GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

AESA AGENCIA ESTATAL DE SEGURIDAD AÉREA

AGENCIA ESTATAL DE SEGURIDAD AÉREA

METHODOLOGY OF SAFETY ASSESSMENT FOR AERIAL WORKS OPERATORS

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1. INTRODUCTION

The Annual Oversight Plan of the Spanish Aviation Safety and Security Agency (hereinafter referred to as AESA) establishes the regulatory control and oversight activities on civil aviation matters in order to ensure compliance with the regulations in air transport. This Plan shall take into account the priorities established by the Safety Committees of Commercial Air Transport, Aerial Works and General Aviation, Airports and Air Navigation.

The Safety Committees are high-level meetings chaired by the Director of the Agency, in which senior management and experts from AESA oversight units, involved in airworthiness, operational and economic oversight, are represented. The Committees, based on the information available from the safety assessment carried out through these methodologies, analyse and decide on the adoption of measures related to prevention and oversight in their field. They will meet on a scheduled basis at least two times a year.

This document includes the Methodology of Safety Assessment for Aerial Works Operators, as a result of the application of the preventive approach[1] in the field of Aerial Works Operators.

On one hand, the methodology is used to establish the prioritization of actions, including additional oversight activities as well as the necessary reallocation of resources. On the other hand, it facilitates the identification of areas susceptible to supervision, providing useful information to the oversight units for the development of their inspection tasks.

The results of this methodology shall be analysed and evaluated within the Safety Committee of Aerial Works.

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[1] The preventive approach complements the traditional approach, based primarily on compliance and oversight. This new approach is based on performance, risk management and safety assurance, and is process-oriented rather than outcome-oriented.

2. OBJETIVE AND SCOPE

2.1 OBJETIVE

The objectives of this methodology are as follows:

- To establish numerical indicators to determine and measure safety-related parameters, values and evolutions, based on the oversight results of aerial work operators, as well as on events and incidents that occurred during their activities.
- To obtain a periodic image of the operational safety level of each operator.
- To monitor the evolution of safety-related parameters.
- To determine the sector's safety trend.
- To identify the domains and the operators where, an appropriate approach of the oversight activity, could promote an improvement in safety.
- To adjust and focus the Annual Oversight Plan of AESA to the results of this analysis.
- To present the results of the analysis in a graphical, simple and intuitive way.

2.2 SCOPE

This methodology applies to all Operators with operating license who are engaged in aerial works.

The selection of operators is carried out on semiannually, coinciding with the Safety Committee of Aerial Works, in order to use the analyses results to make decisions in this committee.

For the purposes of this methodology, Aerial Works Operators are grouped as follows:

– Specialized Operations Operators – Regulation 965/2012
– Operators with Certificate of Special Operator – RD 750/2014

The separation of the operators in these two groups is due to the different applicable regulations that affect the behavior and the distribution of the indicators.

3. DEFINITION OF INDICATORS

Two types of indicators are used:

- **Technical indicators:** measure of the technical risk of the operator in terms of safety in the different domains in which its activity is:
    - Airworthiness: technical status of the fleet of aircraft engaged by the operator in aerial works, through the age and the heterogeneity of the fleet, the continuing airworthiness management organization and the aircraft airworthiness status.
    - Operations: technical status of the operator and its procedures, its management system, crews, training and operations in flight.
    - Occurrence severity: measures the potential severity of the events and occurrences of the operator, referencing them to its exposure factor measured through the number of aircraft cycles of the operator.
    - Reporting culture: measures the operator's occurrence reporting culture by comparing the events reported by it to those reported by other entities.

- **Operation Risk: measure of the operation risk based on the operator activity and the fleet volume.**

The indicators used in this methodology are the following:

INDICATORS				
TYPE	INDICATOR	SUB-INDICATORR	SCOPE	DATA SOURCE
TECHNICAL	Airworthiness	Age of the fleet	Airworthiness Fleet	Aircraft Registration Air Operator Certificate
		Age of the fleet design	Airworthiness Fleet	Aircraft Registration Air Operator Certificate
		Heterogeneity of the fleet	Airworthiness Fleet	Aircraft Registration Air Operator Certificate
		ACAM Program - Aircraft Continuing Airworthiness Monitoring	Airworthiness Aircrafts	ACAM Program results
		CAMO Program - Continuing Airworthiness Management Organisation	Airworthiness CAMO organisation	CAMO Program results
	Operations	Air Operations Program	Operation Management	AIR OPS Program results
		Bases	Fleet Ground Management	Bases Program results
		Fleet Management	Fleet Management	Aircraft Registration
	Occurrences severity		Safety occurrences Safety culture	ECCAIRS – European Coordination Centre for Accident and Incident Reporting Systems
	Reporting culture		Safety occurrences Safety culture	ECCAIRS – European Coordination Centre for Accident and Incident Reporting Systems
RISK	Operation Risk		Safety	ECCAIRS – European Coordination Centre for Accident and Incident Reporting Systems Aircraft Registration

In the following section the indicators and their formulas are defined.

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3.1 AIRWORTHINESS INDICATOR

AIRWORTHINESS INDICATOR	
Acronym	**Definition**
i_{airw}	The airworthiness indicator is divided into five sub-indicators to cover the different airworthiness and maintenance domains. The following sub-indicators are defined: • Age of the fleet • Design age of the fleet • Heterogeneity of the fleet • ACAM • CAMO

Calculation

The calculation of the airworthiness indicator consists on the weighted combination of the sub-indicators.

SUB INDICATOR	WEIGHTING FACTOR	VALUE
i_{ACAM}^{airw}	fp_{ACAM}^{airw}	0,30
i_{CAMO}^{airw}	fp_{CAMO}^{airw}	0,30
i_{age}^{airw}	fp_{age}^{airw}	0,10
i_{TC}^{airw}	fp_{TC}^{airw}	0,10
i_{het}^{aero}	fp_{het}^{aero}	0,20

Typology	Temporality	Domain
Continuous Compound Quantitative	**Periodicity of the calculation** The indicator is calculated at least two times a year (depending on the frequency of the Committee meetings) **Data selection period** The time period is different for each sub-indicator.	Fleet Airworthiness management

Value Range	Formula
0-5	$i_{airw} = fp_{ACAM}^{airw} \cdot i_{ACAM}^{airw} + fp_{CAMO}^{airw} \cdot i_{CAMO}^{airw} + fp_{age}^{airw} \cdot i_{age}^{airw} + fp_{TC}^{airw} \cdot i_{TC}^{airw} + fp_{het}^{airw} \cdot i_{het}^{airw}$

The sub-indicators in which the airworthiness indicator is composed are defined below.

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3.1.1 AGE OF THE FLEET

AGE OF THE FLEET SUB-INDICATOR

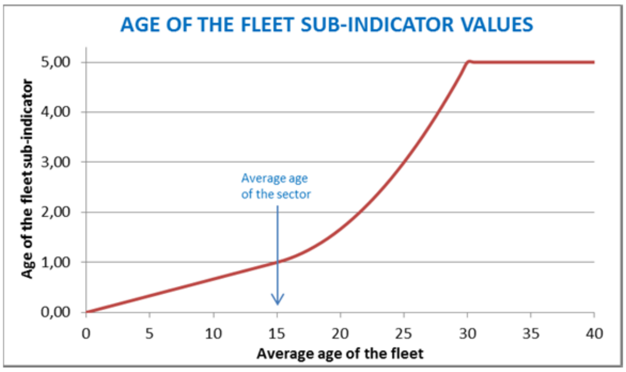
Acronym	Definition
i_{age}^{airw}	Index to compare the average age of an operator's fleet with respect to the average age of all aircraft operating in the same sector. The time elapsed from the manufacture of the aircraft to the time of calculation of the index is defined as the age of the aircraft.

Calculation

The average age of an operator's fleet is calculated and compared to the average age of all aircraft operating in that sector.

Three sections are considered:

- Ages between 0 and the average age of the sector: the variation of the sub-indicator will be linear, taking values between 0 and 1.
- Ages between the average of the sector and two times the averages: the value of the sub-indicator will grow quadratically up to a value of 5 for the average fleet age of two times de average sector fleet age. For the determination of this curve, the slope is kept constant at the point of the sector average and at that point the value of the sub-indicator is 1.
- Ages over two times the average sector fleet age: the value of the sub-indicator will be the maximum, 5.



Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated once a year **Data selection period** Not applicable in this indicator	Airworthiness Fleet

Value Range	Formula
0-5	Being M=Average age of the sector and X= Average age of the operator's aircrafts. If X < M → $i_{age}^{airw} = \frac{X}{M}$ If M<X< 2M → $i_{age}^{airw} = \frac{3}{M^2}x^2 - \frac{5}{M}x + 3$ If 2M<X → $i_{age}^{airw} = 5$

3.1.2 DESIGN AGE OF THE FLEET

DESIGN AGE OF THE FLEET SUB-INDICATOR

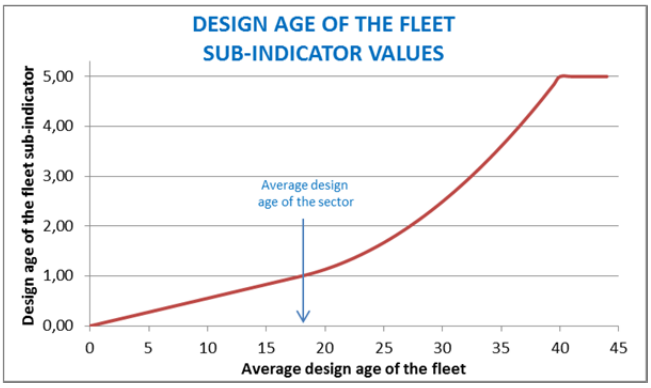
Acronym	Definition
i_{TC}^{airw}	Index to compare the average age of the Type Certificates of an operator's fleet with respect to the average age of all TC of the aircraft operating in the same sector. The time elapsed from the approval of the Type Certificate of the aircraft to the time of calculation of the index is defined as the design age of the aircraft.

Calculation

The average design age of an operator's fleet is calculated and compared to the average designs age of all aircraft operating in that sector.

Three sections are considered:

- Ages between 0 and the average age of the sector: the variation of the sub-indicator will be linear, taking values between 0 and 1.
- Ages between the average of the sector and two times the averages: the value of the sub-indicator will grow quadratically up to a value of 5 for the average fleet age of two times de average sector fleet age. For the determination of this curve, the slope is kept constant at the point of the sector average and at that point the value of the sub-indicator is 1.
- Ages over two times the average sector fleet age: the value of the sub-indicator will be the maximum, 5.



Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated once a year	Airworthiness Fleet
	Data selection period Not applicable in this indicator	

Value Range	Formula
0-5	Being M=Average design age of the sector and X= Average design age of the operator's aircrafts. Si X < M → $i_{TC}^{airw} = \frac{X}{M}$ Si M< X < 2M → $i_{TC}^{airw} = \frac{3}{M^2}x^2 - \frac{5}{M}x + 3$ Si 2M<X → $i_{TC}^{airw} = 5$

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3.1.3 HETEROGENEITY OF THE FLEET

HETEROGENEITY OF THE FLEET SUB-INDICATOR	
Acronym	**Definition**
i_{het}^{airw}	Index that measures the heterogeneity of the models (different Type Certificate) in the fleet of an operator, taking into account the different types of operation declared and the different types of aircraft required for each type of operation.

Calculation

The calculation consists on relating the number of different TC with the total amount of aircrafts in the fleet of the operator, and corrected by a weighting factor that considers the different types of operations carried out by the operator.

The **activity factor** takes into account the number of activities for which an operator is authorized in its Operating License.

It takes values according to:

$$f_{act} = \frac{2}{\sum declarated\ activities}$$

Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated once a year **Data selection period** Not applicable in this indicator	Airworthiness Fleet

Value Range	Formula
0-5	$i_{het}^{airw} = 5 \cdot f_{act} \frac{\sum Number\ of\ TC - 1}{\sum Number\ of\ aircrafts}$

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3.1.4 ACAM

ACAM SUB-INDICATOR		
Acronym	**Definition**	
i_{ACAM}^{airw}	Index that measures the results of the ACAM Program: Aircraft continuing airworthiness monitoring.	
Calculation		
In order to calculate this sub-indicator, the ACAM inspections carried out to the operator's aircrafts during the data selection period are identified, and the findings in those inspections are counted. The sub-indicator is calculated as a rate of findings in each inspection, giving different weights to the findings depending on their category and their closing. **Category Factor**: findings are classified by the oversight unit as category 1 or 2, depending on their gravity. The category factor gives to each finding the following value depending on the category assigned: ▪ Category 1 – Category factor = 3 ▪ Category 2 – Category factor = 1 **Closing Factor (F_c):** the findings of each inspection shall be closed and corrected by the operator. The closing factor assigns the following values in cases where findings remain open or closed: • Open finding – Closing factor = 1.0 • Closed finding – Closing factor = 0.75		
Typology	**Temporality**	**Domain**
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings) **Data selection period** Two years since the date when sub-indicator is calculated.	Airworthiness Aircrafts
Value Range	**Formula**	
No limit	$$i_{ACAM}^{airw} = \frac{3 \cdot \sum(F_c \cdot Findings\ Cat1) + \sum(F_c \cdot Findings\ Cat2)}{\sum ACAM\ Inspections}$$	

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3.1.5 CAMO

<table>
<tr><th colspan="3">CAMO SUB-INDICATOR</th></tr>
<tr><th>Acronym</th><th colspan="2">Definition</th></tr>
<tr><td>i_{CAMO}^{airw}</td><td colspan="2">Index that measures the results of the CAMO Oversight Program: Aircraft continuing airworthiness monitoring.</td></tr>
<tr><th colspan="3">Calculation</th></tr>
<tr><td colspan="3">In order to calculate this sub-indicator, the CAMO oversight inspections carried out to the operator's aircrafts during the data selection period are identified, and the findings in those inspections are counted.

The sub-indicator is calculated as a rate of findings in each inspection, giving different weights to the findings depending on their category and their closing.

Category Factor: findings are classified by the oversight unit as category 1 or 2, depending on their gravity. The category factor gives to each finding the following value depending on the category assigned:
▪ Category 1 – Category factor = 3
▪ Category 2 – Category factor = 1

Closing Factor (F_c): the findings of each inspection shall be closed and corrected by the operator. The closing factor assigns the following values in cases where findings remain open or closed:
• Open finding – Closing factor = 1.0
• Closed finding – Closing factor = 0.75</td></tr>
<tr><th>Typology</th><th>Temporality</th><th>Domain</th></tr>
<tr><td rowspan="2">Continuous
Simple
Quantitative</td><td>Periodicity of the calculation

The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)</td><td rowspan="2">Airworthiness
Aircrafts</td></tr>
<tr><td>Data selection period

Two years since the date when sub-indicator is calculated.</td></tr>
<tr><th>Value Range</th><th colspan="2">Formula</th></tr>
<tr><td>No limit</td><td colspan="2">$$i_{CAMO}^{airw} = \frac{3 \cdot \sum(F_c \cdot Findings\ Cat1) + \sum(F_c \cdot Findings\ Cat2)}{\sum CAMO\ Inspections}$$</td></tr>
</table>

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3.2 OPERATIONS INDICATOR

OPERATIONS INDICATOR	
Acronym	**Definition**
i_{ops}	The operations indicator is divided into three sub-indicators with the aim of covering areas related to operations (for which information is available) and which may involve safety risks. The following sub-indicators are defined: • Air Operations Program • Bases • Fleet management

Calculation

The calculation of the airworthiness indicator consists on the weighted combination of the sub-indicators.

SUB INDICATOR	WEIGHTING FACTOR	VALUE
i_{PVC}^{ops}	fp_{PVC}^{ops}	0,50
i_{base}^{ops}	fp_{base}^{ops}	0,30
i_{fle}^{ops}	fp_{fle}^{ops}	0,20

Typology	Temporality	Domain
Continuous Compound Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings) **Data selection period** The time period is different for each sub-indicator.	Airworthiness Safety

Value Range	Formula
No limit	$i_{ops} = fp_{PVC}^{ops} \cdot i_{PVC}^{ops} + fp_{base}^{ops} \cdot i_{base}^{ops} + fp_{fle}^{ops} \cdot i_{fle}^{ops}$

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3.2.1 AIR OPERATIONS PROGRAM

<table>
<tr><th colspan="3">AIR OPERATIONS PROGRAM SUB-INDICATOR</th></tr>
<tr><th>Acronym</th><th colspan="2">Definition</th></tr>
<tr><td>i_{PVC}^{ops}</td><td colspan="2">Index that measures the results of the Air Operations Program.</td></tr>
<tr><th colspan="3">Calculation</th></tr>
<tr><td colspan="3">In order to calculate this sub-indicator, the air operation program inspections carried out to the operator during the data selection period are identified, and the findings in those inspections are counted.

The sub-indicator is calculated as a rate of findings in each inspection, giving different weights to the findings depending on their category and their closing.

Category Factor: findings are classified by the oversight unit as category 1 or 2, depending on their gravity. The category factor gives to each finding the following value depending on the category assigned:
▪ Category 1 – Category factor = 3
▪ Category 2 – Category factor = 1

Closing Factor (F_c): the findings of each inspection shall be closed and corrected by the operator. The closing factor assigns the following values in cases where findings remain open or closed:
• Open finding – Closing factor = 1.0
• Closed finding – Closing factor = 0.75</td></tr>
<tr><th>Typology</th><th>Temporality</th><th>Domain</th></tr>
<tr><td>Continuous
Simple
Quantitative</td><td>Periodicity of the calculation

The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)

Data selection period

Two years since the date when sub-indicator is calculated.</td><td>Safety</td></tr>
<tr><th>Value Range</th><th colspan="2">Formula</th></tr>
<tr><td>No limit</td><td colspan="2">$$i_{PVC}^{ops} = \frac{3 \cdot \sum(F_c \cdot Findings\ Cat1) + \sum(F_c \cdot Findings\ Cat2)}{\sum Inspections}$$</td></tr>
</table>

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3.2.2 BASES

BASES SUB-INDICATOR	
Acronym	**Definition**
i_{base}^{ops}	Index that measures the results of the Bases Inspections Program.

Calculation

In order to calculate this sub-indicator, the bases program inspections carried out to the operator during the data selection period are identified, and the findings in those inspections are counted.

The sub-indicator is calculated as a rate of findings in each inspection, giving different weights to the findings depending on their category and their closing.

Category Factor: findings are classified by the oversight unit as category 1 or 2, depending on their gravity. The category factor gives to each finding the following value depending on the category assigned:

- Category 1 – Category factor = 3
- Category 2 – Category factor = 1

Closing Factor (F_c): the findings of each inspection shall be closed and corrected by the operator. The closing factor assigns the following values in cases where findings remain open or closed:

- Open finding – Closing factor = 1.0
- Closed finding – Closing factor = 0.75

Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)	Safety
	Data selection period The data of the inspections carried out in the last season are selected.	

Value Range	Formula
No limit	$i_{base}^{ops} = \frac{3 \cdot \sum(F_c \cdot Findings\ Cat1) + \sum(F_c \cdot Findings\ Cat2)}{\sum Inspections}$

3.2.3 FLEET MANAGEMENT

FLEET MANAGEMENT SUB-INDICATOR	
Acronym	**Definition**
i_{fle}^{ops}	Index that measures the complexity of the fleet management.

Calculation

This indicator is composed of two differentiated parts:

- **Fleet rotation:** it quantifies the percentage of aircraft that the operator has in leasing respect to the total of its fleet, as well as the origin of these aircraft, the age and the familiarity with the model.

  The following coefficients are calculated:

  A. Leasing In / Fleet Ratio: The ratio of aircraft to leasing-in, respect to the total number of aircraft.

  $$A = \left(\frac{leasing\ in\ aircrafts}{total\ aircrafts}\right)$$

  B. Leasing Out / Fleet Ratio: The ratio of aircraft to leasing-out, respect to the total number of aircraft.

  $$B = \left(\frac{leasing\ out\ aircrafts}{total\ aircraft}\right)$$

  C. Rotation of models: Index of replacement of leasing in models in two consecutive seasons.

  $$C = \left(\frac{different\ leasing\ in\ models\ to\ previous\ season}{leasing\ in\ models}\right)$$

  D. Risk index by region of origin of the leasing in aircraft: The EASA Fatal Accident Rate by region published in the EASA Annual Safety Report ASR 2013 is used for calculation.

  $$D = \left(\frac{\sum_{i=1}^{n=leasing\ in\ aircrafts} Fatal\ Accident\ Rate)}{leasing\ in\ aircrafts}\right)$$

  E. Age of the design of the leasing in models: The same formula for the calculation of the age design is used.

  Being M=Average design age of the sector and X= Average design age of the operator's leasing in aircrafts.

  Si X < M → $E = \frac{X}{M}$

  Si M< X < 2M → $E = \frac{3}{M^2}x^2 - \frac{5}{M}x + 3$

  Si 2M<X → $E = 5$

- **Fleet Updating: It measures the ratio of fleet updating. It is calculated by comparing the aircraft that appear as registered in the name of the operator with the aircrafts that have an Airworthiness Certificate in force.**

$$F = \left(1 - \frac{aircrafts\ with\ Certificate\ in\ force}{registered\ aircrafts}\right)$$

Typology	Temporality	Domain
Continuous Compound Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings) **Data selection period** Not applicable in this indicator	Safety

Value Range	Formula
No limit	$i_{fle}^{ops} = 10A + 10B + 10C + D + E + 5F$

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3.3 OCCURRENCE SEVERITY

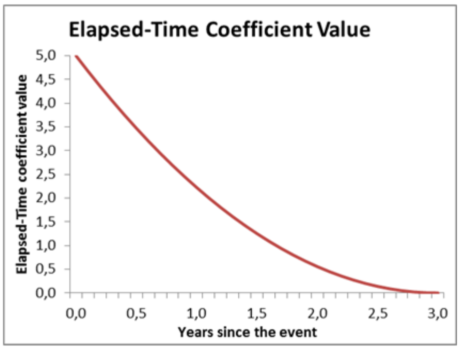
OCURRENCE SEVERETY INDICATOR

Acronym	Definition
i_{sev}	Index that measures the severity of the occurrence of an operator, taking into account its volume of operations

Calculation

The occurrences that occur to each operator in the reference period are selected and are related to their fleet volume.
The following coefficients are calculated:

- **Severity coefficient**
  The value that the coefficient takes depends on the classification of the event:
  – • Accident with fatalities - Coefficient value: 20
  – • Accident without fatalities- Coefficient value: 10
  – • Serious Incident - Coefficient Value: 3
  – • Major incident Value coefficient: 1



- **Elapsed-Time Coefficient**
  This coefficient is designed to dissipate the penalty of events over time. The event is taken into account for three years, and the weight of this penalty during that time is distributed according to the following function:

$$Coef_{Time} = \frac{(Years\ since\ the\ event - 3)^2}{1,8}$$

- **Operations Coefficient**
  This coefficient is designed to dissipate the penalty of the events as a function of the time of exposure of the operator to the danger. For the calculation of the coefficient, the volume of the fleet of the operator and the average of aircraft per operator for its category will be compared. Each aircraft that have an Airworthiness Certificate in force shall be considered within the fleet of each operator.

$$Coef_{Ops\ Vol} = \frac{AIRCRAFTS_{OPERATOR}}{AIRCRAFTS_{TOTAL}\ /OPERATORS}$$

Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings) **Data selection period** Three years since the date when sub-indicator is calculated.	Safety incidents Safety culture

Value Range	Formula
No limit	$i_{sev} = \frac{(\sum_{sucesos} Coef_{Sev} \cdot Coef_{Time})}{Coef_{Ops\ Vol}}$

3.4 REPORTING CULTURE

REPORTING CULTURE INDICATOR		
Acronym	**Definition**	
i_{cult}	Index that quantifies the reporting culture of each operator, by measuring the percentage of occurrences in which an operator has been involved in relation to those notified by the operator	
Calculation		
The occurrences that occur to each operator in a reference period are selected from ECCAIRS and MORS data bases and are related to the reporting entity of each of the events. The indicator is calculated by measuring the percentage of events that are notified by the operator itself. The following events are selected: - Events in Spanish territory - Events with severity greater than or equal to Significant incident - Events occurring in the period of the last year - Events with registration identified in the ECCAIRS register There is a coefficient depending on the severity of the non-notified event, according to the following table:		

SEVERITY	COEFFICIENT
Fatal accident	10
Accident	10
Serious incident	5
Major incident	3
Significant incident	1

Typology	Temporality	Domain
Continuous Simple Quantitative	**Periodicity of the calculation** The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)	Safety incidents Safety culture
	Data selection period A year since the date when sub-indicator is calculated.	

Value Range	Formula
No limit	$i_{cult} = \sum Severity\ Coefficient\left(1 - \frac{Incidents\ of\ the\ operator_{notified\ by\ itselt}}{Incidents\ of\ the\ operator_{all}}\right)$

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3.5 TECHNICAL INDICATOR

The technical indicator unifies all the technical indicators under a single indicator. Its mission is to facilitate the representation of the risk-status and the evolution and trend of each operator in the Safety Risk Area.

<table>
<tr><th colspan="3">TECHNICAL INDICATOR</th></tr>
<tr><th>Acronym</th><th colspan="2">Definition</th></tr>
<tr><td>i_{tech}</td><td colspan="2">This indicator measures the technical risk of the operator in terms of safety in the different domains in which its activity is divided: airworthiness, operations and severity.</td></tr>
<tr><th colspan="3">Calculation</th></tr>
<tr><td colspan="3">Its value results from the weighting of the six technical indicators described in the previous sections.

The value of the weighting factors shall be adjusted for the purpose of:
• Prioritizing some indicators against others (depending on the category of the operators and the reliability of the data used for their calculation)
• Optimizing the representation of the position the operators in the Safety Risk Area

The weighting factors of the indicators has been analysed to meet these objectives and the following values have been determined:

<table>
<tr><th>WEIGHTING FACTORS</th><th>f_{airw}</th><th>f_{ops}</th><th>f_{sev}</th></tr>
<tr><td>VALUE</td><td>1.25</td><td>0.5</td><td>1.25</td></tr>
</table>
</td></tr>
<tr><th>Typology</th><th>Temporality</th><th>Domain</th></tr>
<tr><td rowspan="2">Continuous
Composed
Quantitative</td><td>Periodicity of the calculation

The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)</td><td rowspan="2">Airworthiness
Operations
Safety occurrences</td></tr>
<tr><td>Data selection period

Depending on each indicator</td></tr>
<tr><th>Value Range</th><th colspan="2">Formula</th></tr>
<tr><td>No limit</td><td colspan="2">$$i_{tp} = \frac{f_{airw} \cdot i_{airw} + f_{ops} \cdot i_{ops} + f_{sev} \cdot i_{sev}}{3}$$</td></tr>
</table>

3.6 OPERATION RISK

OPERATION RISK INDICATOR	
Acronym	**Definition**
i_{risk}	Index that quantifies the dangerousness of the activities that an operator of aerial works develops during its operation
Calculation	

There are two coefficients:

Activity Coefficient
This parameter shows what activities the operator has authorized in his License. Two values:

- 1 - Activities declared by the operator.
- 0 - Activities not declared by the operator.

Activity Risk Coefficient
This coefficient measures the activity risk, taking in account the next data.

- Event severity of activity: Being function of severity and time.
  - Severity coefficient:
    - Fatal accident - Value: 20
    - Accident - Value: 10
    - Serious incident - Value: 3
    - Major incident - Value: 1
    - Significant incident - Value: 0,5
  - Time coefficient: This coefficient is designed to dissipate the penalty of events over time. The event is taken into account for five years, and the weight of this penalty during that time is distributed according to the following function:

$$Coef_{Time} = \frac{(Years\ since\ the\ event - 5)^2}{5}$$

For each activity the value of the Event Severity of activity will be the following:

$$Event\ severity_{Activity\ i} = \sum_{Events\ of\ activity\ i} Coef_{Sev} \cdot Coef_{Time}$$

- Volume of activity operations: This coefficient dissipates the severity of the events according to the exposure that each activity has to the danger. For its calculation the following formula is applied:

$$Operations\ volume_{Activity\ i} = 0.4 \cdot \frac{Operators_{Activity\ i}}{Total\ operators} + 0.6 \cdot \frac{Aircrafts_{Activity\ i}}{Total\ aircrafts}$$

Finally, each activity will have an associated hazard that will be calculated by relating the severity of events in the last five years and the volume of operations.

$$Coef\ Risk_{Activity\ i} = \frac{Event\ severity_{Activity\ i}}{Operations\ volume_{Activity\ i}}$$

Each Operator will have a value of Operation Risk Indicator; the value will be the sum of all the hazards associated with the activities. In addition, an exposure factor shall be included depending on the fleet volume of the operator:

$$i_{risk} = 10 * \sum_{Activities} Coef\ Risk_{Activities} + \frac{Number\ of\ operator\ aircrafts}{Average\ aircrafts\ in\ sector}$$

In order to represent the indicator within the Risk Area, a normalization of the values between 0 and 5 following a normal distribution is carried out.

<table>
<tr><th>Typology</th><th colspan="2">Temporality</th><th>Domain</th></tr>
<tr><td rowspan="2">Continuous
Simple
Quantitative</td><td colspan="2">Periodicity of the calculation

The indicator is calculated two times a year (depending on the periodicity of the Committee meetings)</td><td rowspan="2">Safety</td></tr>
<tr><td colspan="2">Data selection period

Five years since the date when is calculated.</td></tr>
<tr><th>Value Range</th><th colspan="3">Formula</th></tr>
<tr><td>0-5</td><td colspan="3">$$i_{risk} = 10 * \sum_{Activities} Coef\ Risk_{Activities} + \frac{Number\ of\ operator\ aircrafts}{Average\ aircrafts\ in\ sector}$$</td></tr>
</table>

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4. GRAPHICAL REPRESENTATION OF INDICATORS

In order to show the results of the assessment analysis of the safety level of Commercial Air Transport operators, a set of graphs have been defined as follows:

- Safety Risk Area
- Technical Safety Area
- Comparison of the value of an indicator for all operators in a category
- Status and evolution of the indicators of an operator
- ACAM Area
- CAMO Area
- OPS Area
- BASES Area

These graphs are displayed in a seasonal way (a fixed photograph of the status of the CAT operators at a given moment in order to identify negative situations) and in a temporary way (evolution of the indicators of an operator in order to identify negative trends). It has been intended these representations to be simple and intuitive.

4.1 SAFETY RISK AREA

The purpose of this representation is to relate the risk and the technical status of the operators by positioning them in a common area that allows comparing the behaviour of operators of the same category.

It is defined with a pair of Cartesian axes with maximum values of 5 units in each axis. These axes delimit the area where the cloud of points formed by the positions that the operators take, and which is referred to as the Safety Risk Area.

The position of each operator is defined by:

- x-axis: value of indicator i_{amb}
- y-axis: value of indicator i_{tp}

Operators are grouped into two areas of safety risk depending on the category to which they belong:

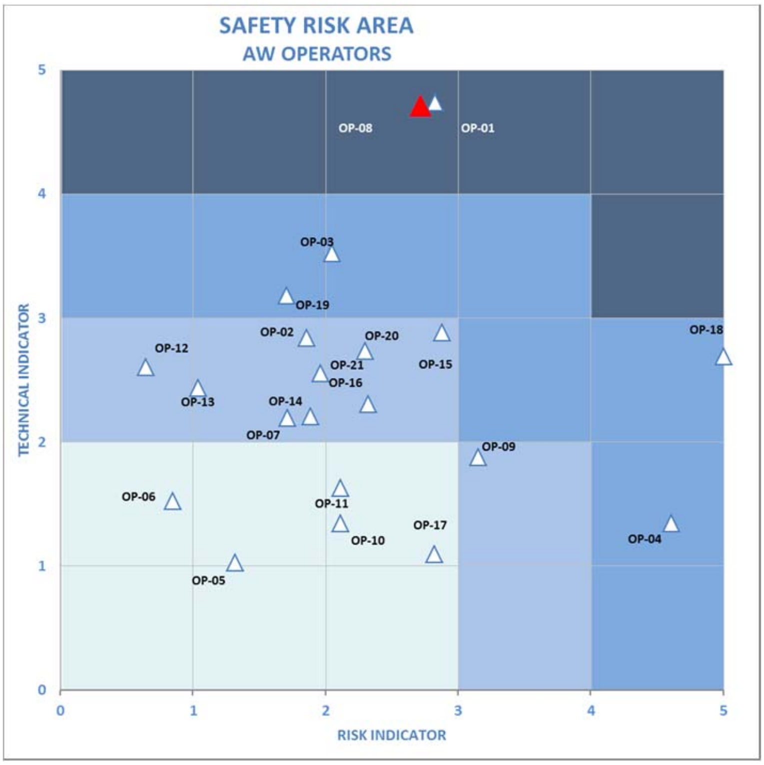
- Operators with Certificate of Special Operator
- Operators without Certificate of Special Operator

The Safety Risk Area defines four types of zones: critical, serious, negative and satisfactory.

4.1.1 SEASONAL REPRESENTATION

The seasonal representation shows a photograph of the safety status of the operators at a given analysis time.

The position of each operator is defined by a point whose value in ordinates takes the value of the technical indicator and in abscissa the value of the risk indicator. The operator positions are marked with a white triangle. The operators which have suffered accidents with fatalities in the last three years have their triangle filled in red with the aim of highlighting them to carry out a deeper monitoring of their evolution.



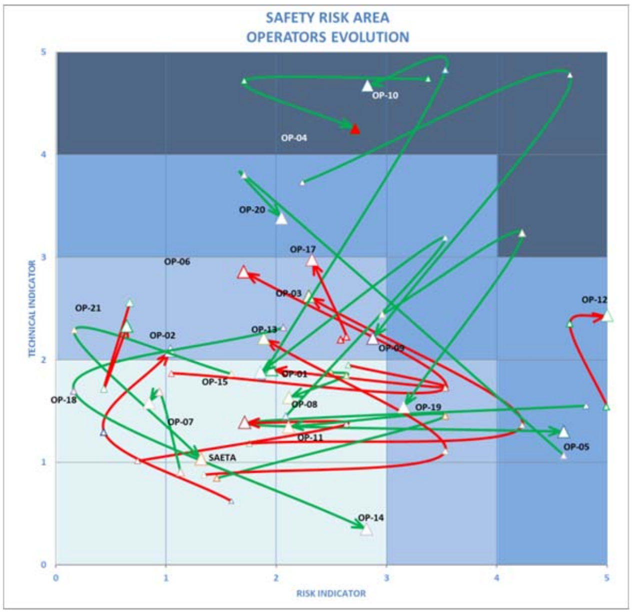
4.1.2 TEMPORARY EVOLUTION REPRESENTATION

From the position of an operator at different times of calculation, it is possible to define the evolution and trend of an operator in the Safety Risk Area. In this way, negative trends can be identified in operators that present a safety risk.

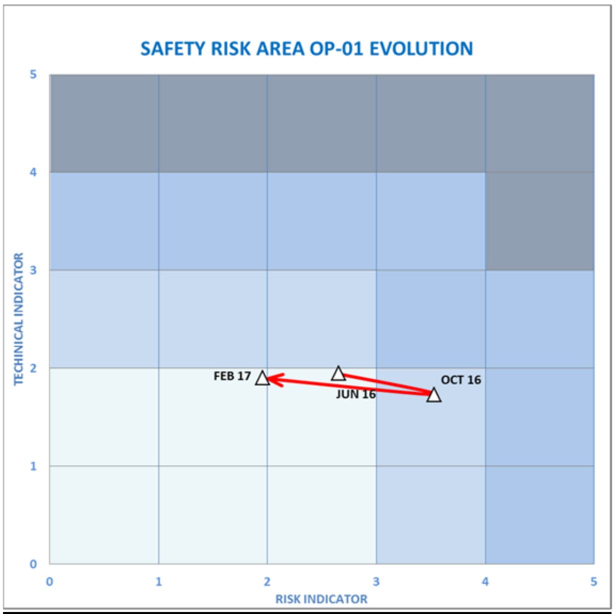
Two types of evolution are distinguished:

- Satisfactory evolution of technical indicator
- Negative evolution of technical indicator

EVOLUTION	TECHNICAL INDICATOR
	IMPROVEMENT
	WORSENING



It is also possible to analyse an individual evolution of an operator along all the different assessments performed in the last years in order to see the effectiveness of the preventive actions carried out.



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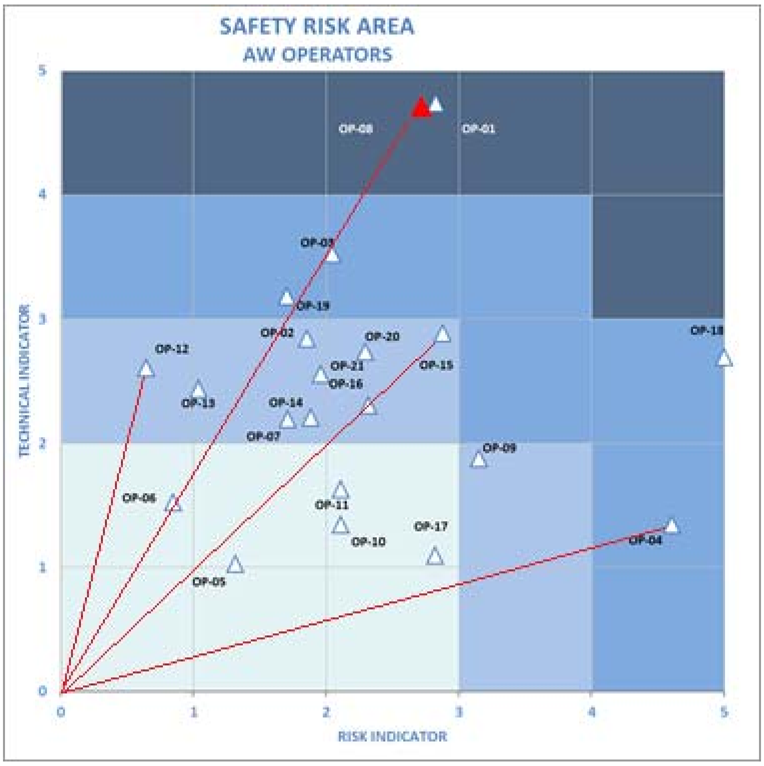
4.1.3 SAFETY RISK INDEX

The Safety Risk Index is defined by the position of an operator in the Safety Risk Area. Its value results from calculating the distance in a straight line from the operator to the origin of coordinates within the risk area.

This index combines in a single value the level of safety associated to each operator, and allows to classify in a clear and simple way the operators according to the value taken by the index. In addition, their variation can be quantified from the previous reference period in order to determine the evolution of the operators



SAFETY RISK INDEX			
1	OP-01	7,270	-0,41
2	OP-02	7,201	+0,30
3	OP-03	6,283	+0,56
4	OP-04	5,382	-0,26
5	OP-05	4,986	-3,23
6	OP-06	4,982	+2,39
7	OP-07	4,807	+0,51
8	OP-08	4,493	-0,15
9	OP-09	4,420	-1,31
10	OP-10	4,120	-2,11
11	OP-11	4,105	-0,20
12	OP-12	4,004	-0,10
13	OP-13	3,738	+1,27
14	OP-14	3,649	-0,22
15	OP-15	3,600	+1,72
16	OP-16	3,547	+0,27
17	OP-17	3,216	+0,81
18	OP-18	3,129	-0,58
19	OP-19	2,842	-1,24
20	OP-20	2,310	-0,25
21	OP-21	1,964	-1,28

4.2 TECHNICAL SAFETY AREA

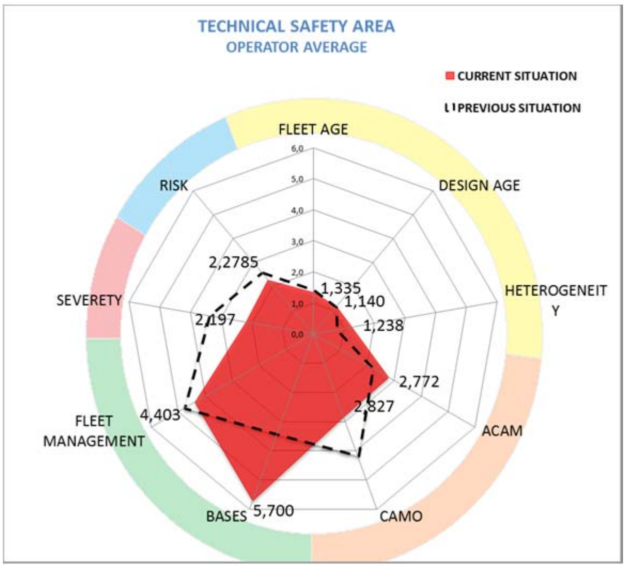
The purpose of this representation is to show the value of the nine technical indicators in a simple and grouped way.

It is called the Technical Safety Area and it is defined as the area limited by the values that take the nine technical indicators of reference. As defined in previous sections, the higher the value of the indicators, the lower the level of safety in the respective domain. Therefore, the greater the Technical Safety Area is, the lower safety level is.

4.2.1 CATEGORY AVERAGE REPRESENTATION AND EVOLUTION

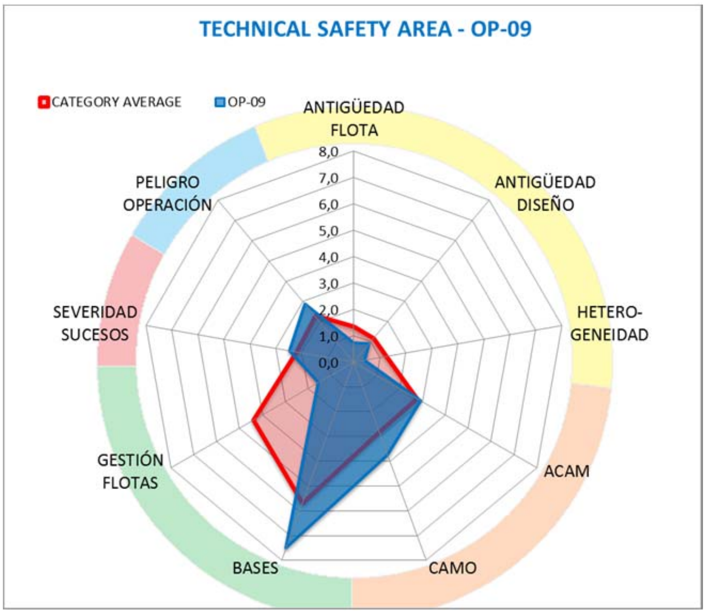
Using the average values of the indicators, the representation of the Technical Safety Area for a category is obtained, so that the areas with the most deficiencies in the safety of a certain category can be easily identified.

In addition, the representation can be used to superimpose the previous state of the Technical Safety Area in order to identify the evolution of the entire sector.



4.2.2 COMPARISON BETWEEN AN OPERATOR AND THE AVERAGE OF THE CATEGORY

From the values of the indicators of an operator it is possible to compare its Technical Safety Area with the average of the category, in such a way that in the points where its area is greater than the average one, it can be identified a worse state of safety in this area.



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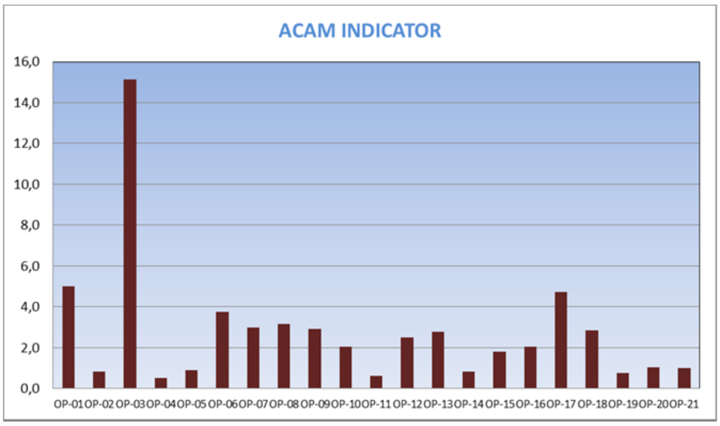
4.3 COMPARAISON OF A SINGLE INDICATOR FOR DIFFERENT OPERATORS

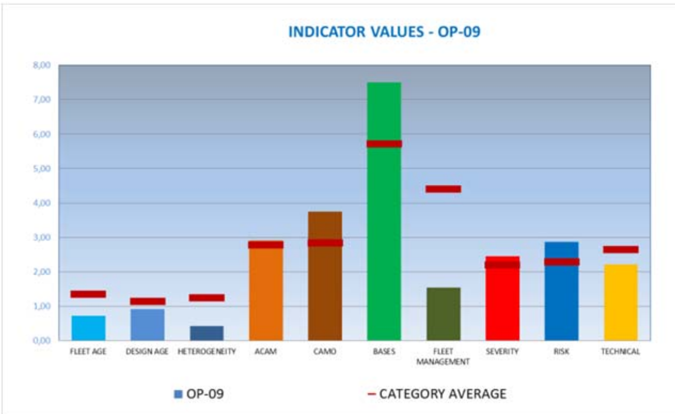
The purpose of this representation is to show the values that a single indicator takes for all operators in the same category.

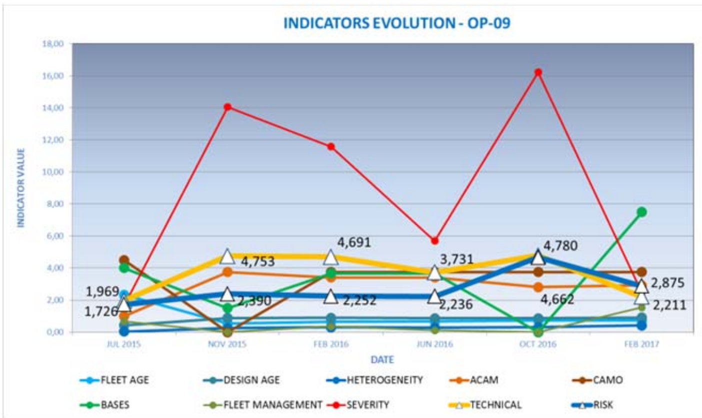
This representation is used to include a classification of the operators according to the value of the indicator, so that the operators that are worse off within each area can be clearly identified.



4.4 STATUS AND EVOLUTION OF THE INDICATORS OF AN OPERATOR

The purpose of these representations is to show the value taken by the different indicators of an operator at a given time, as well as its evolution.





4.5 ACAM AREA

The purpose of this representation is to provide information of the airworthiness monitoring activities included in the ACAM programme.

The inspections are focused on the Key Risk Elements (KREs) that are used to plan and analyse the inspections within the ACAM programme. This representation should:

- Show the monitoring results of the aircrafts of an operator, through the ratio of findings in one of the KREs to the total of findings in all KREs for that operator.
- Compare the results of the operator with the average of all the operators in the same category.
- Highlight the KREs where the operator or the category has more problems.

4.5.1 DEFINITION OF THE KEY RISK ELEMENTS OF AIRWORTHINESS - KRES

Listed below are the KREs in which findings will be classified:

A. AIRCRAFT CONFIGURATION

A.1. Type design and modifications
A.2. Airworthiness limitations
A.3. Airworthiness directives

B. AIRCRAFT OPERATION

B.1. Aircraft documentation
B.2. Flight manual
B.3. Weight and balance
B.4. Marks and signs
B.5. Operational requirements
B.6. Defect management

C. AIRCRAFT MAINTENANCE

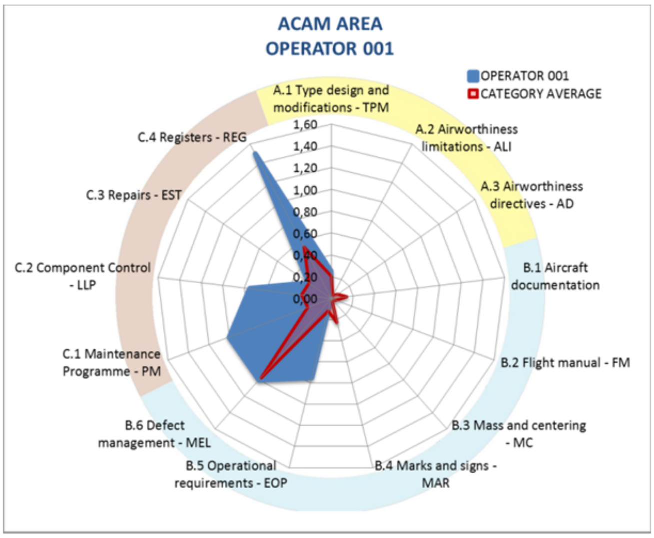
C.1. Maintenance Programme
C.2. Component control
C.3. Repairs
C.4. Registers

4.5.2 REPRESENTATION OF THE FINDINGS IN EACH KRE

The value assigned for each KRE is the ratio of findings per inspection assigned to each KRE.

The representation is a polygon of as many vertices as KRE has been defined, whose area is limited by the values that take the different ratios for each KRE; so the smaller the area is, the better the state of airworthiness safety is.

The area can be compared with the average of operators or with the same operator at different times.



4.6 CAMO AREA

The purpose of this representation is to provide information of the airworthiness management organization monitoring activities included in the CAMO programme.

The inspections are focused on different audit areas that are used to plan and analyse the inspections within the CAMO programme. This representation should:

- Show the monitoring results of the airworthiness management organisation of an operator, through the ratio of findings in each audit areas defined
- Compare the results of the operator with the average of all the operators in the same category.
- Highlight the audit areas where the operator or the category has more problems.

4.6.1 DEFINITION OF THE AUDIT AREAS WITHIN THE CAMO PROGRAMME

Listed below are the audit areas in which findings will be classified:

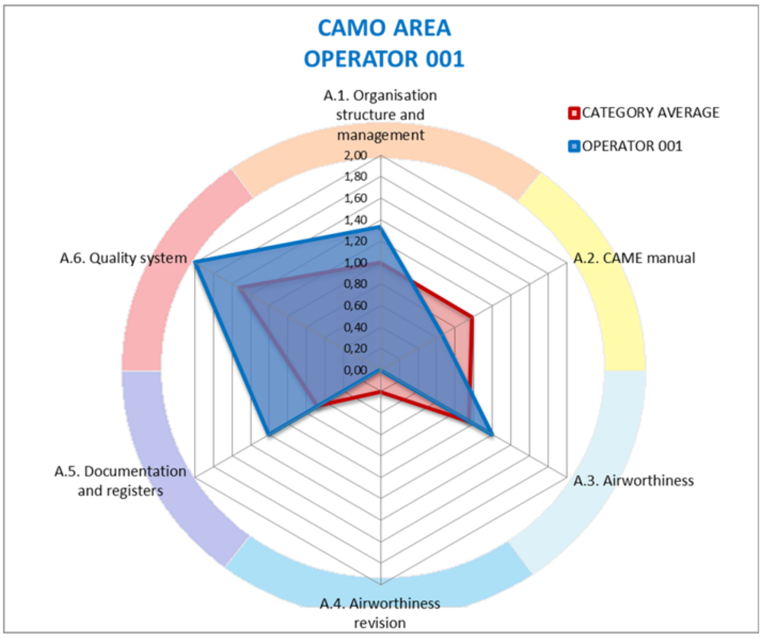
- Organisation structure and management
- CAME Manual
- Airworthiness maintenance management
- Airworthiness revision
- Documentation and registers
- Quality system

4.6.2 REPRESENTATION OF THE FINDINGS IN EACH AUDIT AREA

The value assigned for each audit area is the ratio of findings per inspection assigned to each audit area.

The representation is a polygon of as many vertices as audit area has been defined, whose area is limited by the values that take the different ratios for each audit area; so the smaller the area is, the better the safety status in the airworthiness management organisation is.

The area can be compared with the average of operators or with the same operator at different times.



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4.7 BASES AREA

The purpose of this representation is to provide information to support the planning of supervisory activities of a given operator. This area shall:

- Show monitoring results to each Operator's Bases Program.
- Compare the results in the operator's supervision with the average results of the supervision to all the operators that are in the same category.
- Highlight areas where there are problems at operator and set level.

The values obtained are represented in a polygon of nine vertices.

The weaknesses of the operation will be found in the blocks where the area is larger.