. The fault code may direct the engineer to the relevant problem and prevent the unnecessary presentation of several faults, IFIM tasks or maintenance messages. The investigation found that all AFML pages received by the investigation did not contain fault codes. The absence of the fault code reported by the flight crew may increase the workload of the engineer and prolong the rectification process.

Notification/ communication of repetitive defects:

- After replacement of the left AoA sensor that resulted in misalignment because of incorrect installation, the flight crew of the LNI043 flight was briefed prior flight by the engineer about the repetitive aircraft problems, and the rectification that has been performed.

Repetitive defects as hazards to flight safety:

- The SPD and ALT flags were reported multiple times by the flight crew during three out of four flights before identifying the left AoA sensor as the potential root cause.
- After the fourth flight of that day, the left AoA sensor was not replaced because of lack of spare. Despite the identified left AoA signal failure, the left ADIRU and SMYD 1 C/B were reset, DFCS test successfully passed. The flight crew was then recommended to perform the planned flight to the next stop, where the AoA could be replaced. The SPD and ALT flags on the Captain's PFD most likely had appeared again after the engine started. Although prior to take off, the MEL was not considered. Indicated airspeed or altimeter are NO GO items. The aircraft was released with a known possible recurring defect, that in addition was a NO GO item as per the MEL.

Resolution of the repetitive defects:

- The investigation did not find any evidence of handling the problem as repetitive according to the CMM, other than the statement on the AFML for replacement AOA sensor was 'due to repetitive problem'.

Other:

- n/a

Proposed mitigating actions for the identified safety gaps

- Implement automation for fault/ failure reporting to populate the aircraft technical logbook
- Promote the importance of fault isolating/ troubleshooting instead of fault clearance
- Address repetitive defects as hazard to flight safety
- Communicate repetitive defects adversely affecting flight critical systems to the flight crew prior to flight

Best Intervention Strategy with Safety Issue Assessment
SI-9001 - Inadequate management of repetitive defects

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.18.10.35.04	Republic of Indonesia	29.10.2018	Accident	Boeing 737-8/ PK-LQP / PT. Lion Mentari Airlines
Already existing mitigating actions that may need enhancement	– CAMO repetitive defects management			

8.8 Airbus A319, N521NK, Spirit Airlines, 15.02.2020

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
ENG20LA016	United States of America	15.02.2020	Incident	Airbus A319/ N521NK/ Spirit Airlines

Event summary/ Key elements	**Event summary:** – Loss of both electrical main generators in approach. – Emergency Electrical configuration, Ram Air Turbine (RAT) extended and activated. – Landing with no further incident. **Key elements of the report related to the management of repetitive defects:** – Similar in flight event 2 legs before, similar losses of functions. – Three other previous similar cases on ground (during single engine taxi after landing)	**Event summary:** On 15 February 2020, an Airbus A319-132 aircraft equipped with 2x IAE V2524-A5 engines experienced dual loss of Integrated Drive Generators (IDG), on approach to Sacramento International Airport, California. The fault resulted dual loss of AC BUS 1 and 2, prompting loss of several flight displays and automatic RAT extension to provide electric power to vital systems. The aircraft landed without further incident. The aircraft produced similar symptoms prior to this flight incident on 19th January, on 23rd and 29th January, finally on 14th February. Although troubleshooting has been performed, and maintenance actions carried out i.a.w Airbus AMM and TSM, the root cause of the previous occurrences were not found, but the aircraft was dispatched for operation. The Operator did not contact the OEM as per TSM indication; therefore, the root cause of the previous safety issues could not be found. Further investigations to the component revealed, after analysis of the NVM (Non-Volatile Memory) that one IDG failed their respective frequency control check confirmed by specific fault code as well (145) and the other failed under specific conditions. In the teardown of the IDG-s, it was found that internal cylinder blocks linked to internal hydraulic were significantly worn beyond design limit, which were later on identified and confirmed as root cause of the incident. **Key elements of the report related to the management of repetitive defects:** – The unidentified root cause of the defect. – The repetitiveness of the incident and uneven distribution of events, especially with increase of time intervals in-between. – The (lack) of instruction of the OEM to the Operator for identifying a possible root cause and general guidance in the TSM. Operator did not approach OEM.
Safety gap analysis towards	**Identification of repetitive defects:** – Failure conditions troubleshot as individuals. **Notification/ communication of repetitive defects:** – Unknown **Repetitive defects as hazards to flight safety:** – Obvious critical failure in flight, Electrical emergency configuration. – Electrical emergency configuration occurred twice. After the first one, troubleshooting & power assurance run performed with no findings, the aircraft was returned to service. – Lack of understanding of nature and criticality of the failure condition during the first inflight event. Induced repetition on incident flight.	**Identification of repetitive defects:** The repetitiveness in this specific occurrence shows increase in time interval in between two occurrences, so it is not a good indicator for identification (at some airlines it is not even a repetitive defect i.a.w their approved procedure). The re-appearance is a good mean to check the commonality between occurrences (e.g., single engine taxi, and failure subsequent of GEN 1 and 2 with time offset, imposes a similar load to the other -still operational- IDG.) **Notification/ communication of repetitive defects:** The workorders on the complaint are not very informative and the consulted NTSB docket are weak in term of content and there is no evidence of identified PFR warning/ fault messages on workorders previously. (NTSB Docket - Docket Management System). **Repetitive defects as hazards to flight safety:**

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
ENG20LA016	United States of America	15.02.2020	Incident	Airbus A319/ N521NK/ Spirit Airlines

	Resolution of the repetitive defects: – Airbus contacted after second in flight occurrence **Other:** n/a –	Fault not confirmed/ not found may not mean that the aircraft is fault free. It may mean, that the fault is appearing under specific conditions, especially if it already happened. For this, a proper system knowledge and understanding of the defect interpretation, together with historical fault check is primordial. Otherwise, even if it looks clear, a potential unsafe aircraft can be dispatched for further operation. **Resolution of the repetitive defects:** – OEM involvement, identification of the fault code (with OEM help) and effective maintenance action: IDG replacement. – For the proper teardown of the problem (identify that the fault code 145 is linked to IDG frequency control and then internal parts might causing this problem) requires OEM expertise. – After such involvement of OEM, a prompt answer towards the CAMO and Part-145 is required: replace the IDG. – The in-depth understanding and correlation between events are not part of the TSM and cannot be solely linked to Part-145 organization. This requires a better system understanding and engineering overview which can be part of the CAMO but mainly this expertise is only on the OEM side. **Other:** -
Proposed mitigating actions for the identified safety gaps	– Identification as repetitive ; MIS needs to be able to highlight RF (particularly on critical systems) – Awareness on assessment of the of criticality	1. The occurrence safety criticality must be considered during establishment of repetitive defect handling procedure. 2. A sub-process can be established that requires historical fault check on the aircraft, depending on safety criticality, to identify potential latent hazards in the system. N.B. As a result of this incident, Airbus has improved their TSM by incorporating steps to direct maintenance towards a direct extraction of the post flight report (PFR) and troubleshooting data (TSD) from the GCUs.
Already existing mitigating actions that may need enhancement	– Improve awareness in TSM to deal with repetitive faults	TSM – clearer guidance for operator personnel on the action to be taken if a fault is not found.

8.9 Airbus A321, G-POWN, Titan Airways, 26.02.2020

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
AAIB 1/2021	United Kingdom	26.02.2020	Incident	Airbus A321/ G-POWN/ Titan Airways

Event summary/ Key elements	**Event summary:** – The aircraft just underwent a biocide shock treatment on its fuel system further to a moderate microbial contamination that was detected during scheduled maintenance. – Following this treatment using Kathon biocide, abnormalities with the operation of both engines occurred several flights before the incident. – Incident flight: at around 500 ft, the No 1 engine began to surge… then later, the crew received indications that the No 2 engine had stalled. The crew established that the engines were more stable at low thrust settings and that those settings were sufficient to maintain a safe flightpath. They continued the approach. The aircraft landed uneventfully. **Key elements of the report related to the management of repetitive defects:** Mainly communication between crews of successive flights and with tech engineers & maintenance – Two legs with issue(s) before incident flight. • Leg -3: Crew A, contacted engineer for advice and briefed crew B on arrival about issue experienced at engine 1 start • Leg -2: n/a, Engines functioned normally. • Leg -1: Crew B notified the operator using ACARS. Eng 1 needed three start cycles. Later, "Eng 2 stall" twice experienced during descent. Mayday. On ground, technical control contacted by phone, issue recorded in TLB. Crew B liaised with crew A & with tech. engineer, No fault found, engine stall defect and certificate of release signed off • nb: inappropriate procedure (TSM) applied. • Commander A mentioned he would check engine control indications before take-off by accelerating engines to 50% N1 for longer than usual. – Incident flight • Eng 1 start issues. Crew A contacted technical control. Engine 1 started at third attempt. Crew A contacted technical control again who advised certainly due to ignition fault that should be resolved once engine running. • Engine control indications checked ok, take off commenced…Engine 1 surging…. engine 2 stall…	**Event summary:** The aircraft took off from London Gatwick Airport Runway 26L at 0009 hrs on 26 February 2020. At ~500 ft AGL, #1 (left) engine began to surge. The commander declared a MAYDAY and turned right downwind for an immediate return to the airport but, shortly afterwards, the crew received indications that the #2 engine had stalled. The crew established that the engines were more stable at low thrust settings and the thrust available at those settings was sufficient to maintain a safe flightpath. They continued the approach and the aircraft landed at 0020 hrs. **Key elements of the report related to the management of repetitive defects:** – ECAM alerts that do not provide the flight crew and maintenance personnel with a clear correlation to the actual root cause of the fault. – Assumption that the fault condition does not longer existing if an ECAM alert self-clears, as stated in the OEM's Flight Crew Techniques Manual (FCTM).
Safety gap analysis towards	**Identification of repetitive defects:** – Crews A & B seemed aware of a potentially developing situation, they had exchanges about aircraft recent & current status and also shared with technical engineer and line maintenance. Yet, all issues at engine start were not recorded in TLB. – Line engineer not aware of recent base maintenance and history of start failures on the flights following the maintenance	**Identification of repetitive defects:** ENG X HP FUEL VALVE - ECAM alert ENG X STALL - ECAM alert **Notification/ communication of repetitive defects:** Via aircraft technical logbook and verbally to the flight crew by maintenance personnel.

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
AAIB 1/2021	**United Kingdom**	**26.02.2020**	**Incident**	**Airbus A321/ G-POWN/ Titan Airways**

	– The Technical Control engineer expected that if there was a fault, a fault message or indication problems would occur and the pilots would return to stand **Notification/ communication of repetitive defects:** – Incomplete record in TLB. – Assumption by technical on pilot decision to return to stand if failure reoccurred. **Repetitive defects as hazards to flight safety:** – Common cause affecting redundant critical systems. – Contamination with undissolved Kathon induced repetition of same faults **Resolution of the repetitive defects:** n/a **Other:** Assessment of a previous engine 1 start problem as “a start fault, nothing more than that” by technical control engineer. Too little background information available.	**Repetitive defects as hazards to flight safety:** Engine related fault due to out of specification fuel, resulting in partial loss of thrust of both engines simultaneously. **Resolution of the repetitive defects:** Replacement and/ or servicing of parts contaminated by excessive concentrations of biocide in fuel. Removal of fuel with excessive biocide concentration from aircraft fuel tanks and associated decontamination tasks. **Other:** N/A
Proposed mitigating actions for the identified safety gaps	None	– If enough doubt exists where a non-standard procedure is considered necessary e.g., an engine run prior to take-off on a commercial flight, this should raise flag with flight crew and maintenance personnel that troubleshooting must be continued prior to dispatch. – Review guidance in the OEM’s FCTM that currently states that the fault condition does not longer existing if an ECAM alert self-clears. Consider adding specific guidance that all faults, even those that self-clear or are reset successfully must be entered in the aircraft technical logbook. – Consider guidance to explain that ECAM alerts are generated by sensors that only measure effect, and do not necessarily provide flight crew and maintenance personnel with a clear means to determine root cause at time of failure and thus may be a barrier to optimal decision making. This must be carefully worded so as not to instil doubt of the certified reliability of the ECAM system. – Consider analysis by OEM for any additional guidance/ troubleshooting for fault indications that could be manifestation of root cause that can potentially affect multiple redundant systems, e.g., fuel contamination.
Already existing mitigating actions that may need enhancement	Awareness in TLB	The fuel contamination caused abnormal fuel flow values during the engine starts during the event and preceding flights that were not evident to the flight crew or maintenance personnel. This parameter should be considered in the post-flight analysis of engine/ flight data as potentially useful indicator of fuel contamination. Although engine/ flight data analysis is already in place, an enhancement would be to have a quicker turnaround of the analysis, such that it can be part of the Line maintenance real-time troubleshooting tools, rather than only a long-term trend analysis. With the advent of wide availability of AI, this

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
AAIB 1/2021	United Kingdom	26.02.2020	Incident	Airbus A321/ G-POWN/ Titan Airways
				methodology may be used on an ever-increasing number of parameters that modern aircraft record.

8.10 Boeing 737-500, PK-CLC, PT Sriwijaya Air, 09.01.2021

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.21.01.01.04	Indonesia	09.01.2021	Accident	Boeing 737-500/ PK-CLC / PT Sriwijaya Air

Event summary/ Key elements

Event summary:

- During climbing, the autopilot (A/P) directional control was changed from LNAV to HDG SEL and subsequently the vertical control changed to Pitch V/S and MCP (Mode Control Panel) SPD. These changes required less engine thrust therefore the engine power reduced. The FDR recorded that left thrust lever moved backward and the left engine thrust decreased, however the right engine remained at its climb power setting, resulting in an asymmetric thrust condition. The investigation concluded that the autothrottle (A/T) system command being unable to move right thrust lever was a result of friction or binding within the mechanical system except the torque switch mechanism. The maintenance record showed that the A/T problem was reported 65 times since 2013 and the problem was unsolved and still exist on the accident flight.
- The Cruise Thrust Split Monitor (CTSM) system delayed disengaging the A/T and the thrust asymmetry continued to increase. The investigation believed that the delay of CTSM was due to an error in the spoiler signal value.
- As the thrust asymmetry became greater, the aircraft turned to the left instead of to the right as intended. The aircraft entered an upset condition, and the pilot was unable to recover the situation. Inadequate of upset prevention and recovery training contributed to the inability of the pilot to prevent and recover from the upset condition.

Key elements of the report related to the management of repetitive defects:

- The aircraft was delivered to the Sriwijaya Air in 2012. The investigation noted that the since 2013 until the accident flight, there were 65 problems related to the A/T system reported.
- The engineer's actions in attempting to address the reported A/T problem were dominated by cleaning the connectors (48%). Replacements of several components were also performed. The aircraft maintenance log (AML) recorded replacement of right engine, however the A/T problems still occurred, this showed that the problem was not related to the engine. The engineer actions did not solve the problem.
- The AML also recorded 61 problems related to the difference of engine parameters between left and right engines, including 32 times of A/T disengagement. Most of the differences in the engine parameters were reported during the aircraft on descent. The AML also recorded the lack of thrust lever movement of the right engine as follow:
  - Six pilot reports related to slow response of the right thrust lever to flight idle during descent.
  - Two pilot reports related to the right thrust lever hard to move.
- The lack response or hard to move the right thrust lever indicated that the thrust control cable experienced friction or binding within the mechanical system. A high enough friction force occurring in the throttle control cable can cause the torque switch to open and the throttle lever stopped being moved by the A/T system until the friction force is reduced.

Safety gap analysis towards

Identification of repetitive defects:

- Since 2013 until the accident flight, the AML data recorded 65 pilot reports related to the A/T system and 61 problems related to the differences in engine parameters. The AML record showed that 48% of the A/T system maintenance actions involved cleaning of the electrical connectors.
- The connector cleaning is part of the Electronic Wiring Interconnection System (EWIS) preliminary action however, the connector cleaning might have become a habit during the rectification as it is the easiest rectification action and appeared to be successful. Some of the reported problem appeared to be solved after the connector cleaning performed. The AML record showed that after the engineer had cleaned the electrical connector, the BITE test was performed which showed the result of 'no faults'.
- If the cleaning of the electrical connectors did not solve the A/T system problem, the Flight Management Computer (FMC) Control Display Unit (CDU) provides tools for thorough trouble shooting as directed by the Aircraft Maintenance Manual (AMM). The use of FMC CDU is part of AMM trouble shooting therefore, the AMM reference must be included in the AML as required in the Sriwijaya Air Aircraft Maintenance Procedure (AMP). The 'no faults' results might had been generated by the A/T computer that did not find any fault in the computer nor any electrical power connection to the A/T computer and not considered the reliability of the information from each component of the A/T system. The maintenance actions were stopped after the BITE test resulted 'no faults'.
- Among the 61 pilot reports relating to the differences in engine parameters, more than 53 reports occurred during the aircraft descent. The differences in engine parameters during aircraft descent and the right thrust lever late on the take-off roll while the A/T engaged, most likely might have resulted in the thrust levers split.
- The Quick Access Recorder (QAR) data recorded 7 thrust levers split occurrences between 2020 and 2021. No pilot reported on these occurrences in the AML. Most of the pilots stated that they did not recall the occurrences.
- Based on the maintenance history the engineer referring to the AMM chapter 22-04-10 (A/T System BITE Trouble Shooting) showed a frequency of 18%, while the engineers referring to the AMM chapter 22-31-00 (A/T System – Description and Operation) was 25%. None of the maintenance history recorded the performance of the AMM chapter 71-00-49 (Power Plant – Trouble Shooting (Engine Controls)) trouble shooting procedure for aircraft experiencing thrust lever that is unable to move during A/T engagement.

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.21.01.01.04	Indonesia	09.01.2021	Accident	Boeing 737-500/ PK-CLC / PT Sriwijaya Air

- If the FMC CDU INTERACTIVE TEST was performed for thrust lever movement problem during the A/T system engagement will result to FWD LOOP or THROT SPLIT fault messages. The subsequent trouble shooting steps would use procedure contained in the AMM chapter 71-00-49 (Power Plant–- Trouble Shooting (Engine Controls)). Similarly, for pilot report of thrust lever split event, the same troubleshooting step should also be in accordance with the procedure in AMM chapter 71-00-49, which contained maintenance steps to check the friction of the engine control cable.
- Therefore, the termination of the trouble shooting after the BITE test result of 'no faults' and without the pilot report of thrust lever split, resulted in the engineers stopped the trouble shooting steps and not proceed to examine the engine thrust control as required in AMM chapter 71-00-49. This is likely the reason why the defect prolonged.

Notification/ communication of repetitive defects:
- It is likely that line maintenance engineers were not made aware of the recurring A/T problem on this aircraft and have been performing the BITE test to clear the defect.
- As such further trouble shooting efforts should be initiated by MCC who has been monitoring for recurring defects under its maintenance management program.
- However, the monitoring efforts by MCC did not appear to have raised awareness amongst the line maintenance engineers of the recurring A/T defect and the additional trouble shooting steps in the "INTERACTIVE TEST" function in the FMC CDU menu.

Repetitive defects as hazards to flight safety:
- Not addressed in the investigation report (ref. other for SMS).

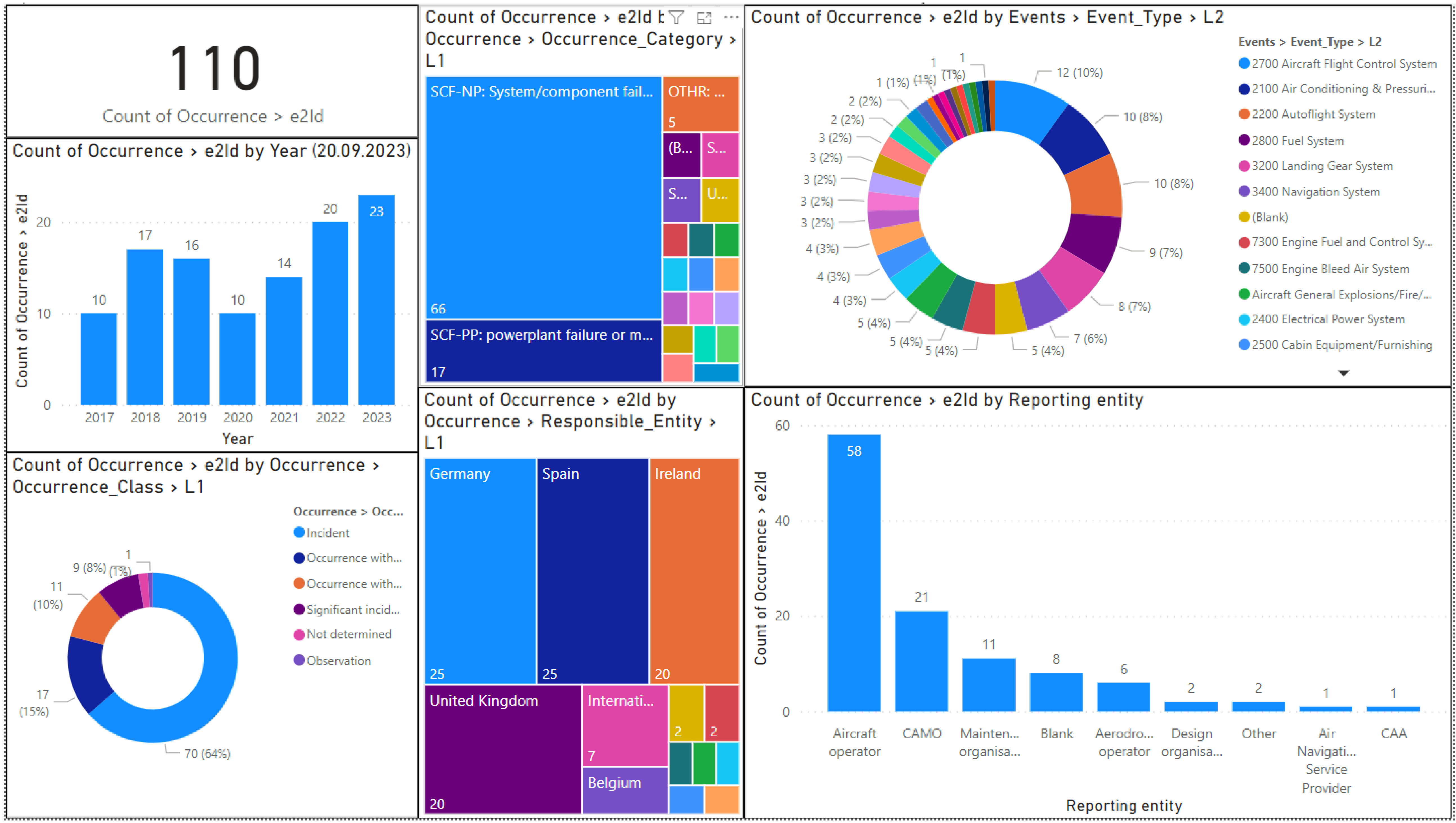
Resolution of the repetitive defects:
- Maintenance records indicated that rectifications performed by line maintenance engineers of similar problem since 2013 were by carrying out a BITE test. After the BITE test result showed 'no faults', the engineers stopped the trouble shooting process and signed off the defect without progressing to the steps of carrying out the 'INTERACTIVE TEST' in the FMC CDU menu.
- The Sriwijaya Air maintenance management established the MCC which has responsibilities including monitoring the defect and DMI rectification. The progress of DMI rectification was recorded and monitored through DMI control/summary. The DMI control/summary was collected and review by the MCC on daily and weekly basis. MCC should have a process in place to identify and definitively resolve recurring maintenance issues.
- It is evident that the recurring defect monitoring efforts under the maintenance management program has not been implemented effectively given the prolonged unsolved A/T defect on the accident aircraft.

Other:
- The investigation received samples of hazard reporting in the period of 2020 which consisted of 565 hazard reports. The evaluation of these data showed that majority of the hazard were reported by ground personnel. Few hazards were reported by pilots and maintenance personnel and there was no hazard report by dispatchers. This unbalance composition of the hazard reporters is likely an indication that the hazard reporting program has not been emphasized to all employees which could result in hazards not identified and properly mitigated.
- The evidence of low rate of FDAP data analysis, unbalance composition of hazard reporters, and the lack of detail in the hazard identification suggested that Sriwijaya Air safety management system (SMS) has not been implemented effectively.

Proposed mitigating actions for the identified safety gaps
- Promote the importance of fault isolating/ troubleshooting instead of fault clearance
- Improve communication CAMO/ AMO/ DAH
- Address repetitive defects as hazard to flight safety
- Implement automation for fault/ failure reporting to populate the aircraft technical logbook

Report number	State/ Area of occurrence	UTC date	Occurrence class	Aircraft type/ aircraft registration/ operator
KNKT.21.01.01.04	Indonesia	09.01.2021	Accident	Boeing 737-500/ PK-CLC / PT Sriwijaya Air
Already existing mitigating actions that may need enhancement	– CAMO repetitive defects management			

9 SIA APPENDIX C - Repetitive defects ECR dashboard (dated 20.09.2023)



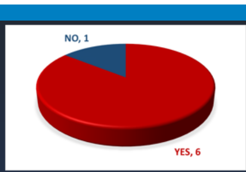
An agency of the European Union

10 SIA APPENDIX D - Delphi study results

Results of the Delphi study (Working Group Members)

1st ROUND RESPONSES

Q1. Do you think there should be a definition of repetitive defect in the regulations / guidance material published by the regulators?



With regards to the above question, could you please explain the reasoning behind your choice? Also, we would be grateful if you can share - if you have one - the definition that you use to identify repetitive defects, and whether you consider repetitive defects on a single registration or across the fleet.

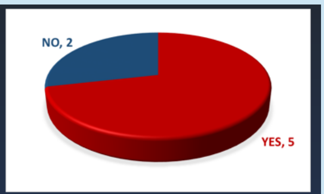
1	Repetitive defects always mean: Poorly repaired spare parts Overloaded material Incorrectly assessed vibrations
2	
3	The reason is for my view on a guidance is to enable a standardisation of the term, which will help to establish a common understanding across the industry. In general, this is tracked for a registration as a BAU but fleet wide similar issues are also picked up in our company as a repeat issue. There are multiple sources of information feed to detect repeat defects and each one of them has a logic for picking up repeat defects. The 3 main sources are the AMOS 'Repeat tracking module', The AirMan and an email feed from a BI server.
4	For distinguishing them from hard faults, and also for clarifying it is not a reliability issue. Repetitive failures are of specific nature. They need to be identified as such (repetitive). Once identified, they often need extra effort for being troubleshot and fixed rapidly. As they are not hard or permanent ones, not confirmed on ground, they need specific care and handling and to do so, they are differently addressed in tech pub, permanent faults using specific tasks for all monitored failures, intermittent ones are addressed in introductions in a general manner. Repetitive Faults have different naming, "intermittent", "chronic", "repetitive", "recurrent"... we need to clarify our definition or at least the scope and clarify what is in and what out of it. Below is the 'description' rather than a 'definition 'I use in that respect to clarify what we are talking about. Repetitive failures, do repeat along the flights on the same A/C. We are not talking about reliability in general nor chronic failures on a batch of A/C but an issue repeatedly experienced on the same aeroplane. Repetitive failures are not necessarily popping up in strictly consecutive flights. They may 'require' certain conditions like for instance, humidity or T° (humidity possibly leading to water icing in an actuator inducing undue torque), vibrations, that may alter the behaviour of an improper electrical contact, making it unstable,...Also, some need several independent contributors at the same time to trigger. They are often tentatively fixed using computer reset. Most of the time uselessly, sometimes unduly. Occurrences of failures as well as resets are not systematically logged which delays the identification of the failure and of its repetitive nature. This maintains the latent condition longer on aeroplane . I don't think it's desirable to give all of these details in a definition of repetitive failures, but I think they may justify the need for a definition to clarify what sets them apart.
5	One single definition could not fit all cases. Repetitive defect definition will depend on the operation type (cargo vs passenger, short vs long range, regular vs charter, etc.). While definition based on Flight cycles may be appropriate for long range cargo operations or charter operations, a definition based on calendar days may be more appropriate for short range regular operations.
6	Regulation is needed to define the term "repeated defect".
7	Reason is to manage safety similar way foo al operators. Definitions that we use 3 times in 10 days for only single registration. There is NO more definition for same failure occurs across all fleet.

2nd ROUND RESPONSES

Q1. Please refer to the 1st round responses to the question below about a definition of the term 'repetitive defect' to be included in the regulatory publications. Now we would like to hear your final thoughts on this issue considering all the points made by other working group members below.
Guidance material should be published by the regulator that helps to build a standardised approach of defining Repeat defects.
Yes, for a definition. To provide standardization, common understanding and, to distinguish repetitive defects on an individual from reliability. Also, it allows to introduce the notion of hidden/latent failure which induces unexpected increase in time exposure to failures' combination
yes it should be.
A definition for repetitive defect is needed maybe based on best practices of other regulators.

1st ROUND RESPONSES

Q2. Do you think repetitive defects should be subject to 'risk assessment' collectively conducted by flight operations and CAMO?



With regards to the above question, could you please explain the reasoning behind your choice? Also, we would be grateful if you can let us know if you are risk assessing the repetitive defects in a systematic manner considering potential adverse effects on the safety of the flight.

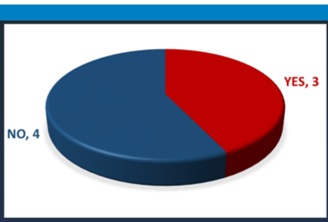
1	Because you have to find out what the cause is when repetitive defects repeat themselves
2	there might be risks to operations which might not be evident for CAMO
3	The above answer is yes but only for those situations where the nature of the defect (or a combination of defects) could have an additional flight safety risk. A point to note here is that all defects are dispatched iaw an approved manual (mostly the MEL), which are risk assessed for the individual system being in-operative.
4	not possible without guidance. And if yes should be limited to critical systems (or potential losses of critical functions)
5	No risk assessment is performed on individual repetitive defects based on my experience.
6	Repeating defects can affect flight safety, one thing is for sure, they make troubleshooting more difficult during maintenance
7	Reason: Every repetitive defect may not be managed same way. For instance, window light and autobrake system repetitive defect can be managed different way. So, risk assessment performed by CAMO ve ops, and results accessible for front personnel(maintenance engineer, pilot, mcc technician). So, they can easily decided-same decided if they encounter ant repetitive defect

2nd ROUND RESPONSES

Q2. Please refer to the 1st round responses to the question below about the risk assessments to be collaboratively conducted by CAMO and Flight Operations. Now we would like to hear your final thoughts on this issue considering all the points made by other working group members below.
Repeat defect management process often involves the OEM - the advice by OEM is risk assessed. In my view the focus should be on timely identification of repeat defect with a defined timeline for a rectification, which should be defined by the criticality of the systems(s) involved. Collective risk assessment by CAMO and flight Ops could be used where the positive fix of the defect can only be confirmed in flight.
Every case will have different criticality. Each deserves being handled with adequate priority. To do so, a risk assessment is needed (for the ones linked to critical functions or systems only?).
CAMO should manage. First of all, ERCS may be performed most common ones that had studied with Pareto by reliability engineering. Some of them can be skipped of course regarding to these risk assessments.
Yes, mostly in defects that have cockpit effect.

1st ROUND RESPONSES

Q3. Do you think the flight crews should be notified of repetitive defects before the flight so that they can consider the potential operational risks?



With regards to the above question on if flight crews should be notified of repetitive defects or not, could you please explain the reasoning behind your choice?

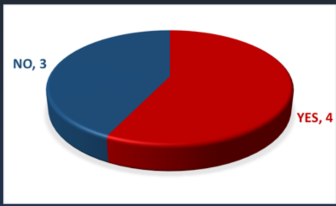
1	The technician declaring the aircraft airworthy should decide to do so
2	Crews need to know if there is any problem (even potential) with the aircraft that they will fly
3	My view is that flight crew should be informed where a feedback of a positive fix is required.
4	too many scenarios to envisage.
5	If the defect is present, it should be notified to the crew as any other aircraft defect. But if the repetitive defect is not present, it should be under investigation and the flight crew should be aware of it so that they can provide further information or to avoid useless repetitive reports of a known issue (depending on CAMO procedure).
6	should only be informed of problems affecting the flight
7	Yes, should be notified but also should be well managed. Because based on my experience, after ops notified, almost every flight same defect will be written to the tech log by captain

2nd ROUND RESPONSES

Q3. Please refer to the 1st round responses to the question below about the notification of flight crews. Now we would like to hear your final thoughts on this issue considering all the points made by other working group members below.
Too many scenarios- so for the process to be practicable, flight crew should be informed where a feedback is required to confirm a positive fix.
No.
Yes of course. MCC or front certfiyimng staff can give sort brief to flight Crew. Or, regarding the CAMO procedure, Flight Ops can easly acces if any defect reported how many times and closed action before further flight.
Yes, flight crew should have full picture of anything that may have operational effect.

1st ROUND RESPONSES

Q4. Do you think repetitive defects should be recorded as 'deferred defects' based on the risk assessment conducted collectively by CAMO and flight ops teams?



With regards to the above question on if repetitive defects should be recorded as deferred defects or not, could you please explain the reasoning behind your choice?

1	This depends on where the repetitive defects are on the aircraft
2	When closed or not turning up again then the repetitive defect is solved and not deferred.
3	My view is that existing defects should not be closed till a positive fix has been established. If the defect cannot be re-produced on the ground, then after troubleshooting attempt (s) a feedback should be requested from the crew and then the defect closed, rather than closing the defect and hoping that is does not repeat.
4	a solid means to ensure limited time exposure and anticipate adequate reaction by the flight crew. Some events show a long-lasting latent situation, then a combination with a second failure followed by inappropriate crew reaction. This would be avoided.
5	The repetitive defect should be recorded as deferred defect because they are not fixed, as the root cause of the failure is not yet identified and corrected. Therefore, the defect should be open (rectification deferred) until the investigation is finished, the root cause identified, the defect fixed, and it is confirmed that it does not reappear in a defined timeframe (FH, FC).
6	"repetitive defects" reports should be kept so that the cause can be found
7	Repetitive defects also recorded deferred item. Otherwise, you miss this. but one point can be added, if you think that you solve the problem, replace the related components. You remove the defer item. But after 2 days the same defect written by captain? So, can we count on it or not?

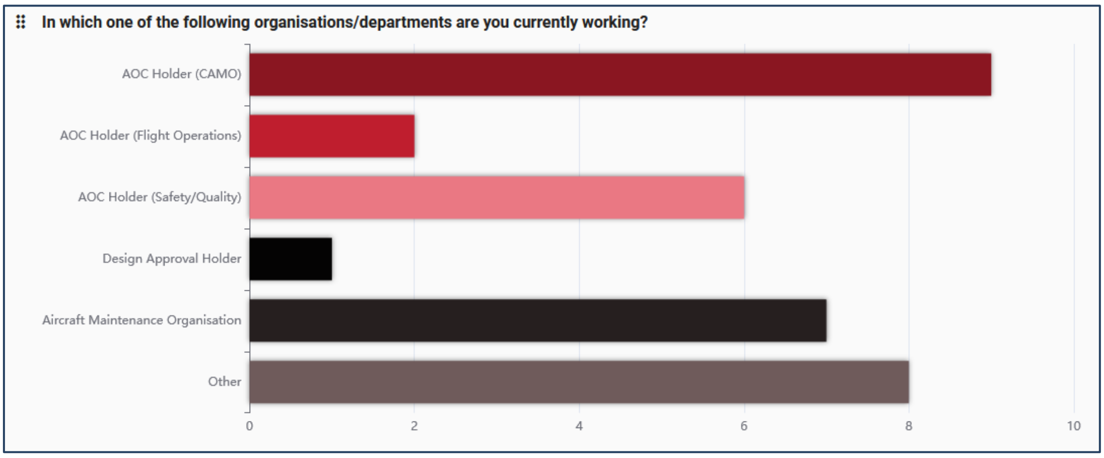
2nd ROUND RESPONSES

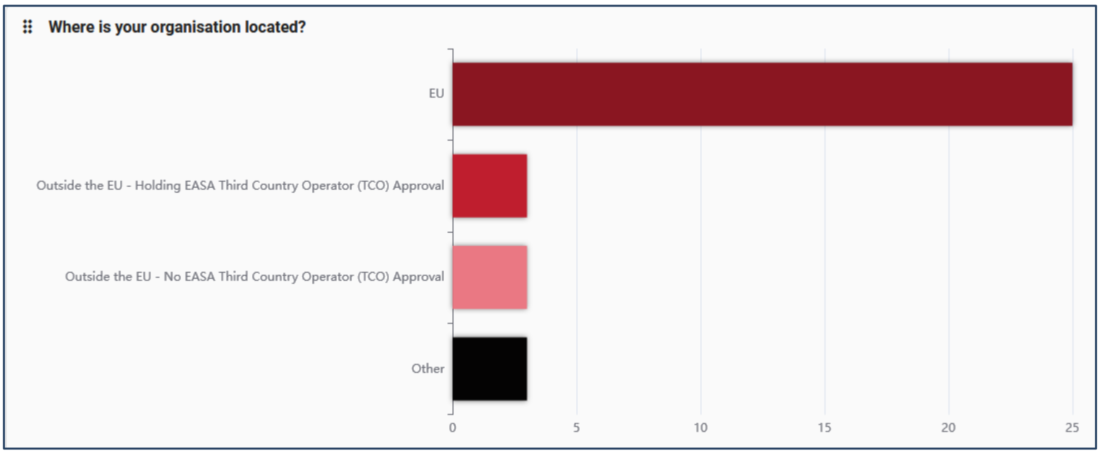
Q3. Please refer to the 1st round responses to the question below about the potential escalation of repetitive defects to deferred defects. Now we would like to hear your final thoughts on this issue considering all the points made by other working group members below.
If a defect repeats, it automatically becomes a deferred defect. Due to the large number of possible scenarios, having a collective assessment is not a practicable solution and would delay the defect rectification. Again, if the defect has repeated 'x' number (as defined in the SPM/ Tech procedure manual) of times within a (defined) certain period then the Repeat defect management process should kick in and should not allow the aircraft to be declared serviceable till a positive fix has been found (if the confirmation of the positive fix is only through a flight report after rectification then the collective assessment can be carried out between CAMO & Flt ops) before the release to flight so that the crew are fully briefed for a feedback).
Yes upon risk assessment by CAMO/Flight crew
DEpends on risk assessment, whether yes or no. After risk assessmnet, maybe further deep investigation can continue with in order to find out root cause.
Yes, there could be a threshold where a repetitive defect becomes a deferred defect to start the MEL rectification interval clock process.

11 SIA APPENDIX E - SenseMaker engagement results

Results of the SenseMaker Engagement
(Experiences of Industry Stakeholders)

DEMOGRAPHICS

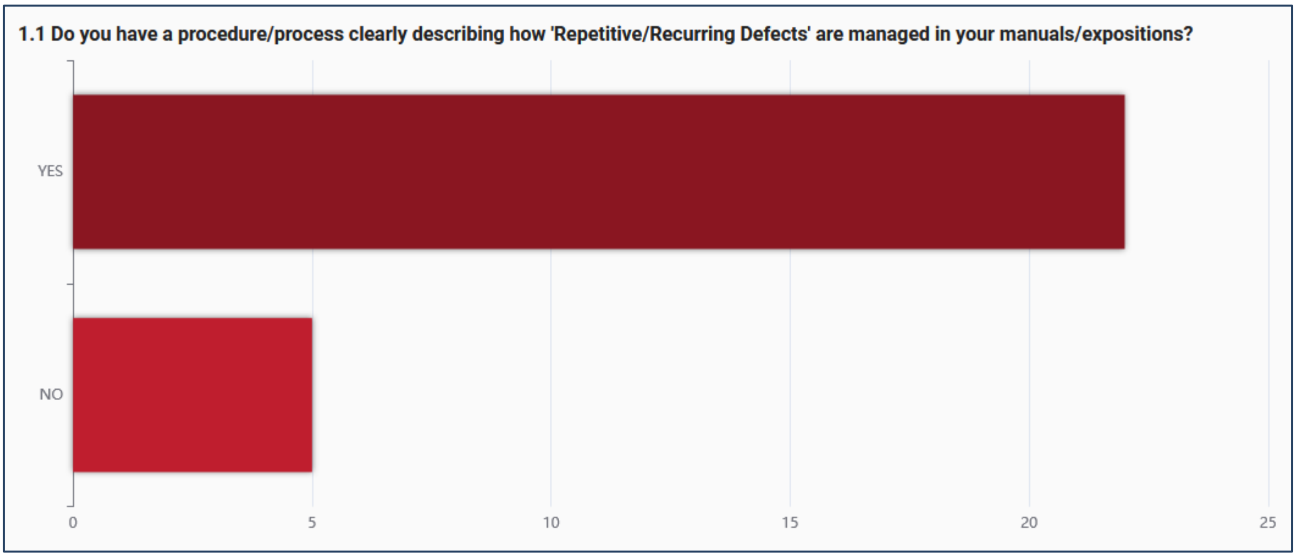




What is the fleet size of your organisation? (If you are working for an AOC Holder, please share your fleet size with us. Otherwise, you can tick N/A)	
90	41
2	54 of A320-232
100	3
7 aircraft.	125 a320 family
23 B787 and 18 B737NG	around 150 a/c with mixture of SR & LR

46 A/C	186x aircraft of A320 Family (A320/320 CEO and NEO) and 1x A330F
1 fleet, 5 aircraft	currently worning on Corporate Safety Quality for Lion Air Group
25	

PART 1 – DEFINITION, PROCESSES & PROCEDURES



1.3 If you have a procedure about repetitive defects, who is responsible for monitoring, making decisions and taking action including - when necessary - 'grounding the aircraft' to carry out extensive troubleshooting and flight testing depending on the associated risks?
It belongs to the responsibility area of maintenance operation control managers.
CAMO Manager advised by his deputy
mcc engineer
Engineering and in some cases, Quality
The responsible is the CAMO production team. MCC is in charge of monitoring and the production engineer is in charge with MCC Manager to define next action taken.
Maintenance Control Center (MCC)
MCC
The Repetitive Defects will be a responsibility of ME department through the Working Group staff in charge during 24/7 hours working shift
The Maintenance Manager together with Quality Department
Troubleshooting Engineer
airworthiness manager
In a first step, mcc department. In second step, in monthly analysis, throught reliability departmen in coordination with operational safety department.
No idea
Maintenance Control Support Group (MCSG) or Technical Services â€“ Powerplants
Maintenance & Engineering department and working group
We only are 145, it's the CAMO responsability
maintenance staff, HT or CFI after FI information about a recurrent problem
Engineer and Quality Control Inspector
We do not have a procedure in the CAMO. Management system is monitoring repetitive defects with internal audits
the engineer and the repeat analyst have responsibility for monitoring the repetitive defect, The Maintenance & Engineering Director has the authority to stop aircraft operations
Quality Division AOC 121 (Quality Inspectors)
Engineer
CAMO CAM
The responsible of monitoring its the Troubleshooting team, and they are planning all the task with MCC, STP and LOG, to check Ground time, Manpower and parts.
A department called "technical support" which depends of Engineering but which has also direct contact with Quality (to assure independence). In case "grounding aircraft is recommended" the decision is taken with AMO and CAMO managers

1.4 How often does your organisation require support from the Type Certificate Holder to resolve a repetitive defect? Also do you sometimes require support from other manufacturers such as systems integrators (i.e. TCH Suppliers) to resolve repetitive defects which have not been rectified despite following the instructions in the fault isolation manuals or troubleshooting manuals published by the TC holder?
It is in very few case, that we require external help. systematic, chronologically well-established troubleshooting contributes to solve the issues. The most difficult part is to establish this chronological order and handover the information to not to perform same task again that did not result any solution or might reintroduce additional defect (e.g.: reinstallation of a not applicable component)
Roughly, once every 3 MO
generally, reliability engineer inform CAMO manager about this issue. at least monthly basis I can say
Very few. Once per year?
We usually can take action without contact the TCH.
Technical support is requested to the TCH or STCH every time the problem is not solved following maintenance manual instructions.
Depends, it is not a usual procedure, but sometimes we need to request support to the a/c manufacturer or (rarely) to the systems integrators
We always contact AIRBUS through our Engineering team if any event occuurs that requires manufactures suggestion
Because of the nature of our business, we don't find this kind of defects
Not very often. Once every 3 Months
Till today never.
Monthly in average
Donâ€™t know
When component change and wiring check failed to rectify the defect, or, the defect cannot be replicated on ground
whenever we have difficulties to solve the problem, even though the TSM and other manual has been followed, we always contact the manufacturer. as well as other manufacturers such as Pratt and Whitney for IAE engine issues.
One Time or Repetitive Inspection in compliance with Service Bulletins or Airworthiness Directives will be authorized by Engineering Authorization to direct the accomplishment
Unknown, but not a usual practise
not sure how many times the frequency, but for some recurring problems that have not been resolved, it is usually communicated / consulted with technical representatives from either TC Holder or TCH suppliers

1.4 How often does your organisation require support from the Type Certificate Holder to resolve a repetitive defect? Also do you sometimes require support from other manufacturers such as systems integrators (i.e. TCH Suppliers) to resolve repetitive defects which have not been rectified despite following the instructions in the fault isolation manuals or troubleshooting manuals published by the TC holder?
It is in very few case, that we require external help. systematic, chronologically well-established troubleshooting contributes to solve the issues. The most difficult part is to establish this chronological order and handover the information to not to perform same task again that did not result any solution or might reintroduce additional defect (e.g.: reinstallation of a not applicable component)
Roughly, once every 3 MO
generally, reliability engineer inform CAMO manager about this issue. at least monthly basis I can say
Very few. Once per year?
We usually can take action without contact the TCH.
Technical support is requested to the TCH or STCH every time the problem is not solved following maintenance manual instructions.
Depends, it is not a usual procedure, but sometimes we need to request support to the a/c manufacturer or (rarely) to the systems integrators
We always contact AIRBUS through our Engineering team if any event occuurs that requires manufactures suggestion
Because of the nature of our business, we don't find this kind of defects
Not very often. Once every 3 Months
Till today never.
Monthly in average
Donâ€™t know
When component change and wiring check failed to rectify the defect, or. the defect cannot be replicated on ground
whenever we have difficulties to solve the problem, even though the TSM and other manual has been followed, we always contact the manufacturer. as well as other manufacturers such as Pratt and Whitney for IAE engine issues.
One Time or Repetitive Inspection in compliance with Service Bulletins or Airworthiness Directives will be authorized by Engineering Authorization to direct the accomplishment
Unknown, but not a usual practise
not sure how many times the frequency, but for some recurring problems that have not been resolved, it is usually communicated / consulted with technical representatives from either TC Holder or TCH suppliers

1.5 Do you have a procedure / process to notify flight crew about 'Repetitive/Recurring Defects' (Note that deferred defects in accordance with the MEL are fully different from repetitive/ recurrent defects, and are not meant here)?
Yes, there is a procedure in place in our electronic technical logbook.
No
Generally, captains only see deferred items before flight. If repetitive defect still open item according to MEL, captain see it. But if we remove the repetitive defects item from logbook. and record it for monitoring purpose to another log. The captain cannot see it.
Not to my knowledge
Yes, we have.
As far as I've been able to see, there is no specific procedure to notify the flight crew about repetitive defects in our manuals
No
Not sure if we have a flow process for it but the point is.. if the repetitive defect not covered by MEL, we have to grounded the aircraft for deep troubleshooting process/comprehensive rectification according to internal policy (Safety notices)
Yes
No
No
No
Yes, we put in Notice to Crew on the T/Log for defects which Highlight any ongoing defect which may cause an operational effect. The crew must always follow the FCOM procedures and not to deviate from it. ii. Request the flight crew to record the event in the technical log or record a snapshot using the aircraft systems.
Yes, we do
Usually emails. Operational Circular if needed
Yes, Flight crews can view DMI through the Crew link website (under the title information) using their private computer / connected device any time before they arrive at the FLOPS. In FLOPS desk, any DMI reported by MCC for a particular aircraft and for the day, are presented in A4 papers clipped and bundled so it can be viewed for pilot FLOPS preflight briefing. â€¢ Any applicable DMI is also directly reported by MCC in the cockpit for pilot preflight briefing. and if there's not available in MEL Crew must be fill the defect to the Aircraft Flight Maintenance Log sheet
No
Lion Group issued policy where crew shall check the history of aircraft on the AFML more depth and more detail, as much as possible, to catch up the repeated and solving problem were made by Engineer.

1.6 Do you think, notification of 'repetitive/recurring defects' can help flight crew to be prepared for certain operational risk scenarios or if it would confuse them or increase their workload?
We have evident reports when flight crew was prepared to this based on similar occurrences or open repetitive defect worksheets that were visible for them in the technical log. Example: performance recalculations before landing related to normal braking defect. They, well in advance, requested longer final approach.
I do. In my opinion that is the aircraft logbook shall be always on board and the flight shall verify the last entrances before starting the floght
If they know the possible/suspicios failure, of course this action prevent confusion.
It will confuse them and increase workload
We think that it is important to maintain the crew as much informed as possible.
I think it would be useful.
OUR MCC INFORM TO THE FLIGHT CREW IF ONE DEFECT COULD BE CONSIDERED REPETITIVE
Of course, it is and it have to
Yes
Of course, it will help flight crew
YES
Would confuse them or increase their workload
It can help
It would increase their workload but can also help them to be prepared for risk scenarios.
Yes
Would confuse them.. Due repetitive it's a preventive maintenance, if not the repetitive will be a MEL item.
It`s positive if operation can be affected
I think it might be risky and can contribute to mislead the flight crew, thinking that it is the same problem when it might be not. The flight crew must strictly follow their approved procedures with an open mind.
prepared for certain operational risk scenarios

1.7 If you wish to share any other thoughts about the above questions, please do not hesitate to include them below
No.
Both Technical and operations department shall work together to address this issue. The problem solving cannot be entirely on the CAMO side
repetitive defect cannot think only same fault for same registration. There should be another definition
No comments.
It is an area that we always oversight.
We, as an MRO, contribute possitively to this subject, and this is highly appreciated by our customers.
I think that procedure for repetitive defects should be implemented on all companies
We also have a back saying policy in our MEL such that when the defect reoccurs within 2 sectors after defect clearance, the engineer will raise the ADD as per MEL but backdating to the original defect raise date.
The CAMO should have a good and proper control of the repetitive defects (register or similar) and share in a mandatory way to the 145 Organizations that work with them
We face several meeting about repetitive defecs, that are defects related to the operation of the A/C, as placards in bad conidtions, screws loose, etc.. Those defects are "normal" during A/C operation.
Based on experience, we have had good results dedicating specific resources to collect and order aircraft repetitive failures. Initially we could obtain graph per aircraft with repetitive failures that follow criteria such as: Pireps/Mareps repeated more than 3 times in X days. In such cases most of times an AMO working 24H and several shifts have many difficulties to detect this repeativity. In these cases, this methodology is capable of detecting such faults and notifying the maintenance team
I suggest to focus on the proper training and experience in the maintenance organizations personal (technician and engineering department) that deal with repetitive faults/defects

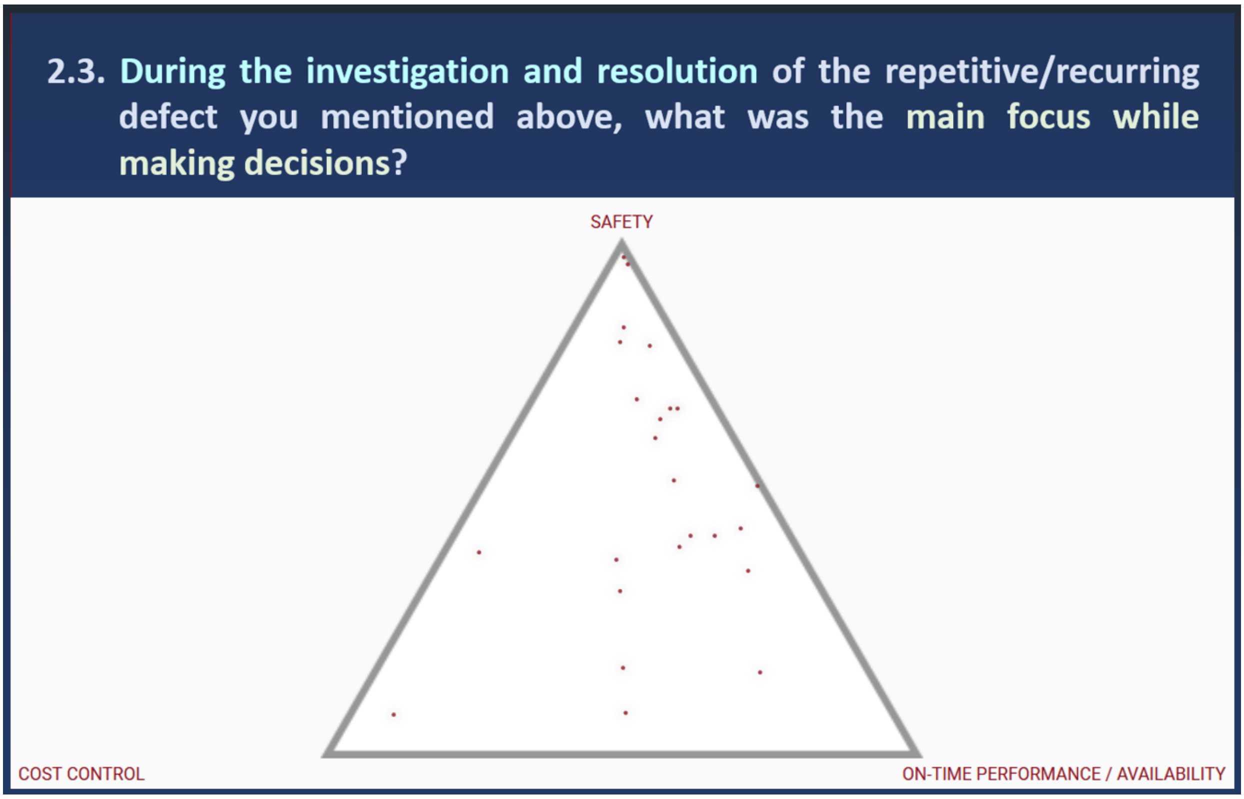
PART 3 – SHARED EXPERIENCES ON MANAGEMENT OF REPETITIVE DEFECTS

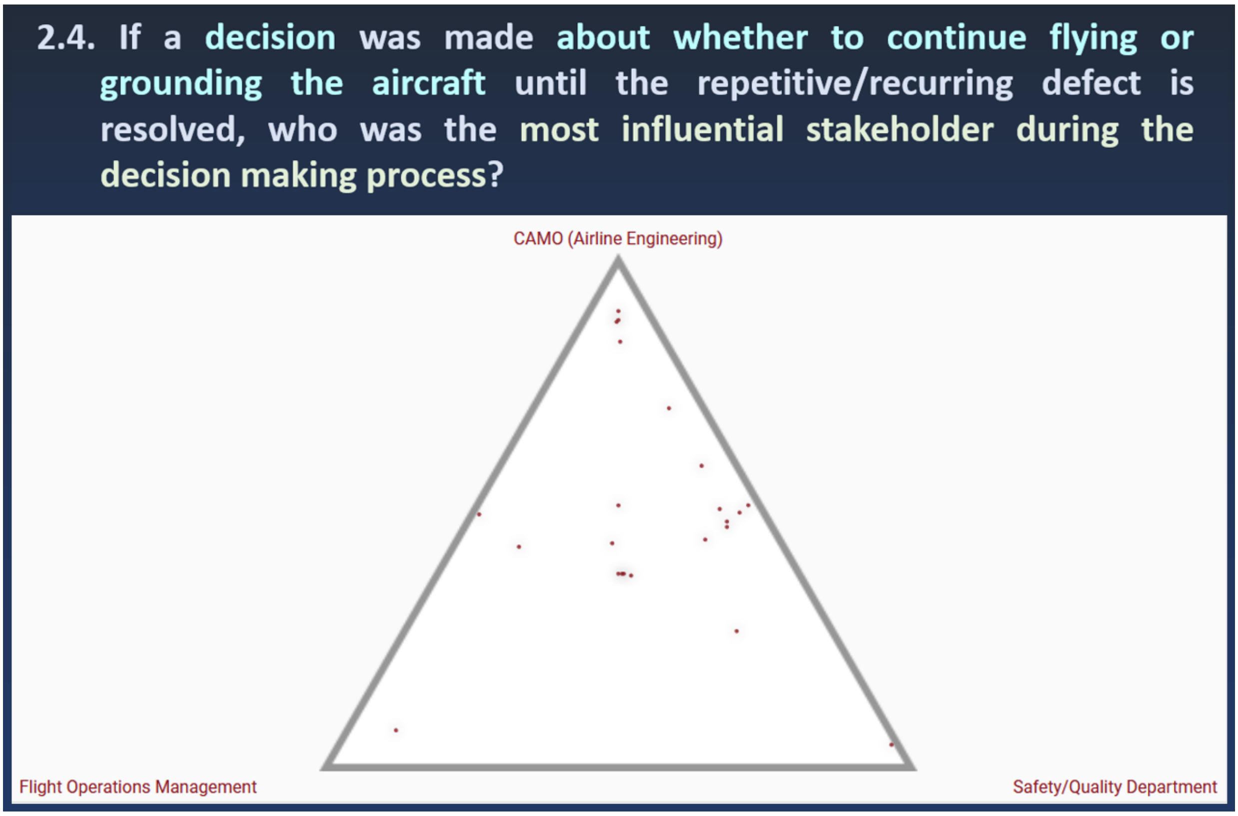
#	Please share one of you lived experiences about repetitive defects.This could be an example of 'lessons learned from an incident or near miss' event or it could also be a positive example where a successful outcome was achieved. Ideally this should be a repetitive/recurring defect in a system that may pontetially pose a considerable operational risk to flight safety. In your shared experience differing views and opinions might have been raised by different people involved. i.e. whether to ground the aircraft or raise a 'deferred defect' until the repetitive defect is satisfactorily resolved.
1	We are currently reviewing several repetitive defect investigations that might have a common root cause. We are operating uniquely Airbus A320 family aircraft, these cases are linked to this type. One important topic for this common cause is the correct modification status of the aircraft which is primordial for eliminating recurrent fault messages coming from non-approved configuration (example: overpressure valve) or less robust MOD configuration (outflow valve and CPC1&2 for loss of pressurization control). Some reoccurring defects might be eliminated from the repetitive defect category because those are procedural non-compliances but at first attempt, looks to be system defects. Example: smell/smoke issues due to APU bleed oil contamination. The contributing factor is the APU oil servicing but the real root cause is the incorrect shut down procedure of the APU by flight crew/maintenance crew.
2	As an example, i could state a GPS constantly loosing signal. On ground all tests were passed and only in cruise conditions the problem appeared.
3	Actually after bad outcomes, repetitive defects much moret strictly monitoring and especialy pre determine MEL Ä±tems, Ä±f front engineers recognize that ther is a repetititve Ä±tem, WE count on the aircraft as an AOG.
4	We had two cases of incorrect clamping of wires, causing smoke in one aircraft.
5	We faced a "flaps disagree" repetitive event in our B737 fleet, during the approach flight phase. This event resulted in an interruption of the flaps movement and a consequent risk to the crew to land with an improper flaps configuration. The difficulty here was that our maintenance staff was not able to reproduce the fault after landing and the checks were always passed. Manufacturer recommendations were followed and the problem seems to be solved. However, this situation caused some worries among the crews for a while.
6	FLAP ISSUE IN 737 FLEET
7	In our Fleet, there was an Airbus A320 experienced an Emergency Descent due to Air Pack Regul 1 and 2 Fault. The Investigation revealed that before the incident there were some repetitive defect regarding Air Pack Regul 1 and just rectified by reset/OPS test only! There was no control regarding that Repetitive Defect from ME due to change of organization effect. Eventually, the problem became a Major failure and resulting to an incident when the other Air pack Regul (no. 2) was failed as well.
8	A320 with FUEL LH XFR VALVE OPEN repetitive ECAM message Followed Troubleshooting Manual TSM 28-15-00-810-819 and LH TANK XFR VALVE 11QP shown in transit. According TSM many components replaced such as ACT 11QP, RELAYS 5QP, 6QP, 13QP, DIDOE MOD 1158VD , FQIC , FLSCU 1&2 , but FAULT persist. Aircraft moved to main base to perform deeper troubleshooting. During last troubleshooting, found wire broken. After repair performed, FAULT disappeared.
9	We found severe corrosion happened on a component due contact between some parts. Contacted the OEM regarding the subject and offered a solution to avoid this corrosion to reproduce. OEM approved and we shared this information with the affected airlines. So far this solution has proved to be effective and no longer have faced severe corrosion that may cause this component to fail on the aircraft
10	Aircraft with repetitive defects on fumes and air conditioning issues

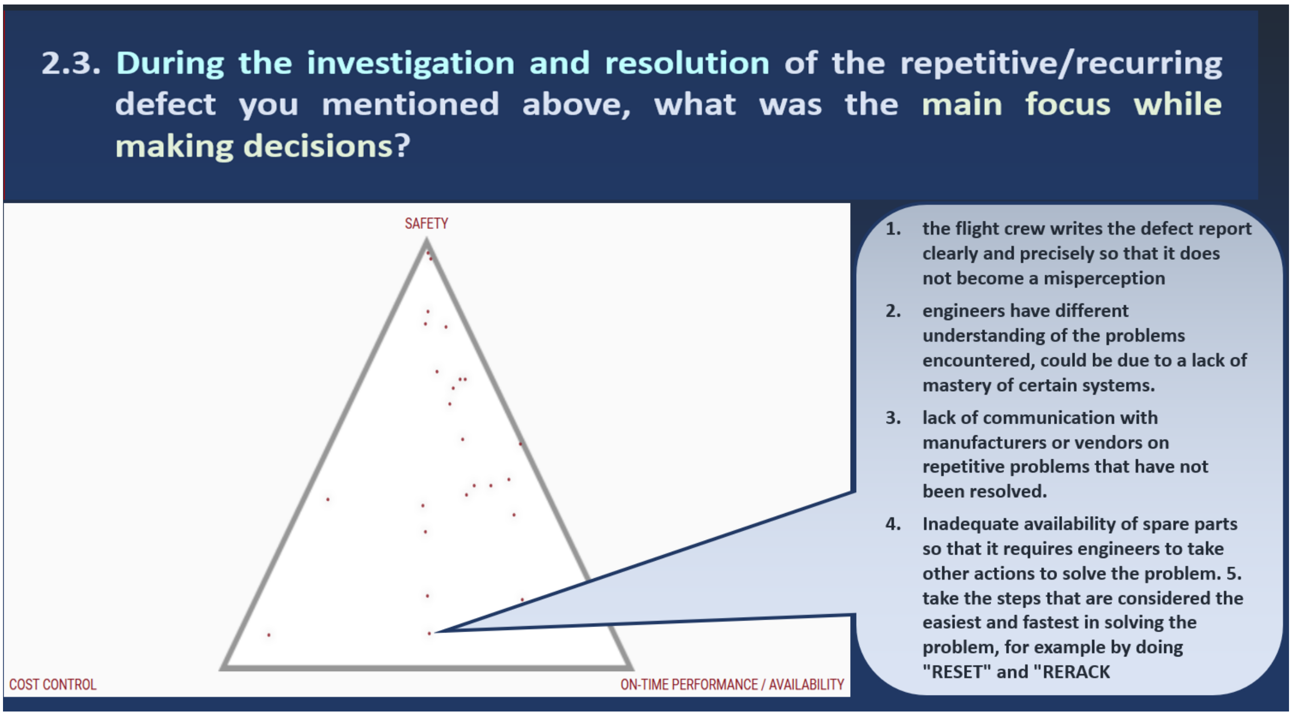
11	In one case, we got a pressurization issue on an aircraft which ground T/S didn't find any issue. The engineer pressurized the a/c and neither find any leak in door area. On the next departure, same issue occurs and caused in flight return. Further pressurization test found ducting repurtured in the aircon bay.
12	30 May 2023, PK-SAH Msn 5230 has several reports from flight crew related to Eng 2 EPR always fluctuated inflight in several legs, in the same day, TSM TASK 71-00-00-810-833-A has been followed by replacement of PRV Eng 2. 31 May 2023, problem still exist, Aircraft considered stopped for maintenance action, as per TSM TASK 71-00-00-810-833-A, replaced SOLENOID-BLEED PRESS REG V CTL, ENG 2 (10HA2) Ref. AMM 36-11-55-000-001 and Ref. AMM 36-11-55-400-001. REF AMM TASK 36-11-52-790-010. Do the Leak Test of the Bleed Pressure Regulator Valve (4001HA) with the Engine in Operation Result Ok. 01 June 2023, Aircraft back to operation with NO defect related to Eng 2 EPR always fluctuated inflight.
13	Hopefully in our organization, due to our fleet and operation, this kind of incident are recurrents. Also our aircrafts are reviwed by our maintenance staff every few hours.
14	May be related to Cabin Temperature Hot condition during on the ground and in flight, there's so many complaints regarding this case also we have some cases regarding the Air Pack Regulator fault during flight time. Based on the cases that happen in our company, it cases have potential consequence Illness/injury to or crew and passenger also have operational impact to our company for the example flight delay, return to stand, and air turnback.
15	Escape slides packs electrical harness incorrectly routed during installation. Electrical harness routing corresponding to a RH position and LH position respectively depends on its installation in the aircraft (LH or RH passenger doors). Pack-assembly is interchangeable and can be installed on a left or on a right door. Electrical harness must be pulled out from girt assembly halves in the flight direction. Then, after quick plug connection, harness excess must be stowed inside the Velcro strip according AMM instructions and information marked on slides surface The issue was solved with a deep promotion and training to the maintenance staff

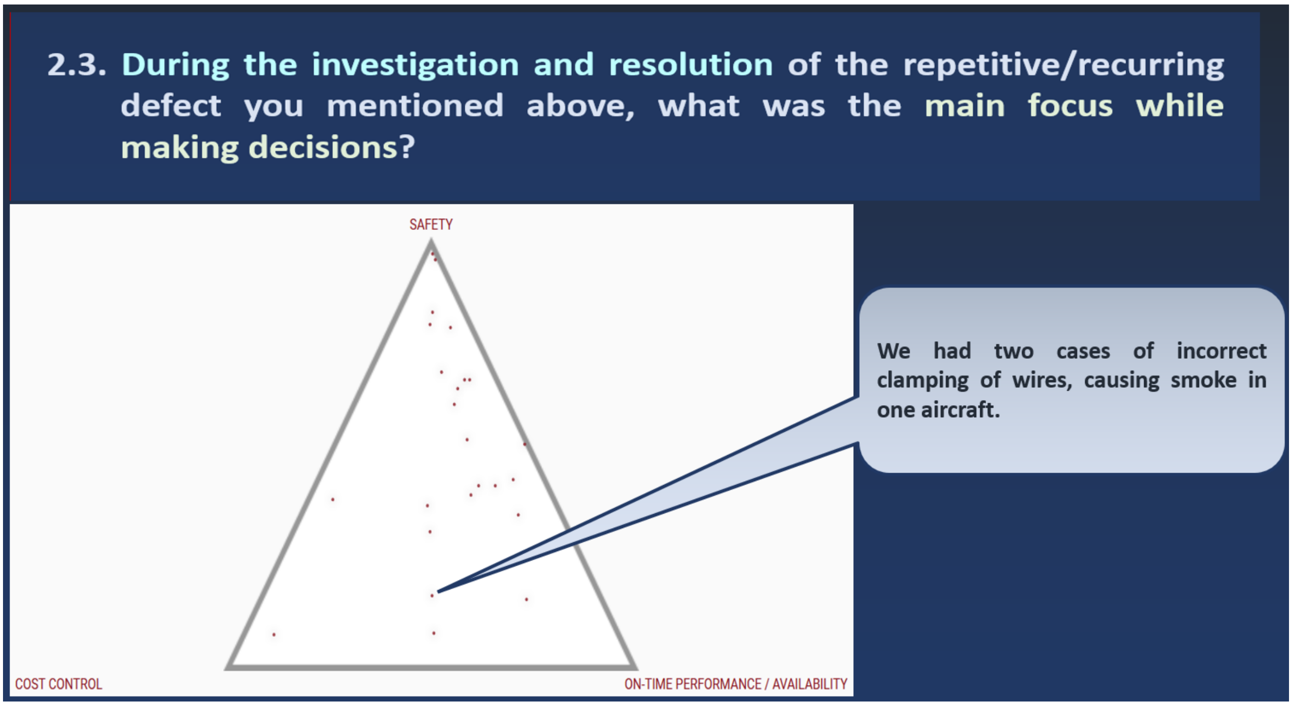
16	1. the flight crew writes the defect report clearly and precisely so that it does not become a misperception 2. engineers have different understanding of the problems encountered, could be due to a lack of mastery of certain systems. 3. lack of communication with manufacturers or vendors on repetitive problems that have not been resolved. 4. Inadequate availability of spare parts so that it requires engineers to take other actions to solve the problem. 5. take the steps that are considered the easiest and fastest in solving the problem, for example by doing "RESET" and "RERACK"
17	Engineer is lack/weak in analyzing the causes of damage (in the trouble shooting process), or lack/weak in mastering the system, so that in the process of solving the damage recurring problems will be repetitive.
18	Raise a deferred defect until the repetitive defect is satisfactory resolved
19	Repetitive defect with a pressure sensor, which was solved by cleaning the sensor but then some flight hours after the indication became to fluctuate again, so the sensor had to be changed after an AOG and cancellation of flights.
20	The most of the examples are to avoid MEL and AOGs, never to avoid an incident or near.. Last time the repetitive monitoring its following the parts already replaced and were Fail on Fit.. The problems last times are with the parts arrived. Its difficult to follow any repetitive fault if you are not sure about new part already installed,.

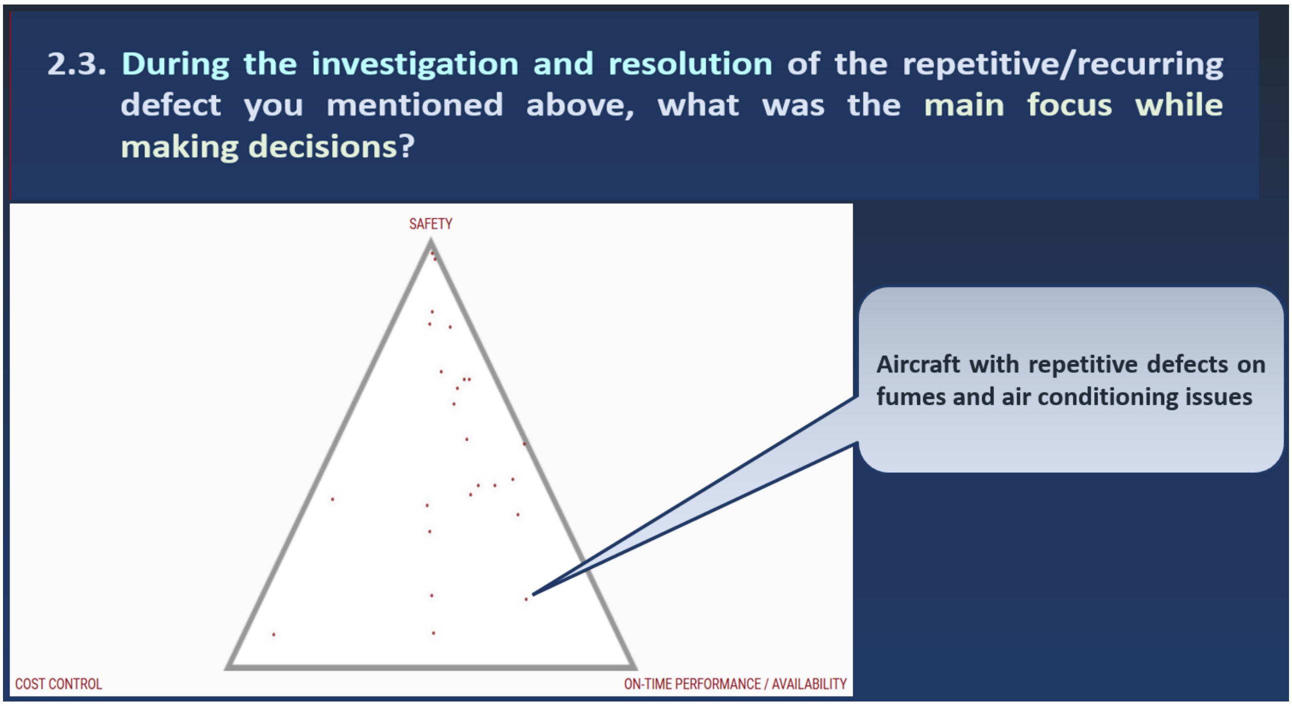
21	We create monthly graphs by plane in which with very basic criteria of the type: if a fault (Pireps+Mareps) is repeated more than 3 times in a given period of time, it is considered a possible repetitive fault. Once the data has been collected, they are classified into 2 groups: those with high repetitiveness (more than 2 or 3 times per week) and low repetitiveness (repeat less than 2 or 3 times per week). In the first case they are usually under the knowledge of the Maintenance or Line Manager and in this case they are already under their control, and then not exposed in the graph. For those of less frequency, they usually go unnoticed and are the ones that are taken to the graph. Their history is investigated (even several months ago) and in general it is usually found that they have been appearing for several months but not detected. All the repetitive failures for said aircraft are noted on the graph. Each fault type in a color with an indication of when each fault occurs and the maintenance action carried out, so that it is known what has not been successful. These charts are published monthly and shared with maintenance staff.
22	I work on an aviation authority. From my experience, many times organizations that have the automatic alerts focus only on the strict definition of Deferred Defects (X reports in Y days) and try to solve that "single" recurring defect based only on these X reports, without going back in time to search for related issues that could help on the analysis. It happened that a component was replaced 5 times in 6 months, but it seemed there were no conexion between them, because apparently, the change solved the problem for several weeks and a new count started. They were treated isolated from the rest. It might not happen in small organization, with few aircraft in the fleet. It usually rings a bell on someone.
23	Good communication about defect symphoms, troubleshooting actions performed between technicians and technical support department. Important keep all technicians informed about previous steps done to avoid repetition When requesting TCH assistance provide as much details possible.

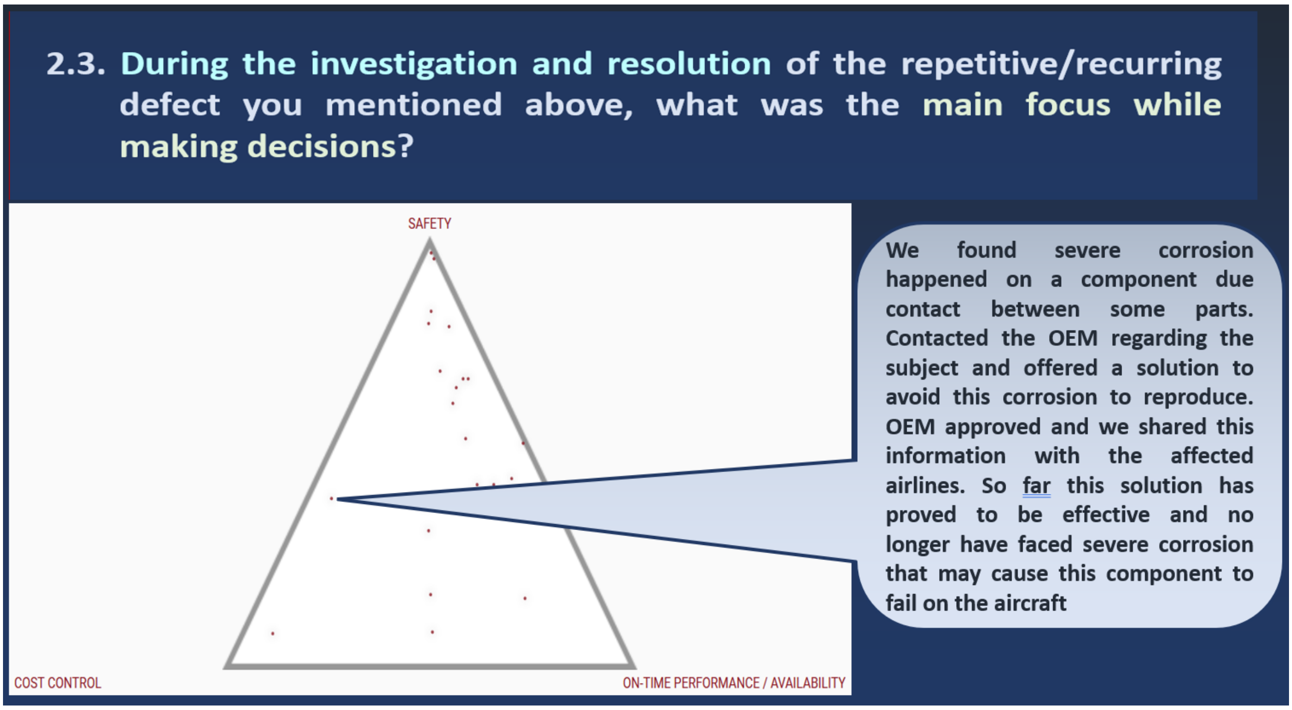


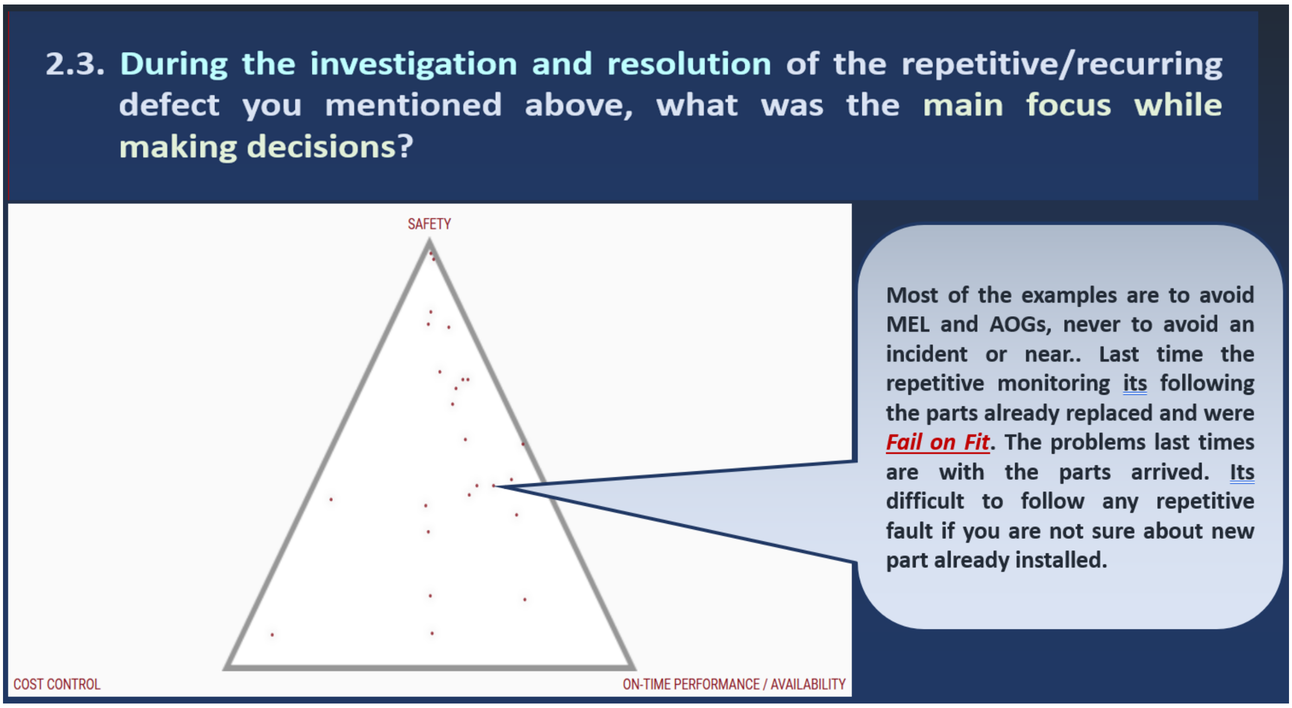

2.4. If a decision was made about whether to continue flying or grounding the aircraft until the repetitive/recurring defect is resolved, who was the most influential stakeholder during the decision making process?
CAMO (Airline Engineering)
Flight Operations Management
Safety/Quality Department


2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?
SAFETY
COST CONTROL
ON-TIME PERFORMANCE / AVAILABILITY
1. the flight crew writes the defect report clearly and precisely so that it does not become a misperception
2. engineers have different understanding of the problems encountered, could be due to a lack of mastery of certain systems.
3. lack of communication with manufacturers or vendors on repetitive problems that have not been resolved.
4. Inadequate availability of spare parts so that it requires engineers to take other actions to solve the problem. 5. take the steps that are considered the easiest and fastest in solving the problem, for example by doing "RESET" and "RERACK

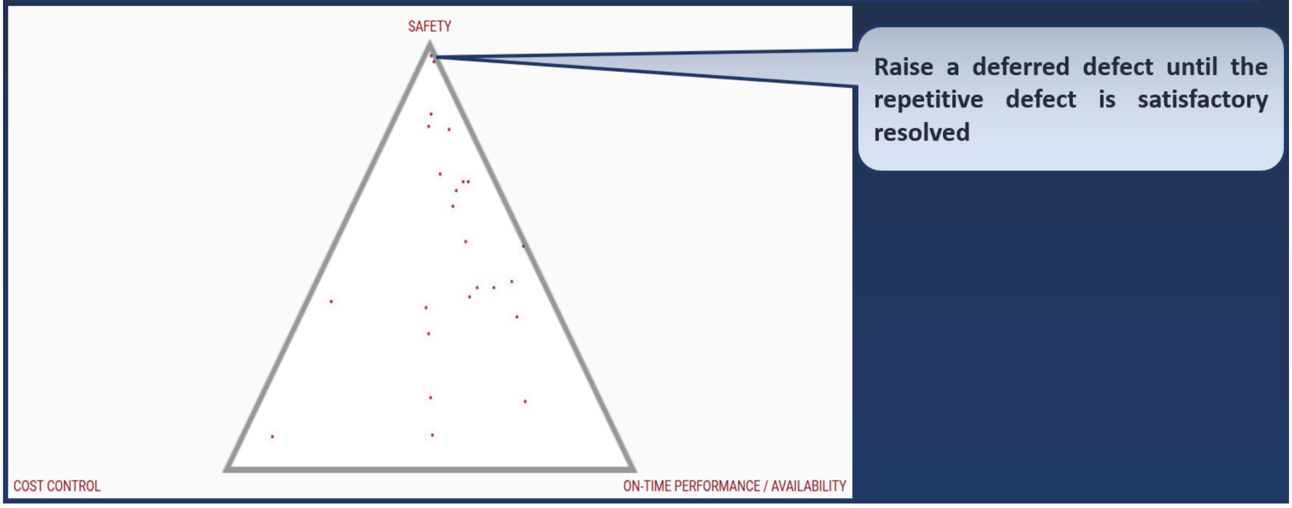

2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?
SAFETY
COST CONTROL
ON-TIME PERFORMANCE / AVAILABILITY
We had two cases of incorrect clamping of wires, causing smoke in one aircraft.


2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?
SAFETY
COST CONTROL
ON-TIME PERFORMANCE / AVAILABILITY
Aircraft with repetitive defects on fumes and air conditioning issues

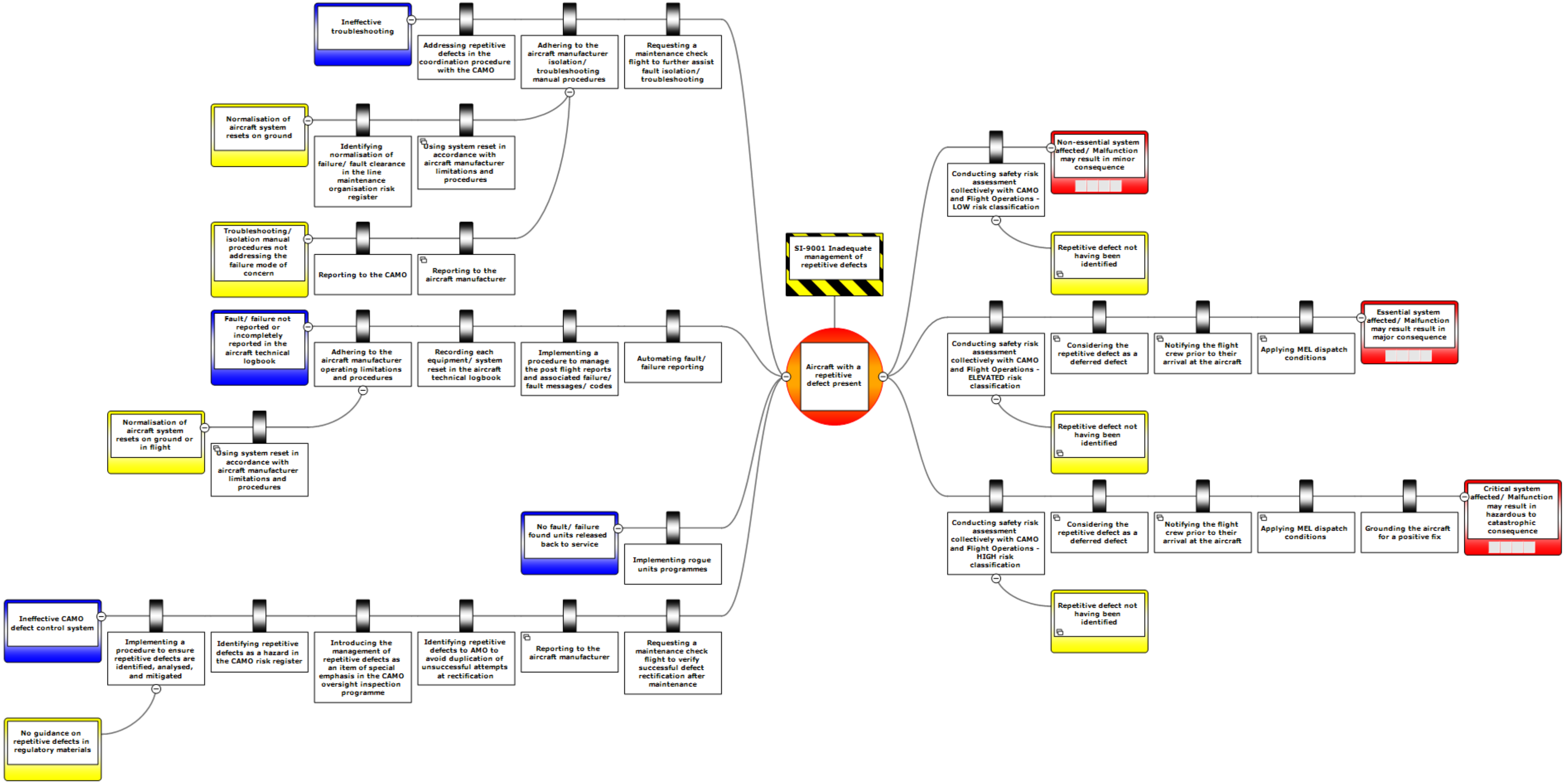

2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?
SAFETY
COST CONTROL
ON-TIME PERFORMANCE / AVAILABILITY
We found severe corrosion happened on a component due contact between some parts. Contacted the OEM regarding the subject and offered a solution to avoid this corrosion to reproduce. OEM approved and we shared this information with the affected airlines. So far this solution has proved to be effective and no longer have faced severe corrosion that may cause this component to fail on the aircraft


2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?
SAFETY
COST CONTROL
ON-TIME PERFORMANCE / AVAILABILITY
Most of the examples are to avoid MEL and AOGs, never to avoid an incident or near.. Last time the repetitive monitoring its following the parts already replaced and were Fail on Fit. The problems last times are with the parts arrived. Its difficult to follow any repetitive fault if you are not sure about new part already installed.

2.3. During the investigation and resolution of the repetitive/recurring defect you mentioned above, what was the main focus while making decisions?



12 SIA APPENDIX F - Bowtie diagram



Best Intervention Strategy with Safety Issue Assessment
SI-9001 - Inadequate management of repetitive defects

Annex B: Detailed definition of the proposed actions

The SIA recommendations in Annex A, section 4.2, were reviewed to confirm their scope. It resulted in slight amendments to improve their description without change to their initial intended objective.

1 RM - Development of guidance material for repetitive defects

The discussions within the working group and the results of the Delphi study clearly indicated that not necessarily a very prescriptive definition such as the statements in the TCCA regulations but a guidance on how CAMOs should consider repetitive defects would be beneficial for all stakeholders, incl. identification, coordination AMO, CAMO, and aircraft manufacturer, risk assessment collectively conducted by CAMO and flight operations, etc.

The guidance should highlight that repetitive defects may present hazard to flight safety and should not be solely addressed by reliability programmes. This will be addressed in the context of the ongoing work for the Rulemaking task 0735 “Regular update of the CAW regulation”.

2 MST - Oversight of CAMOs and AMOs to ensure repetitive defects are effectively managed

- What is the objective of the MST?
    - The main objective is to focus the CA oversight of CAMOs and AMOs to ensure repetitive defects are effectively managed
    - The specific objectives are:
        - to well document as part of CAMOs SMS the hazards and risks associated with repetitive defects which may impact on flight
        - Equally, to well document as part of AMOs SMS the hazards and risks associated with the normalisation of failure/ fault clearance
        - to get coordination procedures between CAMOs and AMOs to address repetitive defects.
        - to ensure that reporting amongst organisations (e.g. also with Design Approval Holder) is to be stressed out, and implementation reviewed, when addressing repetitive defects.
- What is the benefit of this action on MS compared to an action led by EASA (SPT, EVT, RMT)?
    - This is a complementary measure while the regulatory framework is being updated.
    - The benefit is to reduce the safety risks linked to SI-9001 by having through the direct relation “Competent Authority / CAMO/ maintenance organisations under CA oversight” a focus over an oversight cycle of 2 years.
    - This would not be achieved with other types of actions since for the development of this action the Competent Authorities would need to be in the lead for an effective outcome. Indeed it is related to oversight activities that is managed by Competent Authorities.
- What is the expected amount of work for MS to implement the MST?

    - No additional specific workload, it is part of the oversight programme performed by Competent Authorities. It is expected that this action is limited in time.
- Are we not repeating legal obligations on Member States?
    - No. The action’s purpose is not related to legal obligation but rather to providing guidance to Competent Authorities.
- Are we recommending an action that the NAA of a Member States is legally entitled to undertake?
    - Yes since there is a legal obligation to perform oversight.

3 SPT - Promotion of good practices on managing repetitive defects

There are many organisations which implemented robust processes to manage repetitive defects effectively. Nevertheless, the discussions within the working group and the results of the Delphi study have revealed sometimes contrasting views and practices particularly about whether flight crews should be informed about some of the repetitive defects, whether some repetitive defects should be subject to a collective risk assessment and finally, whether sometimes repetitive defects should be treated as deferred defects or not. It can be argued that the differences in opinion on these topics was due to the context and the surrounding circumstances each organisation operates. Therefore, a safety promotion task which aims to explore these differences and share good and innovative ideas would be beneficial for all the other organisations.

Example of practices:

- Communicating that a fault not confirmed/ not found does not mean that the aircraft is airworthy. A proper system knowledge and understanding of the defect interpretation, together with an historical fault check, is primordial.
- Using system resets with caution.
- Recording each equipment/ system reset in the aircraft technical logbook, even when seemingly or perceived as successful.
- Reporting any defect observed by the flight crew, including those that self-clear.
- Adopting common wording between flight crews and maintenance engineers when recording failures/ faults or other events in the aircraft technical logbook.
- Using not only the aircraft technical logbook but also aircraft data through digital tools to monitor and identify repetitions.
- Systematic recording of any troubleshooting manual step performed with results.
- Introducing automation or semi-automation in the reporting of failures and faults based on monitored systems and computers.
- Developing and implementing risk-based approach and procedures to repetitive defects.
- Developing procedures coordinating the different organisations contributing to the management of repetitive defects.
- Timely sharing of information related to aircraft defects, and coordination between the competent authorities for the different domains, e.g., the CAMO competent authority, the Part 145 competent authority and the state of registry competent authority.

Some activities already took place e.g. at the SAFE360 conference 2024: dedicated panel discussion organized to support the promotion of good practices.

Annex C: Safety impacts assessment

1 General introduction for Attachements C and D

Following the European Commission Better Regulation Guidelines[6] and the scope of this impact assessment, it was decided to assess the impacts of each proposed action with the Multi-Criteria Methodology (MCA).

MCA is a method enabling to have per proposed action a score indicating the level of positive or negative impacts. EASA uses scale from -10 (very high negative impacts) to +10 (very high positive impacts) to assess 4 impact assessment criteria in a proportionate manner: safety, environment, social and economic.

The analysis for this BIS focuses on the safety and economic criteria, however social and environment are not relevant for this BIS. The Annex C refers to the safety impacts, while the Annex D refers to the economic impacts.

2 Safety impact methodology

The baseline is to start from the Safety Issue Prioritisaton Index (SIPI) score with the objective to assess to which extent the SIPI is expected to be reduced (i.e. safety is expected to be improved).
This assessment is performed per proposed action through 4 sub-criteria:

- Level of direct expected impact on the Safety Issue
    - This criteria is directly related to the residual risk SIPI score component which evaluates the effectiveness of the current technical, organizational and human factors/human performance barriers.
- Level of additional safety impacts on other Safety Issues
- Level of outreach of the stakeholders
- Level of enhancement of the monitoring of this Safety Issue

[6] https://commission.europa.eu/law/law-making-process/better-regulation/better-regulation-guidelines-and-toolbox_en

3 Results of the safety impact assessment per subcriteria

	Safety scale for	*SI-9001 - Inadequate management of repetitive defects*					
					SIPI score for the component "residual risk"		*3.7*
					SI category		*Mitigate - Define*
	Mitigation actions	**Action #01**		**Action #02**		**Action #03**	
	Title	*Guidance material for repetitive defects*		*Oversight of CAMOs and AMOs on the management of repetitive defects*		*Good practices on managing repetitive defects*	
Sub criteria	***Type of EPAS action***	*RMT*	*Comment*	*MST*	*Comment*	*SPT*	*Comment*
#01	**Direct expected Safety Impact**	5	It will provide clarification on repetitive defects, identification, and management thereof (not limited to reliability programme as it is today)	5	It will raise the focus of competent authorities oversight activities to ensure repetitive defects are effectively managed. This focus is expected for the next oversight cycle.	4	It will enable to share good practices from industry and regulatory stakeholders on how repetitive defects are identified, monitored, resolved, and documented as a key safety risk, as part of their SMS.
#02	**Additional safety impact on other Safety Issues**	0	No link with other Safety Issues	0	No link with other Safety Issues	0	No link with other Safety Issues
#03	**Relevant Domain Outreach**	9.5	CAMOs and CAs are the main addressees of this action. Maintenance Organisations contracted by CAMOs should also benefit from this GM, as it will address the interface between both types of organisations.	6.3	CAs are the main addressee of this action. CAs will have focussed oversight questions on this safety issue. CAMOs and Maintenance Organisations will be subject to these audits.	5.8	A specific publication on best practices regarding maintenance safety issues will address a wide scope of stakeholders, including aircraft operators (i.e. flight crew), and therefore wider than actions 1 and 2.
#04	**Enhancing Monitoring Capacity**	5	The clarification on the definition of repetitive defects will enable a better monitoring of the safety issue by facilitating the identification, and management thereof (not limited to reliability programme as it is today)	8	Through CAs focussed oversight on this safety issue, the immediate effect will be to get more feedback on this safety issue, i.e. improving the monitoring. CAMOs and Maintenance Organisations will be subject to these audits.	2.8	A specific publication on best practices regarding maintenance safety issues may support stakeholders to better monitor this safety issue.
Impact between -10 and +10		**4.9**		**4.9**		**3.3**	
Estimation of the impact of the action on the residual risk		1.8		1.8		1.2	
Expected residual risk SIPI score (New)		1.9		1.9		2.5	
Qualitative statement on the impact		MEDIUM IMPACT		MEDIUM IMPACT		LOW IMPACT	

4 Subcriteria#1 - Direct expected Safety Impact

12.1 General guidelines

This criteria combines 2 dimensions: the level of expected severity of a SI and the expected level of effectiveness of the proposed action.

3 levels of severity are defined:

Table 1 - Severity	
Level	**Consequences**
S1	Fatal accident and/or loss of aircraft
S2	Accident with injuries / repairable aircraft
S3	Occurrence without casualties / no damage to the aircraft

For SRM driven BIS, the level of severity is always S1 as the selected SIs for SIA are based on the highest SIPI scores, i.e. potentially safety events which could end with fatalities or loss of the aircraft.

4 levels of action effectiveness are defined:

	bowtie	Effect	Description
Prevention	left	Eliminate	Complete elimination of the hazard
Prevention	left	Prevent	Reduction of the likelihood that the hazard will occur
Mitigation	right	Control	Reduction of the likelihood that the hazard results in an accident
Mitigation	right	Reduce Damage	Reduction of damage if an accident does occur

The combination of the 2 dimensions provides this template table, starting point of the impac analysis:

Scores	S1 –Fatal accident and/or loss of aircraft	S2 - Accident with injuries / repairable aicraft	S3 - Occurrence without casualties / negligible damage to the aircraft	Type of Barriers impacted by the safety action Tech, Org, HF (positive or negative)
10	*Eliminate*			
9				
8		*Eliminate*		
7	*Prevent*			
6		*Prevent*	*Eliminate*	
5				
4	*Control*	*Control*	*Prevent*	
3				
2			*Control*	
1	*Reduce Damage*	*Reduce Damage*	*Reduce Damage*	
-10 to 0	*Theoretical score, impossible in practice for these sub-criteria*			

By setting maximum scores depending on the level of severity, this enables to have a common reference for any BIS or Impact Assessment performed at rulemaking stage.

12.2 Direct expected safety benefits on the proposed actions

Action #01 - RMT - Guidance material for repetitive defects					
Scores	S1 –Fatal accident and/or loss of aircraft	S2 - Accident with injuries / repairable aicraft	S3 - Occurrence without casualties / negligible damage to the aircraft	Type of Barriers impacted by the safety action Tech, Org, HF (positive or negative)	Comments
10	☐				
9	☐				
8	☐	☐			
7	☐	☐			
6	☐	☐	☐		
5	☐	☐	☐	2)ORG	It will provide clarification on repetitive defects, identification, and management thereof (not limited to reliability programme as it is today)
4	☐	☐	☐		
3	☐	☐	☐		
2	☐	☐	☐		
1	☐	☐	☐		
-10 to 0	*Theoretical score, impossible in practice for these sub-criteria*				

Action #02 - MST - Oversight of CAMOs and AMOs on the management of repetitive defects					
Scores	S1 –Fatal accident and/or loss of aircraft	S2 - Accident with injuries / repairable aicraft	S3 - Occurrence without casualties / negligible damage to the aircraft	Type of Barriers impacted by the safety action Tech, Org, HF (positive or negative)	Comments
10	☐				
9	☐				
8	☐	☐			
7	☐	☐			
6	☐	☐	☐		
5	☐	☐	☐	2)ORG	It will raise the focus of competent authorities oversight activities to ensure repetitive defects are effectively managed. This focus is expected for the next oversight cycle.
4	☐	☐	☐		
3	☐	☐	☐		
2	☐	☐	☐		
1	☐	☐	☐		
-10 to 0	*Theoretical score, impossible in practice for these sub-criteria*				

Scores	S1 –Fatal accident and/or loss of aircraft	S2 - Accident with injuries / repairable aicraft	S3 - Occurrence without casualties / negligible damage to the aircraft	Type of Barriers impacted by the safety action Tech, Org, HF (positive or negative)	Comments
10	□				
9	□				
8	□	□			
7	□	□			
6	□	□	□		
5	□	□	□		
4	□	□	□	2)ORG	It will enable to share good practices from industry and regulatory stakeholders on how repetitive defects are identified, monitored, resolved, and documented as a key safety risk, as part of their SMS.
3	□	□	□		
2	□	□	□		
1	□	□	□		
-10 to 0	*Theoretical score, impossible in practice for these sub-criteria*				

5 Subcriteria#2: Additional safety impacts on other Safety Issues

The objective of this sub-criteria is to determine the potential positive or negative impact of mitigation actions on other risk portfolios within the EPAS or related Safety Issues: "Does the action have side effects on the other Safety Issues. Positive or Negative?"

The SI-9001 Inadequate Management of Repetitive Defects has no connection with other Safety Issues.
#3: Therefore this criteria is not relevant for this impact assessment.

6 Subcriteria#3: Relevant Domain Outreach

The objective of this sub-criteria is to measure the scope of mitigation actions by addressing the generic question, “To what extent does the action reach the relevant stakeholders impacted by the safety action?”.

Action #01 - RMT - Guidance material for repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
CAMO	10	GM is referring to CAMO requirements
National Competent Authorities	9	GM is not linked to an authority requirement directly

Action #02 - MST - Oversight of CAMOs and AMOs on the management of repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
National Competent Authorities	10	CAs are the main addressee of this action. CAs will have a focussed questions on this safety issue.
CAMO	5	CAMOs will be indirectly subject of the MST through the CA oversight.
Maintenance Organisations	5	MOs will be indirectly subject of the MST through the CA oversight.
CAO	5	CAOs will be indirectly subject of the MST through the CA oversight.

Action #03 - SPT - Good practices on managing repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
CAMO	7	Main addressee of this action
Maintenance Organisations	7	Main addressee of this action
National Competent Authorities	5	Indirect addressee of this action
CAO	5	Indirect addressee of this action
Aircraft Operators (pilots)	5	Indirect addressee of this action

7 Subcriteria#4: Enhancing Monitoring Capacity

The objective of this sub-criteria is to estimate "To what extent the addressees will better (or not) monitor the Safety Issue within the safety action perimeter?".

Action #01 - RMT - Guidance material for repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
National Competent Authorities	5	The clarification on the definition of repetitive defects will enable a better monitoring of the safety issue by facilitating the identification, and management thereof (not limited to reliability programme as it is today)
CAMO	5	

Action #02 - MST - Oversight of CAMOs and AMOs on the management of repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
National Competent Authorities	8	Through CAs focussed oversight on this safety issue, the immediate effect will be to get more feedback on this safety issue, i.e. improving the monitoring. CAMOs and Maintenance Organisations will be subject to these audits.
CAMO	3	Through CAs focussed oversight on this safety issue, the immediate effect will be to get more feedback on this safety issue, i.e. improving the monitoring. CAMOs and Maintenance Organisations being subject to these audits will also pay more attention to this safety issue, and as a side effect it will improve the monitoring
Maintenance Organisations	3	

Action #03 - SPT - Good practices on managing repetitive defects		
Direct stakeholders outreached by the mitigation action	**Estimated impact from -10 to + 10**	**Comments**
National Competent Authorities	4	A specific publication on best practices regarding maintenance safety issues may support stakeholders to better monitor this safety issue.
CAMO	4	
Maintenance Organisations	2	
CAO	2	
Aircraft Operators (pilots)	2	

Annex D: Economic impacts assessment

As per information provided in the Annex C, section 1, the following table provides the assessment of the economic impacts of the proposed actions.

1 General guidelines

On EASA resources, the following analysis was conducted.

For Action 3, the workload for the safety promotion task was assessed according this baseline:

Types of Safety Promotion deliverables	Standard SPT Baseline for resources		
	SPT team hours	SPT mission budget	SPT procurement budget
Campaign (several events, videos, publications, ...)	320	5000	50000
Package (several publications grouped)	80	1500	5000
Publication (e.g. only one short information like a webpage publication on EASA website)	16	0	500
Annual total resources in average for the SPT activity	**1 FTE (1600 hours) for a specific topic**	**30000**	**225 000€**

On top of these resources, the different directorates may need to provide specific inputs for the content of the safety promotion material. An additional workload is also to be estimated based on the consideration that the CT Directorate provides an average annual volume of 2400 hours for safety promotion tasks and FS Directorate provides 4000 hours.

These impacts are measured with a scale from -10 to +10 looking at the resource intensity usage by using this a non-linear scale:

Scale	*Score*	*Share of resources used with a linear scale*	*Share of resources used with a non-linear scale*
Very high	10	100.0%	100.0%
	9	90.0%	80.0%
	8	80.0%	60.0%
High	7	70.0%	40.0%
	6	60.0%	30.0%
Medium	5	50.0%	20.0%
	4	30.0%	15.0%
	3	30.0%	10.0%
Low	2	20.0%	5.0%
	1	10.0%	1.0%
Negligible	0	0.0%	0.0%

Principle behind this non-linear progression of the weights: *Due to the current Agency resources issues, it is important to capture that any additional resource has a significant impact.* *For instance, with a linear scale, an increase of 10% of the workload would get a score 1 of 10, meaning very low negative impact. But with a non-linear scale attributing more importance to this 10% of increase, the workload would get a score 3 out of 10, meaning already a medium negative impact.*

Draft Actions 1 to 3 are assessed in the sections 7.2 and 7.3.

2 Implementation on the draft RMT and MST actions

Draft RMT:
The RMT with 1 to 2 weeks of work on development the technical content has a negligible on the EASA resources. Regarding stakeholders, the GM may create very minor additional work with its implementation in the CAMOs and MOs. This will be compensated by potential higher benefits than the workload impacts by creating efficiency instead remaining with an inefficient management of repetitive defect.

Draft MST
Each oversight cycle has his own focus. There is indeed a part of the preparation of any regular oversight to focus on a specific issue. By focusing on repetitive defects in the next oversight cycle, this will not add any additional hours compared to the standard work as well from Competent Authority side than on Maintenance stakeholders side.

Summary table for draft RMT and MST actions:

Impact between -10 (very negative) and +10 (very positive)

Impact on:	Action #01		Action #02	
	Guidance material for repetitive defects		*Oversight of CAMOs and AMOs on the management of repetitive defects*	
	RMT	*Comment*	*MST*	*Comment*
Affected stakeholders				
Target to support the action implementation	*CAMOs, CAs*		*CA inspectors*	
Final outreach	*Maintenance licence staff*		*CAMOs, MOs, CAOs*	
Economic impact - overall	0	Extremely low resources impact at EASA level and potential benefits to be materialised at a later stage for CAMOs and MOs.	0	Oversight focus integrated in the current oversight workload
EASA resources	*Negligible*	*1 to 2 weeks to develop the GM requirements*	*Negligible*	*Oversight focus integrated in the current oversight workload*
Stakeholders resources	*Negligible*	*The GM may create very minor additional work with its implementation in the CAMOs and MOs. This will be compensated by potential higher benefits than the workload impacts by creating efficiency instead remaining with an inefficient management of repetitive defect.*	*Negligible*	*Oversight focus integrated in the current oversight workload*

3 Implementation on the draft SPT action

The SPT actions belonged to these standard SPT deliverables:

Type of SPT per Action for the SI-9001	Types of Safety Promotion deliverables
Action 3 - Good practices on managing repetitive defects	Publication (e.g. only one short information like a webpage publication on EASA website)

Impact on SPT resources:

Impact	Score		SPT team working hours		SPT mission budget		SPT contract budget		CT ressources		FS ressources		
Total annual ressources =>			1 600 hours		30 000 €		225 000 €		2 400 hours		4 000 hours		
				Action 1		*Action 1*		*Action 1*		*Action 1*		*Action 1*	
Threshold			100.0%		100.0%		100.0%		100.0%		100.0%		
Scale													
Very high	10	100.0%	1 600		30 000		225 000		2 400		4 000		
	9	90.0%	1 440		27 000		202 500		2 160		3 600		
	8	80.0%	1 280		24 000		180 000		1 920		3 200		
High	7	80.0%	1 280		24 000		180 000		1 920		3 200		
	6	60.0%	960		18 000		135 000		1 440		2 400		
Medium	5	40.0%	640		12 000		90 000		960		1 600		
	4	20.0%	320		6 000		45 000		480		800		
Low	3	10.0%	160		3 000		22 500		240		400		
	2	6.0%	96	2	1 800		13 500		144		240		
Very low	1	4.0%	64		1 200		9 000	1	96		160		
Neutral	0	2.0%	32			0	4 500		48	0	80	1	*
											*5 hours for FS1		

The average per action of the above scores provide this overall impact:

Action 1
Good practices on managing repetitive defects
SPT Publication
-0.8
LOW IMPACT