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Human factors guide to continuing airworthiness

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Contents

1. GENERAL CONSIDERATIONS

1.1. Presentation of the guide

1.1.1. Purpose of the guide

This guide is a tool to assist in the practical application of human factors principles in continuing airworthiness activities.

This new version incorporates:

- Feedback from experience related to human factors in the maintenance activities of the 145 organisation,
- Human factors in Continuing Airworthiness Management activities of the Part CAMO organisation (replacing previous Part-M/G organisations).

The purpose of this guide is as follows:

- Present the basic principles related to human factors
- Explain in concrete terms the concepts and expectations associated with human factors in the context of continuing airworthiness,
- Highlight important issues and specify certain complex elements to be put in place;
- Highlight the specific features that need to be taken into account in each area;
- Propose some practical solutions for the implementation of the human factors principles,
- Propose specific topics on HF that may be of interest to develop.

The main sources associated with this guide are the texts of Regulation (EU) No 1321/2014 and the associated AMC/GM on continuing airworthiness, Regulation (EU) No 376/2014 on occurrence reporting and the principles published in this field by ICAO (Doc ref: 9824/AN450), ICAO (Doc ref :10151) on human performance for regulators.

This guide is not designed as training material for human factors.

It should not be considered as an exhaustive, restrictive document, nor as a set of additional regulatory obligations.

The elements proposed in this guide must be assessed and adapted to each organisation according to its size, its field of activity, the level of technology in question and its own business culture.

The practical elements proposed in this guide should be taken first and foremost as examples. This can be used to identify and put in place practical solutions that are adapted to each organisation.

In the context of the implementation of human factors within an organisation, it is essential that the organisation does not to confine itself to this information alone. Organisations should make use of the numerous other documents published on human factors in general and in particular those relating to continuing airworthiness.

1.1.2. Definitions and abbreviations

- *Human Factors (HF): principles which apply to aeronautical design, certification, training, operation, and maintenance and which aim at a safe interface between the human and the other components of the system in taking into account human performance.*
- *Human performance: human capabilities and limitations that impact the safety and efficiency of aeronautical operations.*
- Just Culture: A culture in which front-line operators or other persons are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated[1];
- Positive safety culture: A sustainable set of values, standards, attitudes and practices within an organisation that seeks to minimise staff exposure to conditions that may affect flight safety.
- Safety management system: A systematic approach to safety management, including organisational structures, accountability, responsibilities, policies and procedures.
- Quality system (or compliance monitoring system): A system for monitoring the compliance of the organisation with the applicable requirements

1.1.3. References

- ICAO Doc 9824: Guide to Human Factors Related to Aircraft Maintenance.
- Regulation (EU) 2018/1139 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4th July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency.
- Commission REGULATION (EU) No 1321/2014 of 26th November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks — Annex II, Part 145 and Annex VII part CAMO.
- Regulation (EU) No 376/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 3rd April 2014 on the reporting, analysis and monitoring of occurrences in civil aviation.
- French Decree of 22 December 2008 on the implementation of safety management systems for public air transport undertakings and maintenance organisations and its instruction.

1.1.4. Application of the guide

This guide is primarily addressed to the following continuing airworthiness organisations:

- Approved continuing airworthiness management organisations Part CAMO, or organisations applying for Part CAMO approval to perform continuing airworthiness management whether integrated with or independent of a commercial air transport operator with a 1008/2008 licence.
- Part-145 approved maintenance organisations or organisations applying for a Part 145 approval to carry out maintenance activities on aircraft, engines and aircraft equipment.

While the regulations for the time being do not formally introduce human factors for Part 21 production organisations, combined organisations Part CAO, or training organisations Part 147, these organisations may choose to implement certain elements related to human factors presented in this guide which they consider applicable to their organisations.

Persons working outside approved organisations such as owners performing continuing airworthiness management, pilot owners performing maintenance on their aircraft, or independent mechanics may also use this guide as part of their continuing airworthiness activities.

[1] REGULATION (EU) No 376/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, amending Regulation (EU) No 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007

1.1.5. Structure of the guide

This guide has 4 chapters.

- Chapter 1: General information regarding human factors.

- Chapter 2: A chapter providing details on human factors subjects related to continuing airworthiness, structured in 11 main topics applicable to all organisations involved:

    1. HF aspects related to organisation
    2. HF aspects related to staff
    3. HF aspects related to means
    4. HF aspects related to the data
    5. HF aspects related to facilities and working environment
    6. HF aspects related to subcontracting
    7. HF aspects related to procedures
    8. HF aspects related to the continuing airworthiness activities of the organisation
    9. HF aspects related to the records
    10. HF aspects related to quality management
    11. HF aspects related to risk management

  Each topic in Chapter 2 is composed of:

  - An introduction of the main principles of the human factors applicable to the topic in question and common to the CAMO and 145 organisations.
  - A “PART CAMO” box with additional information related to the topic in question and dedicated to the continuing airworthiness management activities of PART CAMO organisations
  - A “PART 145” box with additional information related to the topic in question and dedicated to the maintenance activities of 145 organisations

    The boxes “PART CAMO” and “PART 145” provide additional information specifically concerning the CAMO part and the Part 145 organisations:

    - Requirements and AMC/GM that formally include a reference to human factors (e.g. human factors = 145.A.30 (e) training and associated AMC/GM)
    - Elements from human factors and associated regulatory references (e.g.: Just culture = AMC 145.A.60 (b) (2))
    - Human factors considerations related to activities exist in part CAMO or 145 as appropriate (e.g.: line maintenance working environment = 145.A.25 (b) (6))
    - Examples of situations and practical solutions that can address certain human factors issues (e.g. Situations requiring special consideration to be given to the fatigue aspects of mechanics)

- Chapter 3: This chapter is devoted to the implementation of the human factors approach within the organisations.

- Chapter 4: This last chapter proposes a list of practical references/tools on human factors.

1.2. History of human factors in aviation organisations

The introduction of human factors into aviation organisations was originally concerned with airline pilots, as international statistics revealed a significant contribution of piloting errors in accidents at that time.

While major airlines were the first to take these human factors concepts into account as early as the late 80s, the regulatory obligation to apply human factors principles for technical crews was formally introduced in the OPS Regulation at the end of the 90s under the concept of Crew Resource Management (CRM).

As regards maintenance activities, certain human factors concepts have been introduced in the first version and subsequent revisions of the JAR145 Regulation (e.g.: Working conditions, recurrent training in human factors for certifying staff...) and in JAR66 (e.g.: Human Factors Assessment — Module 9).

The concept of human factors in maintenance activities appeared more generally and formally in 2003 with Regulation (EC) No 2042/2003 Part 145 of Regulation (EC) No, subsequently amended under reference (EU) No 1321/2014.

The revision of Regulation (EU) No 1321/2014 of March 2020 now incorporates human factors for Continuing Airworthiness Management Organisations; Part CAMO.

1.3. Concept of Human Factors in Regulation (EU) No 1321/2014

Whenever a process involves one or more people, there is the need to consider human factors.

As continuing airworthiness management and maintenance activities remain highly focused on human activities, human factors concern most continuing airworthiness activities.

A few regulatory requirements clearly mention the concept of human factors, such as requirement 145.A.30 (e), which formally requires the personnel of 145 maintenance organisations to have appropriate knowledge of human factors principles.

On the other hand, on reading Regulation (EU) No 1321/2014, the formal reference to the concept of 'human factors' is not systematically mentioned in all areas which may have a link with human factors without meaning that these areas are not concerned by these human factors concepts.

While the number of references to human factors are limited in the Regulation, many of the rules in the requirements and AMC, as further specified in this Guide, are directly justified by human factors aspects. In other words, there is an implicit requirement to consider human factors.

A typical example is the working environment in 145 maintenance organisations. Since the JAR 145 Regulation, and subsequently with Part 145, precise rules apply to the working environment. There is a need for sufficient space, to control noise, temperature, light and bad weather: All these elements are very important human factors topics to take into account. Experience has shown that there is a need to provide appropriate environments and to adapt engineers to specific environments in order to minimise the risk of errors.

However, requirement 145.A.25 and AMC 145.A.25 related to facilities make no mention of the concept of human factors.

This also applies to human factors for continuing airworthiness management organisations Part CAMO. Overall, the concept of human factors appears few times in the regulatory texts of the CAMO PART whereas human factors concern most continuing airworthiness management activities.

One of the objectives of this guide is therefore to specify, in addition to the formal references to human factors in the regulatory texts, all the subjects coming from and/or concerned by human factors.

Underneath are the tables with the main requirements and AMC and GM that may be affected by human factors. Grey references correspond to texts that formally mention human factors.

1.3.1. References to HF in Part CAMO Regulation (applicable since March 2020)

Themes	Requirements	AMC	GM
Occurrence reporting	CAMO.A.160	AMC1 CAMO.A.160	
Management system (risk management and compliance management)	CAMO.A.200	AMC1 CAMO.A.200 (a)(2) AMC1 CAMO.A.200(a)(3) AMC2 CAMO.A.200(a)(6) AMC4 CAMO.A.200(a)(6)	GM1 CAMO.A.200 GM1 CAMO.A.200(a)(2) GM1 CAMO.A.200(a)(3) GM2 CAMO.A.200(a)(3)
Internal safety reporting scheme	CAMO.A.202	AMC1 CAMO.A.202 (b)(3)	GM1 CAMO.A.202
Contracting and subcontracting	CAMO.A.205		GM1 CAMO.A.205
Facilities	CAMO.A.215	AMC1 CAMO.A.215	
Record-keeping	CAMO.A.220	AMC1 CAMO.A.220	
Continuing airworthiness management exposition	CAMO.A.300	AMC1 CAMO.A.300 AMC2 CAMO.A.300	
Personnel requirements	CAMO.A.305(a) CAMO.A.305(b) CAMO.A.305(c) CAMO.A.305(d) CAMO.A.305(g)	AMC1CAMO.A.305(a)(4)(a)(5) AMC1 CAMO.A.305(c) AMC1 CAMO.A.305(d) AMC1 CAMO.A.305(g) AMC2 CAMO.A.305(g) AMC3 CAMO.A.305(g) AMC4 CAMO.A.305(g) AMC5 CAMO.A.305(g)	GM1 CAMO.A.305(g) GM2 CAMO.A.305(g) GM3 CAMO.A.305(g)
Airworthiness review staff	CAMO.A.310		
Continuing airworthiness management	CAMO.A.315(a) CAMO.A.315(b) CAMO.A.315(c) CAMO.A.315(e)	AMC1 CAMO.A.315(c) AMC2 CAMO.A.315(c)	
Continuing airworthiness management data	CAMO.A.325	AMC1 CAMO.A.325	

1.3.2. References to HF in Part 145 Regulation

Themes	Requirements	AMC	GM
Facilities requirements	145.A.25	AMC 145.A.25(a) AMC 145.A.25(b)	
Personnel requirements	145.A.30(a) 145.A.30(b) 145.A.30(c) 145.A.30(d) 145.A.30(e)	AMC 145.A.30(d) AMC1 145.A.30(e) AMC2 145.A.30(e)	GM1 145.A.30(e) GM2 145.A.30(e)
Certifying staff and support staff	145.A.35(d) 145.A.35(f)	AMC 145.A.35(d) AMC 145.A.35(f)	
Equipment and tools	145.A.40	AMC 145.A.40(a) AMC 145.A.40(b)	
Identification/Segregation of components	145.A.42	GM1 145.A.42(a)(ii) AMC1 145.A.42(c)	
Maintenance data	145.A.45(a) 145.A.45(c) 145.A.45(d) 145.A.45(e) 145.A.45(f)	AMC 145.A.45(c) AMC 145.A.45(d) AMC 145.A.45(e) AMC 145.A.45(f)	
Production Planning of	145.A.47(a) 145.A.47(b) 145.A.47(c)	AMC 145.A.47(a) AMC 145.A.47(b) AMC 145.A.47(c)	
Performance of maintenance	145.A.48(a) 145.A.48(b) 145.A.48(c)	AMC1 145.A.48(b) AMC2 145.A.48(b) AMC3 145.A.48(b) AMC4 145.A.48(b) AMC 145.A.48(c)	GM 145.A.48(c)
Certification	145.A.50	AMC 145.A.50(b) AMC 145.A.50(e)	
Records	145.A.55		GM 145.A.55(a)
Occurrence reporting	145.A.60(b)	AMC 145.A.60(b)	
Safety and quality policy, maintenance procedures and quality system	145.A.65(a) 145.A.65(b)	AMC 145.A.65(a) AMC 145.A.65(b) AMC 145.A.65(c)(1) AMC 145.A.65(c)(2)	GM1 145.A.65
Maintenance organisation exposition	145.A.70	AMC 145.A.70(a)	GM 145.A.70(a)

1.4. General information on human factors

1.4.1. Objectives related to the instruction of HF

Human factors play an important role in understanding, detecting, avoiding, analysing and mitigating errors related to continuing airworthiness tasks, adverse events and non-conformities in general.

The regulatory requirements for the consideration of Human Factors by continuing airworthiness organisations are justified primarily by the objective of improving flight safety.

While human factors are undoubtedly useful in the management of errors, it is important not to limit the subject to the concept of error alone. The term 'human factors' must first and foremost be seen as a positive concept. Human factors are often responsible for the proper functioning of an organisation, the smooth running of its processes, the quality of its products and the quality of life at work for staff.

Given the multiple and transverse aspects of human factors, the HF implementation can therefore also have many other benefits for the organisation in terms of process optimisation, product/service reliability, management of change and in other areas not covered by this guide (health and safety at work, human resources, etc.).

1.4.2. Definitions of the Human Factors

According to Regulation (EU) No 1321/2014, the concept of "Human Factors" means principles which apply to aeronautical design, certification, training, operation and maintenance and which seek safe interface between the human and other system components by proper consideration of human performance. 'Human performance' means human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Human factors are the factors linked to the individual physiological, psychological and sociological characteristics of each person. They also relate to elements external to those persons in the frame of their activities which may change their behaviour positively or negatively, with the associated consequences for their activities.

The basic principle of a human factors approach is to better adapt the environment to the human in the context of his activities and, in certain cases, to take measures to allow human to better adapt themself certain environmental constraints (e.g.: Noise, low temperatures, etc.). The concept of the environment here also refers to the working environment, needed information and the resources needed for these activities.

Knowledge of human performance enables each individual to be better aware of their capabilities and limitations, but also of those persons around them in the context of their professional activities, in order to anticipate the possibility of errors, to avoid errors, to detect errors and to take action to avoid adverse effects on safety.

It is interesting to distinguish the application dimension of HF from the knowledge of the related human and social sciences. In fact, this approach allows each person, in a proactive and more systematic manner, to "think HF" as part of his/her own tasks but also, if this is the case, in the context of his/her management, organisation and methods within the organisation.

This approach is not in itself a new method, a new way of understanding certain subjects. In the past, human factors has often intuitively been taken into account in the area of continuing airworthiness. The introduction of human factors into the regulation corresponds to a more systematic approach for the consideration of human factors by organisations and by concerned actors in the management of continuing airworthiness activities.

1.4.3. Human capabilities and limitations

Human factors are the underlying human traits that support human performance, i.e. the human capabilities and limitations involved in continuing airworthiness activities.

Examples of the contribution to these activities made by strong human performance include:

- Perception,
- Reasoning,
- Actions,
- Memorisation,
- Communication,
- Moving,
- Handling tools and materials with dexterity
- Resilience in a range of working environments (noise, extremes of heat, humidity etc)…

Human capabilities and limitations are characteristics that can be common to a large number of individuals and others that are specific to each individual.

The level of capabilities and limitations varies from person to person. It varies according to age, build, health, biological rhythms adopted, situations experienced, life events (marriages, births but also deaths, conflict, pain, stress…).

Examples:

In terms of vision, humans have a maximum horizontal field of vision of approximately 180 degrees but some have a reduced field of vision in a transiently or not (loss of vision in one eye).

For a large majority of people, it is possible to work in a narrow location, but only some people can work inside an aircraft tank, in an extremely small area (non-claustrophobic, flexible, small build).

With regard to fatigue, in general, it is more appropriate to work in daytime rather than at night. On the other hand, some people have a preference for working in the morning and others the evening; they are ‘larks’ or ‘owls’. The latter in the course of their work will feel more comfortable performing complex work at the end of the evening than the former.

Each person ultimately has its own capabilities and limitations, such as:

- The ability to be a leader,
- A high level of stress resistance,
- A significant memorization capacity,
- Above average physical capacity,
- A degraded vision (myopia),
- Vertigo.

Processes and systems in organisations are often built to be used by people who correspond to “average individuals” according to their general knowledge levels in their specialities. HF makes it possible to take into account the existence of differences between individuals or certain particularities.

1.5. 'Human factors' or 'human and organisational factors'?

Both the Continuing Airworthiness Regulation (EU) No 1321/2014 and the Basic Regulation (EU) 2018/1139 refer only to the concept of 'human factors', whereas numerous documents in this area often refer to the concept of 'human and organisational factors' (HOF).

Two sets of factors do indeed exist:

- Factors related to the human abilities and limitations of individuals within the organisation, in their working environments, in relation to other persons in the organisation.
- Factors related to the organisation itself, its structure, management style, culture, hierarchical/functional chart, organisation of work, management systems in general.

It could be thought that the concept of human factors in EU regulations focuses only on each individual: 'How will I manage the situation?'; 'how can I manage the task that I to perform in view of my capabilities/limitations?'; 'how do I take account of particular human factors contexts (managerial pressure, fatigue level, bad weather, night) in order to minimise the risk of errors?'; 'What strategy will I use to deal with this particular situation?'.

The fact that references to human factors in the Continuing Airworthiness Regulation are mainly associated with human factors training of persons could also lead to this interpretation.

The aim of this guide is to show precisely that human factors even under the rules apply not only to each individual and his or her environment but also to the organisation with its particular features. A safety culture is an example of a factor associated with the organisation that can positively or negatively influence the actions and decisions of each individual.

Human factors address by default the working situations of individuals and their interaction with the outside world. They refer to disciplines such as ergonomics and psychology. The concept of organisational factors includes disciplines such as social psychology, sociology, management sciences.

This concept extends the scope somewhat and introduces the idea of "thinking the business" as a whole (business culture, management style, etc.), considering group behaviour, studying processes and human interactions related to the organisation.

Since the introduction of human factors in Part 145, the human factors approach has been aligned with the concept of human and organisational factors.

Management and the organisation as a whole have always been presented as important elements in the process of implementing HF concepts in an organisation. The concepts of human factors were not limited to staff training and were not focused solely on individuals. The human factors approach has always sought a general approach within the organisation, covering all categories of staff and all activities, organisations and processes involved.

In the remainder of this guide, the concept of "human and organisational factors" must be understood as being part of the concept of "human factors" specified in the Regulation.

1.6. Representation of HF

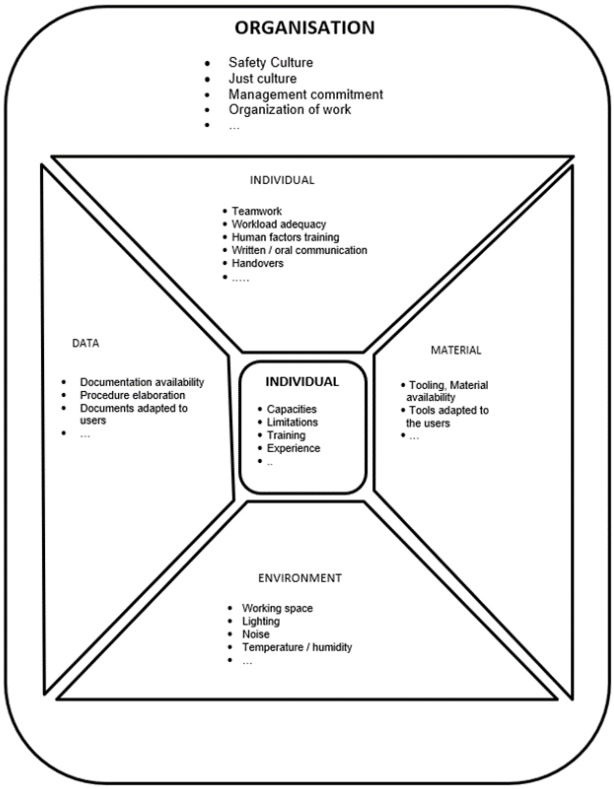
One way of understanding human factors is to look at people's capabilities and limitations in relation to their own functioning, but also with regard to their surroundings in the context of their activities, including the role of the organisation itself.

When we talk about human factors, we talk about internal and external factors that influence behaviour, which can have an impact on activity and work.

A possible schematic representation associated with human factors (based on the traditional SHELL representation) is to imagine an individual with his or her own capabilities and limitations (internal factors), plus everything around that individual (external factors), namely:

- other individuals concerned /Liveware,
- Information / Software,
- Materials /Hardware,
- Environment,
- upstream organisation structure.

Shell diagram

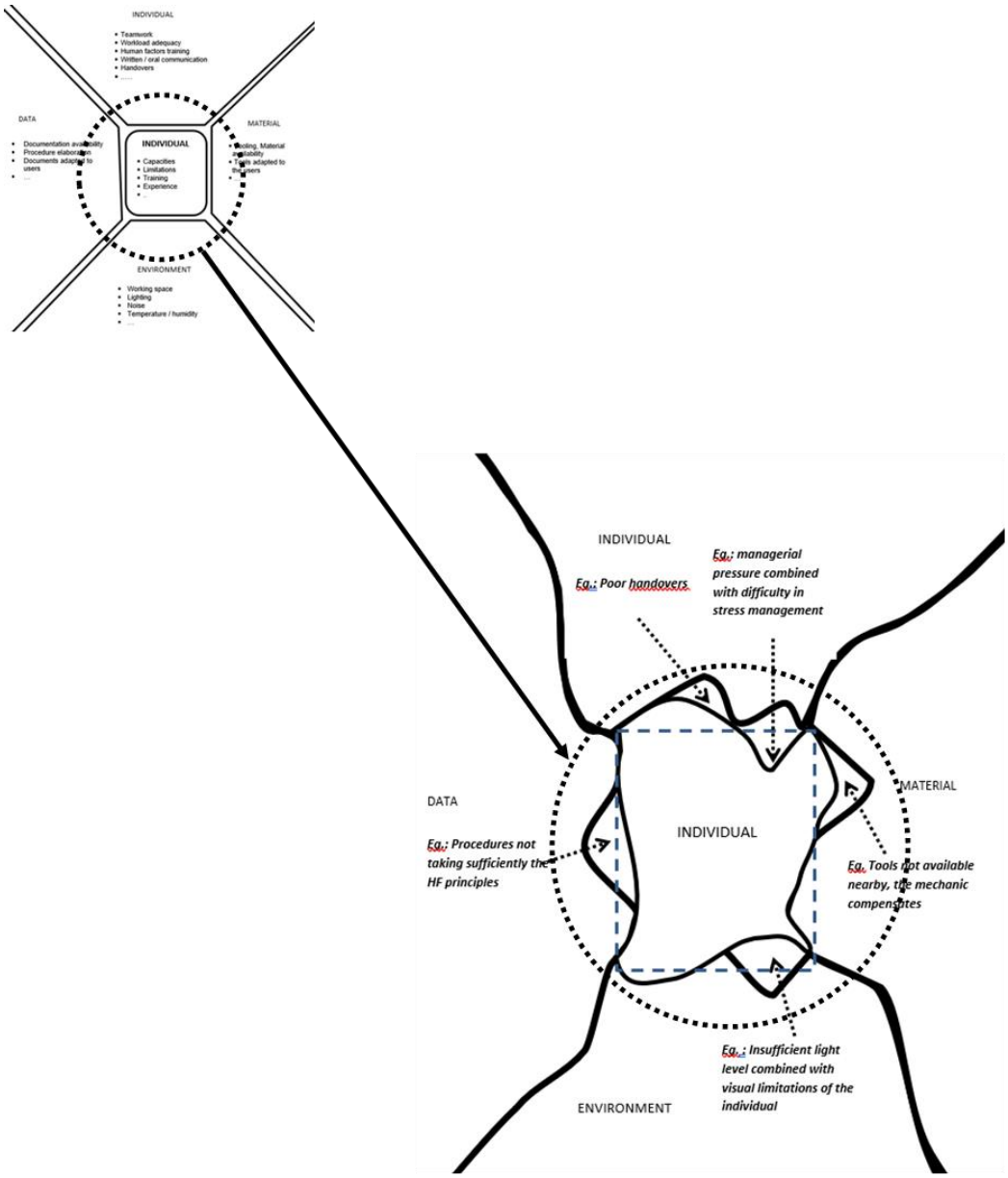


HF representation by integrating the organisation

The human factors approach should not be limited to training, to the skills and knowledge of each person with regard to human factors, but to practical measures to adapt the organisation as a whole to human factors.

The principle of human factors is not only to make people aware of their limitations and their intrinsic capabilities, but also to focus on links, interfaces with external elements needed in the course of a given activity, the adaptation of people to these external elements and the adaptation of these elements of the organisation to people.

By repeating the above diagram, and focusing on an individual's human factors in the course of his or her work, an example of a real situation on the ground could be represented by the diagram below, i.e. with interfaces, not perfectly adapted links between an individual and his or her environment, materials, information and other persons working with him or her.



As adaptations cannot, of course, be perfect at all times, in all circumstances the aim of this human factors approach is to improve as much as possible these interfaces, these levels of adaptation, and to improve the organisation in general.

1.7. Human factors and errors in the context of continuing airworthiness

While human factors should not only be involved in the concept of error, they are indeed very useful in managing, anticipating, detecting, reporting and analysing human errors associated with undesirable events and ultimate events.

1.7.1. Errors in undesirable and ultimate events

Serious incidents and accidents are most often caused by a combination of errors involving different actors, processes and domains.

Originally, the majority of accidents were related to aircraft design, but improvements to the reliability of aircraft has made it possible to change this. Studies now show that the majority of accidents concern aircraft operations with causes often related to human factors.

Unlike other highly automated areas, continuing airworthiness activities are still mainly planned, performed and controlled by people and are therefore relatively more prone to error.

While the accident rate has generally decreased over decades to a particularly low rate, the introduction of quality systems and then the introduction of safety management systems in the context of continuing airworthiness, all this combined with the HF approach, have proved necessary to feed into the virtuous circle of continuous improvement of these activities, to detect, analyse, understand and correct malfunctions and thus reduce the risk of errors.

1.7.2. General information on errors

In all areas and in all occupations, the concept of error exists. It is an element that must be associated with any human activity. Even highly competent individuals can involuntarily make mistakes. Error is an integral part of the learning and development process of individuals and organisations.

It is also by making mistakes that we become aware of the need to reduce the risk of error (saving time, savings, safety, health, etc.). Experience is built by observing personal mistakes and those of other people.

However, learning how to minimise errors improves operational efficiency, effectiveness and safety. Understanding the working conditions that best support human performance, their flexibility, adaptaility and reliabiity, is thus an important element of organisational management.

If the human being is flexible, adaptable, reliable and therefore has great qualities in the context of technical activities, he can also be vulnerable and certain conditions can reduce his performance.

Due to a lack of general or specific training, limited experience, inadequate means, degraded environmental conditions, certain physical/psychological particularities and all the other reasons set out in this guide, individuals may perform their duties inadequately and thus make mistakes.

In the frame of accidents and serious incidents, errors performed by front-line people are often highlighted. This is often referred to as “human error”.

However, this term can be of little use in the prevention of accidents and incidents because, although it indicates where the system has at end failed, it does not help to identify the underlying causes of the shortcomings in the protection mechanisms (or barriers). As such, it does not help to identify the mitigations needed to avoid such events in the future.

As already reported, serious events are often the result of several errors or malfunctions at different levels of the organisation (training, planning, management, operations..) which come together at the same time. Most of the factors contributing to these errors depend primarily on organisations (processes, interfaces, means, etc.) and not directly on individuals.

1.7.3. Types of basic error

The types of errors observed in practice may be limited to the outcomes: failure to perform a task, the partial completion of a task, an incorrect way of performing a task, the use of incorrect means/resources to carry out a task. These tasks concern both those linked to the organisation's main activity and support activities.

The main errors related to continuing airworthiness management (engineering/technical management activity) are:

- Error in taking account of information (e.g. Input error),
- Misunderstanding of information (e.g. Misinterpretation of the implementing rules for an AD),
- Incorrect processing of information (e.g. Incorrect calculation of a task due date),
- Incorrect decision on continuing airworthiness (e.g.: Error in the decision not to apply an optional SB),
- Incorrect recording of information (e.g. Task considered incorrectly as already applied to aircraft).

In the context of the maintenance, the main errors are as follows:

- Failure to carry out a maintenance task or assembly of a given component,
- Incorrect completion of a task (e.g.: Incorrect installation of component, incorrect tightening of fixing, unauthorised modification, etc.),
- Installation of unsuitable equipment, use of unadapted tools, unsuitable product (e.g. Installation of a part not suitable for the aircraft, use of an incorrect ingredient, etc.).

1.7.4. The origins of these errors

The origins of errors are not limited to the physical capacities and mental (cognitive) abilities of the parties involved. Often, each error can be explained by one or more different contributory factors and reasons, for example:

- Failure to comply with technical data or procedures,
- Application of an unauthorised procedure, not referenced in the technical data,
- Supervisors accepting non-use or use of incorrect technical data,
- Incorrect recording of the tasks carried out,
- Personnel fatigue,
- Lack of vigilance, lack of awareness of the eventual consequences,
- Lack of assurance or, conversely, too much self-confidence;
- Routine,
- Tunnel effect,
- Demotivation,
- Personnel not properly trained to carry out the task in question,
- Too high pressure/level of stress,
- Insufficient communication,
- Language difficulties (reading, drafting, communicating in English, etc.),
- Incorrect or ambiguous maintenance procedures and data,
- Lack of handover when changing teams,
- Problems related to the interruption of work (distraction, reassignment of a person to a more priority task),
- Malfunctions in teamwork, supervision, coordination,
- Occasional unavailability of the necessary resources (maintenance data, equipment, tools, etc.),
- Degraded working environment (e.g.: Low light levels).

1.7.5. Errors and violations

It is important to make a clear distinction between errors and violations.

In both cases, these are planned actions not carried out as planned, which do not allow the objective to be achieved.

Errors are linked to actions not carried out as expected but involuntary. This may include errors in the definition of what to do (wrong diagnosis or lack of knowledge), but also errors in the performance and control of the expected task.

Violations are linked to actions not carried out in accordance with best practice, data or procedures, but this time on a voluntary basis. These are voluntary modifications of the applicable rules. These can be routine violations or exceptional violations.

There can be various explanations linked to violations, including seeking optimal, productive solutions. Those responsible for these violations can adopt such behaviour for 'the right cause', sometimes to help a company due to a lack of resources (time, documents, tools, documents, etc.).

The seriousness of a violation may be determined according to the individual's level of knowledge of the rules to be complied with (e.g. Failure to comply with the formal ban on working under the influence of alcohol) and knowledge of the potential impact on flight safety (e.g. Wellknown consequences of not carrying out an inspection classified as critical).

1.7.6. Not just classifying an event as "human error"

As already mentioned, any person may be led to make more or less serious errors in the course of his or her professional activity.

The analysis of an event should not be limited to the conclusion that the event comes from "human error". This type of conclusion permits only to determine at the end the level at which the system disfunctionned and not the actual causes of the malfunction.

Isolating an error in an analysis is only a first step and simply answering that this is "a human error" should not be considered as a sufficient and acceptable response. The aim is not to find the responsible person (s) but above all to understand the reasons for an event happening in order to address its causes.

1.8. Not everything is a HF problem either.

While it is necessary to systematically ask good questions about human factors topics related to such events, situations, plans for change, it is important not to reach the opposite situation to consider that “everything is a human factors problem”.

In some cases, when it is difficult to explain a particular situation, it may be easy to classify an event as a ‘human factors problem’. It is therefore important to clearly define when it is appropriate or not to mention human factors.

Not everything should be classified as human factors: First, the human factors aspect is primarily linked to the organisation in question. For example, a non-compliant product with a hidden defect resulting from a human error in another maintenance organisation that has been correctly installed on the appliance by a maintenance organisation should not be classified as human factors by the maintenance organisation that installed that part.

Systemic problems in an organisation, even if they concern staff directly, are not necessarily to be classified as human factors problems. For example, a decision by the management of an organisation to operate voluntarily with chronic and continuous under-staffing across all domains of the organisation should not be classified as a human factor finding. The origin in this case is a managerial error, which must be treated as such.

Human factors concern above all situations “at the margin”, one-off, specific inadaptations associated with specific conditions.

1.9. Positioning of the Human Factors with regards to the Safety management system and Quality System

It is already not obvious to position “human factors” in regard to the ‘safety management system’, the “quality system” (or “compliance monitoring system” for the CAMO part) or the “management system” (CAMO), given that there are often human factors involved in risk management, event investigations and the management of findings.

The CAMO Part Management System is a concept that brings together the compliance monitoring system functions and the safety management system functions.

The Quality System for Part 145 or the Compliance Monitoring System for Part CAMO part is a very process-oriented system, oriented on management of non-qualities, non-conformities and on the continuous improvement.

The safety management system is a system that focuses on the hazards and risks associated with activities.

A human factors approach applies to all processes, including under these two systems. It is a way of “seeing”, analysing in detail an activity, a problem, a process, an occurrence, a risk, a danger on aspects related to human limitations and capabilities.

A human factors approach is not a system as such, as in SMS or QS, but an essential approach to the proper functioning of the organisation.

Human factors make it possible to define procedures that are more suited to the staff who are going to use them, to improve working conditions and to adapt resources. They also make it possible to understand malfunctions, non-conformities of a given process which are not necessarily directly linked to risks, but which may subsequently generate situations with safety risks. Human factors is also very useful in understanding events, security risks upstream of their appearances but also retrospectively.

Human factors are transverse and should not be reduced to being integrated into the SMS, to become one of the elements of the SMS. It should also be noted that the regulations have incorporated human factors well before the introduction of the concept of SMS.

2. Human factors TOPICS RELATED TO PART CAMO AND PART 145

This chapter deals with human factors for each standard and common topic related to continuing airworthiness organisations, specifying HF aspects specific to CAMO and 145 organisations.

2.1. Organisational human factors aspects

2.1.1. Commitment of Management

The organisation's management should formally specify how the organisation is working to make safety its primary objective.

One of the key elements associated with the HF approach is, without any restriction, the commitment on the part of the organisation's management, and first and foremost the Accountable Manager, to implement Human Factors within the organisation.

This commitment should include a commitment to train staff in human factors and to enforce its principles in the activities/processes of the organisation, including those related to Just Culture.

This commitment should be published and distributed to all staff of the organisation and non-approved subcontractors working under the quality system of the organisation.

Part CAMO
According to CAMO.A.200 (a) (2), the organisation's management should formally commit to key safety-related principles and include this commitment in its CAME manual or in an associated manual (e.g., Management system manual). According to AMC1 CAMO.A.200 (a) (2) item (b) (3) and (b)(5), the safety policy should include a commitment to apply the Human Factors principles, to encourage staff to report errors, hazards, adverse events, and to apply the principles of just culture.

PART 145
According to requirement 145.A.65 (a), the organisation shall establish a quality and safety policy and include it in its MOE Manual. According to AMC 145.A.65 (a), this policy should include at least a commitment to apply the Human Factors principles and to encourage staff to report errors and adverse events.

2.1.2. Organisational structure/ responsibilities / management

The accountable manager must ensure that both operational staff and those responsible for the quality and management of safety are appointed within the organisation's structure.

With regard to Human Factors, which rather correspond to an approach, a method, a way of taking human aspects more systematically into account in management, the organisation should define the most suitable organisation structure in regard to the FH domain.

The organization may decide to consider that HF do not require any particular organizational structure to support this HF approach or, on the contrary, may decide to set up a dedicated HF structure within the organization to coordinate, set up, manage the actions related to HF.

As human factors is a transverse activity, the company may choose to assign it to its compliance or safety management function or to have a dedicated HF organizational structure.

A specific organisation may be limited to one HF coordinator and/or HF focal point for the organisation and/or per field.

In any case, it is important that all the management (managers, leaders, supervisors, decision-makers, managers, etc.) get involved without restriction with regard to this HF approach practically in the field, through concrete facts, and not only verbally or when the actions related to HF do not generate any cost and not just when human factors lead to a negative outcome.

Middle management greatly influences how these principles will be used in day-to-day activities. One of the challenges for management is the arbitrage between safety/ human factors objectives and other business objectives (punctuality, productivity, trade, etc.). These challenges should be taken into account by senior management to help and support local management in taking human factors into account when taking decisions. This can be done, for example, through specific training courses on this issue related to operational arbitrage.

The management has a major role in promoting safety, a positive safety culture and a just culture.

PART CAMO
As regards the Human Factors in particular, there is nothing in the Regulation to specify how this area should be managed and structured in practice. AMC3 CAMO.A.305 (g) makes only a reference to staff involved in compliance monitoring and in safety management including the application of the HF principles, investigators and trainers to safety including HF. In view of the novelty of the Human Factors principle in CAMO organisations since March 2020, CAMO organisations should pay particular attention to the organisation to be considered in order to implement these concepts and accompany this HF approach in the early stages.

PART 145
As regards the Human Factors in particular, there is nothing in the Regulation to specify how this area should be managed and structured in practice. AMC2 145.A.30 (e) refers only to 'Human Factors staff' and 'Human Factors' trainers

2.1.3. Culture

The management culture within the approved organisation is the set of values, practices and methods shared by all staff of the organisation. These are the ways of thinking and acting that characterise an organisation that establishes its identity and makes it unique.

A positive safety culture is a sustainable set of values, norms, attitudes, and practices within an organisation that minimises staff exposure to conditions that may affect flight safety. In a positive safety culture, common safety concerns, commitments and responsibilities are promoted effectively across the organisation.

A positive safety culture is based on a high level of trust and respect between staff, mid-level and senior management. It should be created and supported at management level and relayed by local management. As with trust, a positive safety culture takes time and effort and can be easily and quickly lost.

An organisation with a good safety culture is the one that has successfully institutionalised safety as a core value of the organisation whose staff at all levels of the organisation share the same safety concerns.

In the case of regulations applicable to continuing airworthiness organisations, there is a reference to ‘positive safety culture’ and ‘just culture’. The concept of ‘just culture’ in these regulations is one of the components of the ‘positive safety culture’. In the past, there has been a reference to ‘non-disciplinary culture’, but this term has been replaced by the more appropriate term ‘just culture’.

Just culture is often used in the relevant regulations in the context of occurrence reporting as a condition for individuals to report occurrences without fear of sanctions.

European Regulation (EU) No 376/2014 on occurrence reporting defines just culture as “a culture in which front-line operators or other persons are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated”.

Just culture should be associated more generally with errors, discrepancies, malfunctions and not only on occurrence reporting. In a just culture, errors detected by any means or known through the internal reporting system are not punished by default. However, those who act imprudently, who are responsible for violations by taking deliberate and unjustifiable risks, who seek to hide them, may be liable to disciplinary action.

Regulation (EU) No 376/2014 and Articles L.6223-1 and -2 of the French Transport Code define a framework for the protection of staff who notify in regard to their employer and to the State.

A just culture should not be limited to declarations, commitments. The organisation should define the organisation, the responsibilities within the organisation to ensure the proper implementation of this just culture, define internal rules describing how the principles of just culture are guaranteed and applied within the organisation, should actively support the management on these issues, should set up committees to distinguish between error-related and violation cases. These internal rules should be widely consulted within the organisation (directorates, HR, staff representatives.).

It is also important to train, raise awareness among operational actors, the other staff of the organisation, the managers on the principles of just culture and safety culture and inform staff about the existence of the “Just Culture Observatory” within the French DGAC.

In addition to containing the “just culture” presented above, the broad concept of “positive safety culture” should, depending on the case, include other components:

- Notification culture: Organisational climate in which people are encouraged, rewarded to notify difficulties in applying rules and procedures, inadequate means, mistakes and identified risks to flight safety. This notion of encouraging the reporting of errors is a key element. This is a clear, precise, formal and written commitment on the part of the Directorate.
- Communication culture: The organisation collects and analyses relevant data and actively disseminates safety information to all staff. The aim is to share as much information as possible that is useful to everyone. The level of authority of a person is no longer assessed by the amount of information he or she has in his own right, but by his or her ability to distribute it to those who need it in the course of their work.
- Learning culture: The organisation is able to learn from its mistakes, is aware and takes the necessary steps to provide all necessary training to its staff.
- Adaptation culture: The organisation is able to adapt effectively to different developments, sees changes as positive, as opportunities.
- Information culture: Operational staff and managers have up-to-date knowledge of the technical, human, organisational and environmental factors that determine safety.
- Flexibility culture: Ability to reconfigure themselves to deal with urgent or high-risk situations.

In general, a culture of an organisation may be too weak or too cumbersome, too closed or open, too bureaucratic or not formalised, too marked by secrecy, too unsuitable and not sufficiently shared internally, too focused on its history and not enough on its future.

If a culture cannot be measured as such, it is important that the organisation can have tools (audits, questionnaires, improvement indicators, etc.) to to ask the right questions on the the company’s culture in order to take the necessary improvement measures in this area if necessary.

PART CAMO

Corporate culture in the general sense is mainly referred to in the Part CAMO as the “positive safety culture”.

This concept of positive safety culture and the concept of just culture are addressed in the GM1 of Annex Vc, GM1 CAMO.A.200, AMC1 CAMO.A.200 (a) (2), GM1 CAMO.A.200 (a) (2), AMC1 CAMO.A.200 (a) (3), GM1 CAMO.A.200 (a) (4) and AMC1 CAMO.A.202.

In particular, the GM1 of Annex Vc, the GM1 CAMO.A.200 (a) (2) refer to Regulation (EU) No 376/2014 and to the definition of ‘Just Culture’ in that Regulation (in particular Article 16 (11)). The concept of just culture as conditions for individuals to report occurrences is presented in the AMC1 CAMO.A.202 (a) and (b) (2).

PART 145

If there is no detailed element in the Regulation on Part 145 on the general concept of culture, the French Decree and instruction SMS dated 22 December 2008, which apply to all 145 organisations, introduce this concept of ‘positive safety culture’.

The only reference to the concept of culture in Part 145 is the “just culture” which, according to AMC 145.A.60 (b) (2), should allow for the free notification of occurrences where necessary without fear of sanctions. If Part 145 does not yet refer to Regulation (EU) No 376/2014, the latter Regulation, which defines the concept of ‘just culture’ (in particular Article 16 (11)) applies to 145 organisations.

2.1.4. Occurrence reporting

2.1.4.1. Subject

The Human Factors play an important role in the reporting and management of occurrences.

This chapter is not intended to describe in detail all the objectives, processes related to the management and reporting of occurrences. Its purpose is to highlight only the aspects important relating to the human factors to be taken into account in this field.

It is already necessary to make a clear distinction between the internal safety reporting scheme and the occurrence reporting system. The first is the one used by the organisations' front-line staff to 'trace' major events internally, but also errors found, difficulties in applying rules and procedures, inadequate means and identified risks to flight safety. The second system concerns the organisation's notification to the Authority and the entities concerned of significant occurrences observed and notified internally.

In general, the internal safety reporting scheme for detecting, reporting and dealing with occurrences is a complex process to be put in place and operated effectively, for reasons mainly related to the Humans Factors:

- Fear of the penalty,
- Management pressures,
- Fear of conflicts between colleagues, with the hierarchy,
- Too cumbersome reporting system,
- Too partial treatment, lack of inadequate action or uncomplete action,
- Culture of secrecy.

This process therefore requires particular attention from the organisations. Such notifications can only be made if a positive safety culture is in place, including an adapted just culture.

PART CAMO

According to CAMO.A.202, Part CAMO organisations must establish internal safety reporting scheme, some of which occurrences must be reported to the Authority according to CAMO.A.160.

According to AMC1 CAMO.A.202, the internal safety reporting scheme should allow for the free and frank reporting of any potentially safety-related occurrences, including incidents, errors or near accidents, safety issues and identified hazards.

Organisations Part CAMO shall raise awareness among their staff on the need to report errors in the context of continuing airworthiness management (e.g.: Error in entering a deadline of an AD in the monitoring system) and not merely reporting errors related to the completion of the maintenance.

PART 145

According to 145.A.60 (b), 145 organisations must establish an internal occurrence reporting system, some of which occurrences must, according to 145.A.60 (a), be reported to the Authority.

2.1.4.2. Occurrence reporting tools

While significant incidents during the operation and management of continuing airworthiness of aircraft and maintenance are generally known by management and reported, there are a number of errors or risks of errors, hazards that are detected by the front-line operators themselves and which should be notified, failing which they will not be analysed and addressed.

This internal reporting system should not be considered by the operational staff and the management as a means to “bypass” the organisational/management structure in place. It should primarily be used to collect some of the errors found by staff in order to improve the system itself. The notifications in question should be made by the persons who committed or failed to commit the error or by persons who discovered an error made by another person without the latter having realised that error.

The principle of notification should not be regarded as negative, as a system of staff denunciation itself. It is therefore important to make staff aware that this is not the case, to remind them the primary objective of this system and to put in place, in addition to the just culture, rules guaranteeing the confidentiality of the information received in the context of notifications.

The notification system should be designed in such a way as to be easily and quickly used by staff. For example, it is important to avoid requiring unnecessary information in large quantities to use several types of forms, long forms to be filled in. The system should be flexible enough to encourage individuals to report and transmit the information they get.

Different communication media can be used such as handwritten notes, simple forms, dedicated IT systems, e-mail, telephone, direct interviews with people. While a form may in some cases may be very useful, it should not, due to its complexity and difficulty in completing it, discourage the reporting of occurrences.

Staff should be trained in the use of this notification system (Theme 10 of the HF training) and know the minimum type of information needed to be transmitted in order to possibly initiate an investigation.

In order to be able to deal thoroughly with a given event, formally notified information may not be sufficient in many cases. It is therefore necessary to be able to meet and discuss with the persons directly or indirectly concerned on the subject.

Interviews in the context of surveys of reported occurrences should be based on clearly identified processes using appropriate tools.

PART CAMO
According to CAMO.A.300 (a) 10 and AMC1 CAMO.A.300, the organisation shall describe the procedure for internal safety reporting scheme in its CAME manual.

PART 145
According to 145.A.70 (a) 12 and AMC 145.A.70 (a) (ref: Chapter 2.18 of the MOE), the organisation shall describe in its MOE all its procedures associated with the requirements from 145.A.25 to 145.A.90, therefore including also 145.A.60 (b).

2.1.4.3. Confidentiality

In order to avoid sanctions or conflicts, individuals may want to report events anonymously. For fear of being identified or identifying a person, these anonymous notifications are generally too poor and difficult to use and therefore have little interest in most cases.

The basic principle is that any person who is required to observe an error committed or not by him/her is responsible for notifying it so that it can be analysed and used by others.

A fault would be to retain knowledge of an error or risk of error which could subsequently recur with serious consequences.

The only way of knowing the real contributory factors of an event is to obtain from the individuals concerned maximum details of the actual situation at the time of the event, including the personal situation (illness, fatigue, personal events, etc.) of the persons concerned (physical, psychological, and psychosocial aspects). All this requires real transparency on the part of actors on the subject.

The quality of such information depends to a large extent on the freedom of speech of the persons concerned and their trust in the guarantees linked to the confidentiality of the information transmitted.

The report system should guarantee to staff that such information remains confidential. Staff should be able to rely on formal commitments by management and managers on the subject.

In this context, it is important that intermediate notes or reports related to reported occurrences do not mention any specific data, personal information related to privacy, medical information or information related to medical confidentiality (concept of de-identification of records).

Regulation (EU) No 376/2014, which is also applicable to all organisation and concerning notification of occurrences, also places great emphasis on this concept of confidentiality.

PART CAMO
According to AMC1 CAMO.A.202 (a) and (c), the organisation must ensure confidentiality in the context of notifications.

PART 145
While the concept of confidentiality is not formally mentioned in Part 145, it is fully applicable to 145 organisations and is one of the conditions for such occurrences to be effectively reported internally.

2.1.4.4. Investigators, analysts

The organisation should designate persons responsible for handling occurrence reports.

Those persons should be above all impartial, objective and independent.

They should, in addition to their technical skills, have appropriate skills in the field of communication, in interviewing the staff concerned by these events, in collecting, analysing and compiling available information on the subject, in the proper conduct of the surveys.

Given the complexity of the investigation process, it is important that persons designated as investigators are properly trained in this area.

Such persons should have sufficient legitimacy from staff to obtain documents and information relating to the events to be studied and should be able to meet freely with people in the various sectors of the organisation and give confidence to those interviewed. They should have sufficient authority, precise guarantees from management to effectively guarantee the confidentiality of the information obtained.

Responsibility for a given investigation should be formally attributed to a person authorised by the organisation and placed under the authority of a person independent of the activities in question.

PART CAMO

AMC3 CAMO.A.305 (g) refers in particular to staff performing internal investigations and the need for them to be trained in HF.

PART 145

In part 145, there is no reference to staff carrying out internal investigations.
According to GM2 145.A.30 (e), the concepts of knowledge of investigative rules are rather linked to quality staff.
In all cases, as organisations have to analyse their events, this work can only be done by suitably qualified persons, including on HF who are essential in the analysis process.

2.1.4.5. Occurrences' analysis

The Human Factors approach is of major interest in the analysis of reported occurrences. It makes it possible to understand the events that have taken place taking into account general and specific human performance and to provide a 'human' and pragmatic vision for the treatment of events. The analysis of events should not only be used to see what happened, nor to identify those directly concerned, but should above all make it possible to identify the causes and contributory factors. The analysis of events is often a complex exercise. There are several methods that make it possible to identify the associated causes from events. The organisation should choose the method of analysis depending on the case and adapted to its activity, which take sufficient account of the human factors. The methods in question include the following:

1. **BOWTIE method**

This method combines a fault tree (identifying causes) and an event tree (identifying damage caused). It organises, around each undesirable event, the prevention barriers that prevent it from happening, and the protection barriers that limit their consequences.

This allows an overall analysis of the links between hazards, causes, effects on events and a set of barriers. This approach is based on useful visualisation and demonstration functionalities in risk management.

This comprehensive approach makes it possible to:

- assess the contribution of each cause and the severity of each risk,
- identify and position barriers to prevention and protection,
- assess aggravating factors that reduce the effectiveness of barriers,
- assess the robustness and contribution of barriers to risk mitigation,
- assess the impact of these barriers on the overall risk scoring.

Due to its detail and precision, this method should particularly used for critical events where it is necessary for the barriers to be easily understood. The effectiveness of the barriers can be analysed in terms of HF: training, organisation, cooperation, interface, decision-making, etc. The Bowtie method is adapted to the positive approach to human performance and the systemic analyses expected in this area.

2. **HFACS-ME method** (Human Factors Analysis & Classification System — Maintenance)

The HFACS-ME method is based on the model of Reason's 'Swiss cheese'; It links individual's deficiencies to supervision, business conditions and organisational framework. It is a tool for in-depth analysis of the human and organisational dimensions. Mainly used for retrospective analyses of major events, it can also facilitate a proactive approach by identifying recurrent vulnerabilities that show systemic weaknesses in risk management. It is highly documented and applied to many business areas with a strong HF dimension in risk management.

3. **MEDA method** (Maintenance Error Decision Aid)

Support to the Decision on Maintenance Errors (MEDA) is a directly designed method for the retrospective analysis of aeronautical maintenance events. It considers that the error is not intentional and that it is necessary to shed light on the factors which may have contributed to its occurrence; Their reduction then limits the risk of repeating errors. These factors must be investigated at the workplace and in its environment, supervision and organisational dimensions. This method is structured and well documented: principles, analytical steps, implementation guide.

4. **Causal tree method**

The causal tree method consists in analysing and representing the causes that contributed to the occurrence of a failure, generally based on experience feedbacks. It is based on an accident model as a series of closely related causes. A failure results in others in cascade. Rather, it works for the workstation step and less in a systemic approach and for open activities where many processes interact, and people have important adaptive and retrieval functions.

5. ‘5 whys’ method and ‘5 M’ method

The ‘5 whys’ method is a simplified variant of the cause tree method. It seeks to investigate the primary causes by going beyond the surface of the facts.

This method is retroactive. Its approach is linear. It is easy to implement in relation to non-complex events. The method makes it less easy to identify interactions.

For ensuring that all important causes are identified, it is useful to combine it with the 5M method (Labour, Means, Methodology, Material, Milieu).

Example of a simplified analysis using the 5 whys method:

Observed event = “A mechanic fails to perform a maintenance task”

1. Why? = improper restart of a procedure after an interruption,
2. Why? = non-recording which tasks were performed when interrupted,
3. Why? = significant pressure and stress when interrupted,
4. Why? = line management insufficiently aware of risks related to interruptions and significant managerial pressures,
5. Why? = HF training for local managers do not sufficiently address the subject, the practical conditions to respect, the instructions to recall and the points to check when they must ask a person to interrupt a task as a matter of urgency.

It is important to plan and put in place an action plan associated with the investigation to be carried out and the interviews to be planned. All persons who have been directly or indirectly involved in an error or who hold information which could help to the analysis of that error should be freely accessible.

In some cases, it is possible to consider studying practically and visually the event depending on possibilities offered (concept of reconstitution).

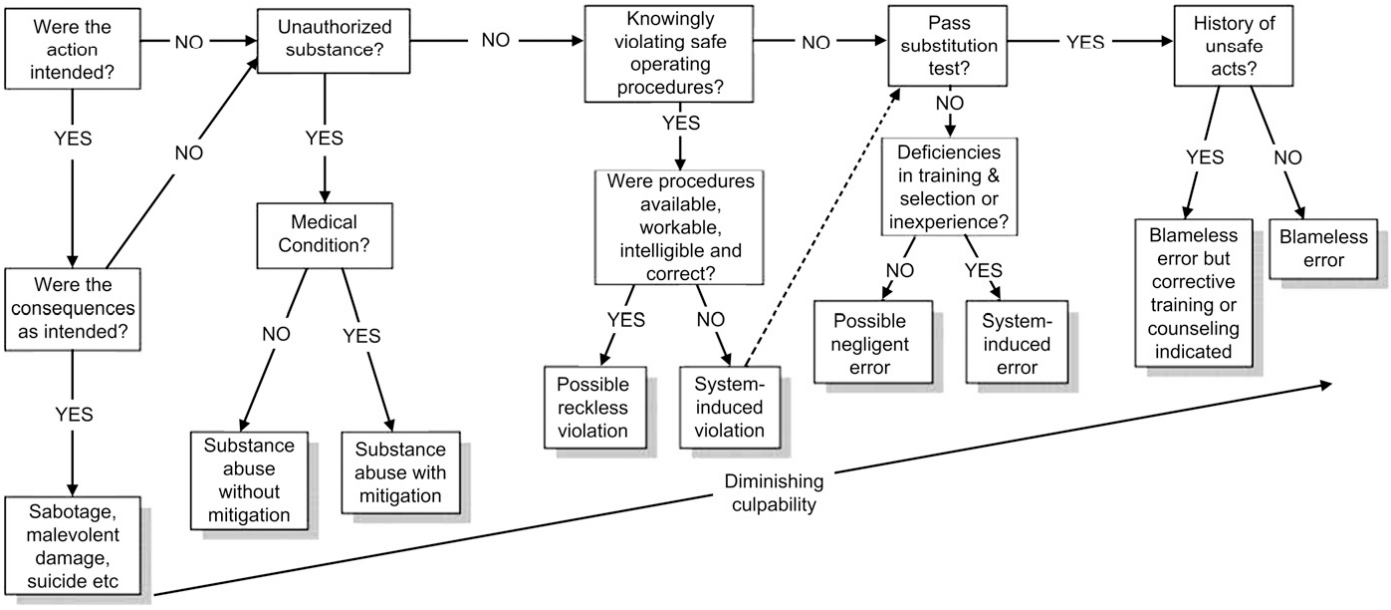
It should be possible to perform interviews calmly, with complete discretion, in a quiet atmosphere and without being disturbed at any time.

In the context of just culture, it is essential not to guide analysis in the search for individual responsibilities by default.

Depending on the case, event analysis may also require classifying the nature of errors and the nature of deviations from the rules and how serious they are, i.e., their consequences on flight safety.

To assess whether an error is related only to the person who made it or could have been made by a colleague, the “substitution test” method can be applied. It consists of determining whether a person who has received the same training, who possesses the same experience, privileges or responsibilities as the person directly involved in an event could have in the same circumstances (environmental, resources-related, personal circumstances, etc.) committed the same error. This exercise may be carried out with several persons meeting the criteria in question. If this is the case, corrective actions must concern all persons potentially concerned.

In addition, a decision tree such as the one below can help differentiating between errors and violations in order, in most cases, not to punish the first line actors concerned and to take appropriate decisions (refreshing training to raise awareness of actors concerned, review general training, review procedure…).



PART CAMO

According to AMC1 CAMO.A.202, the organisation should have a process to analyse causes and contributory factors, including technical, organisational, managerial and HF aspects.

PART 145

According to AMC 145.A.60 (b), the organisation shall identify event contributing factors. Although not formally mentioned, the analyses must include the HF aspects associated to the events and not be limited to technical aspects.

2.1.4.6. Corrective actions and feedback

Corrective actions (procedures, maintenance data, training, awareness raising, etc.) which would be inappropriate for a given event (e.g.: punishment of a person) could progressively discourage staff from using occurrence reporting systems and thus reveal counterproductive.

Corrective actions should also cover all HF related causes and should not be limited to technical actions (changes to the product concerned, etc.).

Corrective actions may be limited to the people concerned but may also concern a whole category of staff of the organisation if need be.

Feedback on the analyses and actions taken related to the reported occurrences should be made promptly to the persons who reported the occurrences and to all other relevant persons of the organisation to continue encouraging them to report occurrences and to demonstrate the safety relevance of their reporting.

Feedback is an element that should demonstrate to all staff that they have an active role in safety management and can also improve the safety level of the organisation.

This makes it possible to ensure the sustainability of the system, which is based primarily on the motivation and commitment of each individual.

PART CAMO

According to CAMO.A.202 (c) (1) and AMC1 CAMO.A.202 (b) (4), the organisation shall address the causes and contributing factors identified for each event analysed and implement appropriate corrective actions following these investigations.

According to AMCI CAMO.A.202 (d), the organisation shall provide individual and global feedback to staff on the actions taken to ensure that staff will continue using the reporting process.

PART 145

According to AMC 145.A.60 (b), the organisation must implement actions to address the causes identified for each event analysed. As these events are also analysed on HF aspects, corrective actions for these HF aspects need to be put in place.

According to AMC 145.A.60 (b) 4, the organisation must provide individual and generalised feedback to staff on the actions taken to ensure that staff will continue using the reporting process.

2.2. Staff-related HF aspects

2.2.1. General considerations

Many Human Factors aspects concern individuals.

One important element highlighted in the Human Factors approach is to provide staff with HF training.

The organisation shall establish and monitor the competences of personnel involved in continuing airworthiness activity. In addition to the technical expertise needed to perform a given function, competences should include a practical understanding of Human Factors and human performance appropriate to the functions of the individuals in the organisation.

The primary objective of Human Factors training is to give all persons directly or indirectly involved in continuing airworthiness an understanding of human limitations and performance to consider in continuing airworthiness activities, and of the factors contributing to errors, their impact on flight safety and the consideration that errors can be avoided.

This training should globally demonstrate the importance of Humans Factors in continuing airworthiness.

HF training is a key measure as it makes it possible to raise staff awareness of Human Factors, to bring them to question themselves and to take certain measures when they are themselves in certain situations.

The principle is that, based on the awareness of error contributing factors, everyone can react anticipatively to avoid potential errors, for instance by declaring themselves unfit to perform a task when relevant.

The HF knowledge acquired by a person linked to his or her activities should enable him or her to have, in a certain way, some reflexes to monitor their abilities and limitations.

For example, a person who arrives at work or takes on a particular task should ask whether he or she can carry out the work properly, the task he has been assigned. If, for various reasons (fatigue, medicines, etc.), an individual does not feel fit or ready for the task or is not fully prepared, he or she should discuss it with the local management and envisage possible solutions:

- Reassigning the task to another person
- or confirming that the task can been carried out by this person under certain conditions (e.g., by reading with greater care the procedure to be applied, by signing-off in more detail each sub-task performed, by defining longer time to perform the task, by providing for more frequent breaks, or by providing for additional checks by an independent person, etc.

Moreover, as already pointed out above, HF is not just an approach centred on each individual. It is also an approach which concerns organisations and thus managers and actors who have specific roles in applying the HF programme, in managing services/processes, in working methods, in managing resources, etc.

The principle of training is also to enable these people to apply their HF knowledge to staff under their responsibility, to the processes and to the activities for which they are responsible (e.g., considering the rules allowing technicians to use aircraft access without fear of the height).

One of the complex points regarding HF training is training effectiveness evaluation. It is quite easy to organise assessments of theoretical knowledge acquired in HF training, but it is less easy to assess level of adoption and practical implementation of these principles by those trained persons.

While measures related to the Human Factors approach also correspond to other concrete actions to adapt environments, resources, and information, it is clear that Human Factors training of the organisation's staff is essential because it allows ensuring that Human Factors principles are taken into account in the long term in the organisations.

The HF as already specified are not an element of the SMS, nor an element of the quality system (or compliance monitoring). This is an element that is different but closely related to the SMS and the quality system.

HF training may be carried out at the same time as safety and quality training

PART CAMO

According to CAMO.A.305 (g), the organisation shall establish and control the competency of personnel, including appropriate knowledge of Human Factors and safety management principles.
As already specified, HF are neither part of the Safety Management System or of the Quality (or compliance monitoring) system. This is a different but closely related element to the SMS and to the Quality system.

As regards HF training, the AMCs for Part-CAMO organisations propose by default to organise HF training together with Management System training under the heading 'Safety Training' (see AMC3 CAMO.A.305 (g)). It is important to make a clear distinction between these principles.

PART 145

According to 145.A.30 (e), the organisation shall establish and control the competence of the personnel, which formally includes knowledge of Human Factors.

Unlike the Part CAMO, the HF knowledge requirement is separated from the Safety Training requirement specified in the French Decree of 22 December 2008 on SMS.

2.2.2. Staff to be trained

It is noted, referring to certain accidents and incidents, that Humans Factors aspects linked to human errors and events are not limited to front line operators (technicians, technical agents) but also concern other staff in the organisation (management, staff involved in support activities, etc.).

In general, the Human Factors approach is effective in the long term if all staff are aware of and trained in Human Factors and understand the importance and challenges of Humans Factors for them, for the organisation and for safety in general.

HF training therefore concerns most of the organisation's staff, namely:

- Management,
- Operational staff performing the organisation's activity,
- Support staff or services,
- Quality (or Compliance Management) system personnel,
- Safety Management System personnel,
- All other personnel involved in the organisation's technical activities,
- All persons responsible for defining and managing Humans Factors training (e.g.: HR, Management) and technical trainers/evaluators.

Other employees indirectly involved may also be concerned by HF training (e.g.: Facilities Manager dealing with buildings, premises, etc., sales agents, etc.). While a large proportion of staff should receive HF training, some employees are not concerned (e.g., executive assistant, accounting agents, cleaning staff, reception staff, security staff, etc.).

PART CAMO

According to AMC3 CAMO.A.305 (g) persons to be trained in HF are:

- Nominated persons,
- Product line manager in Continuing Airworthiness management,
- Compliance monitoring staff,
- Safety management staff,
- Persons directly concerned by the application of HF principles,
- Internal occurrences analysts,
- Safety trainers (including HF),
- Airworthiness review staff,
- Technical support staff (planners, specialists, record management staff),
- Staff involved in developing and revising of maintenance programmes and assessing their effectiveness, or working on reliability programmes,
- Contract staff with limited duration contract in the above categories.

Although not formally specified in Part CAMO, the following personnel should also receive HF training:

- Accountable Managers: they must have a good understanding of their responsibilities vis-à-vis the organisation and must therefore have at least Human Factors awareness,
- Staff of non-approved subcontractors working under the organisation's approval.

PART 145

According to AMC 145.A.30 (e), the list of persons concerned by HF training for Part 145 is as follows:
- Maintenance manager, intermediate managers, and supervisors,
- Quality staff and auditors,
- Human Factors staff (Human Factors coordinators, trainers, etc.),
- Certifying staff, support staff and technicians, including specialised services staff,
- Technical staff working in support services such as the technical office, preparation, and document management,
- Store department staff, purchasing department staff;,
- Staff managing and operating ground equipment (platforms, groups, access, docks, etc.).

Although not formally specified in Part 145, the following personnel should also receive HF training:
- Accountable Manager: they must have a good understanding of their responsibilities vis-à-vis the organisation and must therefore have at least Humans Factors awareness,
- Contract staff with limited duration contract,
- Staff of non-approved subcontractors working under the organisation's approval,
- Safety Management System staff concerned by to the French Decree of 22 December 2008 on SMS (Safety manager / Coordinators, investigators).

2.2.3. Training programme

The basic HF training programme should cover the following main topics:

1. General information on Human Factors (definition, objectives, accident, and incident statistics, etc.)
2. Safety culture and organisational factors (safety culture, just culture, HF related organisational factors, responsibilities of management and of staff, etc.),
3. Human errors (theories, type of errors, violations, error consequences, prevention and detection barriers, etc.),
4. Human performance and limitations (vision, hearing, memory, health and fitness, etc.),
5. Human Factors related to the working environment (pressure, workload, duty times and shift work, noise, lighting, etc.),
6. Human Factors related to procedures, information, practices, and tools (type of inspection, recording, use of procedures, critical tasks, avoidance of errors),
7. Human Factors in communication (change of team, dissemination method, cultural differences, etc.),
8. Human Factors in teamwork (responsibilities of each person, of the team, of managers, decision making, etc.),
9. Professionalism and integrity (importance of keeping knowledge up to date, behavioural errors, self-confidence, etc.),
10. Presentation of the organisation's safety and HF (internal reporting, interest of external reporting, just culture, investigations, processing, feedback) system.

It is important to distinguish between HF issues related to technical activities (e.g.: manual dexterity, application of procedures, etc.) from more general HF issues (e.g., communication, management of working time and workload, teamwork, situational awareness, leadership / decision-making, etc.) and from HF issues regarding the organisation (e.g.: management commitment, reporting process, etc.).

This programme is a standard programme that organisations can enrich depending on to their experience and knowledge, organisational particularities, and activities.

Subjects may be combined, divided, or ordered differently depending on the characteristics of the organisation, activities and the personnel concerned.

The organisation should also consider including in this training complementary subjects which might not be included in the basic programme defined in the Regulation.

Examples of complementary topics:

- In the "communication" chapter, organisations could develop, as appropriate, specific training on certain new modes of communication (use of personal mobile phones, more widespread use of new audio/video communication tools like skype or equivalent, communication by SMS, etc.).
- In the "teamwork" chapter, organisations, as appropriate, could develop teleworking aspects and provisions to maintain team cohesion in the case of teleworking, etc.
- In the chapter on "professionalism and integrity", organisations could develop, as appropriate, aspects regarding relations between colleagues, with management, with the organisation in general (reliability, transparency, values, respect for others, positive attitude, support for others, active listening, mutual assistance, cooperation, strength of proposals, curiosity, initiative, recognition, delegation, etc.).

AMC3 CAMO.A.305 (g) defines the expected outcomes of the safety training which should cover the topics presented in GM2 CAMO.A.305 (g). This GM2 offers the following training syllabus:

1	**General and Introduction to Safety Management and HF** 1.1 Need to address safety management and human factors 1.2 Statistics 1.3 Incidents	5	**Environment** 5.1 Peer pressure 5.2 Stressors 5.3 Time pressure and deadlines 5.4 Workload 5.5 Shift work 5.6 Noise and fumes 5.7 Illumination 5.8 Climate and temperature 5.9 Motion and vibration 5.10 Complex systems 5.11 other hazards in the workplace 5.12 Lack of manpower 5.13 Distraction and interruption
1a	**Safety risk management** 1a.1 Hazard identification 1a.2. Safety risk assessment 1a.3. Risk mitigation and management 1a 4 Effectiveness of safety risk management	6	**Procedures, information, tools and practices** 6.1 Visual inspection 6.2 Work logging and recording 6.3 Procedure — practice/ mismatch /norms 6.4 Technical documentation — access and quality
2	**Safety culture/organisational factors** 2.1 Justness/Trust 2.2 Commitment to safety 2.3 Adaptability 2.4 Awareness 2.5 Behaviour 2.6 Information	7	**Communication** 7.1 Shift / task handover 7.2 Dissemination of information 7.3 Cultural differences
3	**Human errors** 3.1 Error models and theories 3.2 Type of continuing airworthiness management and maintenance tasks 3.3 Violations 3.4 Implications of errors 3.5 Avoiding and managing errors 3.6 Human reliability	8	**Teamwork** 8.1 Responsibility 8.2 Management, supervision and leadership 8.3 Decision-making
4	**Human performance and limitations** 4.1 Vision 4.2 Hearing 4.3 Information-processing 4.4 Attention and perception 4.5 Situational awareness 4.6 Memory 4.7 Claustrophobia and physical access 4.8 Motivation 4.9 Fitness/Health 4.10 Stress 4.11 Workload management 4.12 Fatigue 4.13 Alcohol, medication, drugs 4.14 Physical work 4.15 Repetitive/ complacency	9	**Professionalism and integrity** 9.1 Keeping up to date and currency 9.2 Avoiding error-provoking behaviour 9.3 Assertiveness
		10	**Organisation of the Human Factors approach** 10.1 Safety policy and objectives, just culture principles 10.2 Notification of errors and hazards, internal safety reporting scheme 10.3 Investigation process 10.4 Action to address problems 10.5 Feedback and safety promotion

The greyed subjects are the differences with the HF training programme for 145 organisations.
This programme includes topics dedicated to safety management and to the company's SMS (Chapter 1.a) in addition to transverse subjects on HF. It is important to make a clear difference in training on the positioning of HF vis-à-vis the SMS.
The HF subjects listed above are globally the same as those for HF courses for part 145. It is important to differentiate HF training expectations for CAMO. HF training is primarily aimed at CAMO staff as part of their continuing airworthiness management activities (e.g., too noisy environment, insufficient working space, fatigue, etc.). This training should also address HF aspects applying to maintenance and to mechanics to ensure that maintenance-related continuing airworthiness management decisions take HF aspects properly into account.
In Chapter 6, a specific additional point could cover, for example, the activities of entering information in the continuing airworthiness management organisation's information systems, and the associated risks of errors. In Chapter 7, additional points could cover the understanding of order forms and files sent to maintenance organisations, and communication with contractors.

PART 145

The Human Factors training syllabus presented in GM 145.A.30 (e) introduces practical knowledge of human factors within a 145 approved organisation.
GM 145.A.30 (e) suggests the following HF syllabus:

1	**General and introduction to the Human Factors** 1.1 Need to address Human Factors 1.2 Statistics 1.3 Incidents	5	**Environment** 5.1 Peer pressure 5.2 Stressors 5.3 Time pressure and deadlines 5.4 Workload 5.5 Shift work 5.6 Noise and fumes 5.7 Illumination 5.8 Climate and temperature 5.9 Motion and vibration 5.10 Complex systems 5.11 Hazards in the workplace 5.12 Lack of manpower 5.13 Distraction and interruption
		6	**Procedures, information, tools and practices** 6.1 Visual inspection 6.2 Work logging and recording 6.3 Procedure — practice/ mismatch /norms 6.4 Technical documentation - access and quality 6.5 Critical maintenance tasks and error-capturing methods (independent inspection, reinspection, etc.)
2	**Safety culture / organisational factors**	7	**Communication** 7.1 Shift / task handover 7.2 Dissemination of information 7.3 Cultural differences
3	**Human errors** 3.1 Errors models and theories 3.2 Type of errors in maintenance tasks 3.3 Violations 3.4 Implication of errors 3.5 Avoiding and managing errors 3.6 Human reliability	8	**Teamwork** 8.1 Responsibilities 8.2 Management, supervision and leadership 8.3 Decision-making
4	**Human performance and limitations** 4.1 Vision 4.2 Hearing 4.3 Information-processing 4.4 Attention and perception 4.5 Situational awareness 4.6 Memory 4.7 Claustrophobia and physical access	9	**Professionalism and integrity** 9.1 Keeping up to date / currency 9.2 Error provoking behaviour 9.3 Assertiveness

	4.8 Motivation 4.9 Fitness/Health 4.10 Stress 4.11 Workload management 4.12 Fatigue 4.13 Alcohol, medication, drugs 4.14 Physical work 4.15 Repetitive tasks / complacency		
		10	**Organisation's HF program** 10.1 Reporting errors 10.2 Policy to encourage notification 10.3 Error investigations 10.4 Action to address problems 10.5 Feedback

The greyed subjects are the differences with the HF training programme for the Part CAMO organisations. The syllabus for CAMO organisations specifies the subjects of Chapter 2, namely:
2.1 Justness/Trust
2.2 Commitment to safety
2.3. Adaptability
2.4. Awareness-raising
2.5. Behaviour
2.6. Information
These subjects are fully adapted and can be applied by 145 organisations.
In Chapter 4, an additional point could be the vertigo of technicians working at height. In Chapter 6, bearing in mind that written communication is the main means of communication for a mechanic, an additional point could cover raising awareness on use and application of maintenance data (documentary structures, reading, printing, etc.). In Chapter 7, a specific additional topic could cover, for example, technicians working in a multilingual team.

2.2.4. HF trainer

Humans Factors trainers play a crucial role in successfully implementing a Human Factors approach in the company. They help promoting the “HF culture” for staff by persuading them that individual, voluntary and continuous participation in the Human Factors approach allows making a major contribution to improving flight safety.

As in any field, it is important that HF trainers be competent in this Human Factors domain and be pedagogue.

Given the subject in question, the subjects to be addressed, trainers should perceive the interest of Human Factors and should be interested in these issues. It is preferable to involve voluntary trainers for HF training courses rather than designating trainers who wouldn’t necessarily be comfortable with this type of training.

The main aim of this training is to change minds, to change certain attitudes of individuals within an organisation rather than to convey detailed knowledge.

Trainers should have an open mind in all aspects of human sciences, psychology, have the ability to get staff express themselves in this field during training and have good listening on these subjects.

For Human Factors training, it is important that trainers be credible enough to convey the message to staff. They should be recognised, accepted by trainees. They should have a certain legitimacy within the organisation.

Trainers should have both theoretical and practical knowledge of these subjects. They should be able to teach HF in participatory mode, in a theoretical manner, but also be able to share real HF related situations with trainees. Their expertise should not be limited to theoretical knowledge of HF.

It is sometimes preferable for trainers to be independent of the work activity of the staff to be trained, making it easier for staff to report experience without fear of judging their abilities.

It is important that the HF trainer be an active actor, a relay, a reference in safety-related subjects, with participatory pedagogy competences and good knowledge of HF related subjects (Safety Management System, Quality system or Compliance Monitoring, event reporting / management, etc.).

In addition to the above qualities, trainers should also fulfil the following conditions:

- Proven training experience or pedagogical competence (sufficient and current training),
- At least 3 years of experience in aviation,
- Appropriate knowledge of continuing airworthiness activities,
- Completion of a full Human Factors training in the context of continuing airworthiness of 3 to 5 days duration,
- Completion of SMS training,
- Evaluated in a real training situation. Evaluation by another HF trainer/evaluator or an external body.

HF trainers should regularly be trained in this field to avoid repeating over training courses the same information or even information that would no longer be current.

Trainers should continue to keep abreast of developments related to HF but also of new maintenance and continuing airworthiness management methods that may have links with HF.

Recurrent training of trainers themselves can be provided through conferences, seminars or working groups on Human Factors.

As noted above, HF trainers should have experience in aviation and knowledge of continuing airworthiness activities. A generalist HF trainer or from fields very different from aeronautics (e.g., medical, rescue, nuclear, chemistry, etc.) is very likely to have difficulties in “getting the message across” to trainees working in continuing airworthiness if they have little knowledge of their jobs.

When the trainer's practical experience in the field is insufficient (e.g., HF trainer with mainly experience in air operations) a possible solution is to organise the training with a more theoretical part by the generalist HF expert complemented by a more practical HF training course by a continuous airworthiness expert trained in HF. Training can also be organised in pairs, with training being delivered at the same time by two trainers, the 'practical' trainer providing examples, work situations, etc. during the theoretical training course of the 'generalist' trainer.

PART CAMO
According to AMC3 CAMO.A.305 (g) trainers should receive initial and continuation Humans Factors training.

PART 145
According to AMC2 145.A.30 (e) trainers should receive initial and continuation Human Factors training.

2.2.5. External training

The elements presented above show the benefits for organisations of having their own trainers for HF training. They have a good knowledge of the organisation, its developments, observed and reported events, and staff and know better than anyone the internal HF training needs. They can keep abreast of developments in the organisation regarding Humans Factors related aspects and thus be close to individuals and training needs in the field.

In some cases, it may be difficult for organisations to have HF trainers in-house. This is particularly true for very small organisations. Some companies also choose to contract HF training to an external body to ensure a training legitimacy.

In such cases, Humans Factors training may be delivered by independent trainers or by training organisation acceptable to the Authority.

Regarding the acceptance of companies delivering HF training, approved continuing airworthiness organisations delivering Human Factors training in-house and Part-147 organisations delivering basic Human Factors training are by default considered acceptable by the Authority to deliver HF training to other continuing airworthiness organisations based in France.

An approved continuing airworthiness organisation wishing to use the services of a HF training organisation (not Part-145, not Part-CAMO and not Partie-147) or of an independent trainer should verify compliance with the conditions of 2.2.4 and the additional conditions below.

Competency	**Basic criteria for delivering HF initial training**	**Other equivalent criteria**
Pedagogy	Have received training as a professional trainer by a recognised organisation.	Worked for at least 3 years as adult education trainer in a professional field and pass evaluation on HF pedagogical aspects by an external body or evaluator.
Aeronautical airworthiness knowledge and experience	Working knowledge in the field of maintenance and/or continuing airworthiness management (e.g., professional experience, work or studies carried out, internship in company, etc.).	Completed at least 3 years in aeronautical maintenance and/or continuing airworthiness management.
Human factors	Diploma recognised by National Education (at least University Diploma or Master level) in human sciences.	Completed at least 60 hours of training in HF domains.

The continuing airworthiness organisation and the external trainer or the external training organisation should meet for preparing the training prior to delivering any training so that the trainer can account the organisation's characteristics and the typical events it has experienced involving Humans Factors to integrate these aspects into the training.

It is recommended that external trainers perform a phase of observation of the organisation's actual activity. A study of the HF elements described in the CAME (Continuing Airworthiness Management Exposition) and/or MOE (Maintenance Organisation Exposition) and reporting system is recommended to provide trainees with information on HF related internal operating resources and means.

If this HF training preparation phase by the external trainer and the organisation is essential, designated persons from the organisation involved in the HF approach (HF correspondents, Head of SMS, etc.) should also take part in the training sessions of the organisation's staff to assist the external trainer on all matters relating to the organisation's general and specific activities.

This principle is even more important for an external trainer with in-depth basic HF competences but without substantial practical experience of continuing airworthiness.

As regards the validation of eLearning training, the continuing airworthiness organisation should define acceptability criteria prior to evaluation and define the evaluation processes for accepting or not certain eLearning HF training tools.

PART CAMO

According to AMC3 CAMO.A.305 (g) (d), Humans Factors training may in some cases be delivered by independent trainers or training organisation which must be acceptable to the Authority.

Part CAMO Organisations that deliver Human Factors training in-house and Part-147 organisations delivering basic Human Factors training are considered acceptable by the French Authority to deliver HF training to Part CAMO organisations

PART 145

According to AMC2 145.A.30 (e) (3), Human Factors training may in some cases be carried out by independent trainers, by training organisation which must be acceptable to the Authority.

145 organisations providing their Human Factors in-house training and Part-147 organisations that carry out basic training are considered acceptable by the French Authority to provide HF training in 145 organisations.

2.2.6. Recognition of previous HF training

The recruitment of staff in the organisation may lead to assessing the acceptability of HF training completed in the past by these persons.

It is possible ex post to accept initial HF training courses completed in the past, provided that sufficient information is available regarding the entity that provided the training and the training itself to allow:

- Checking compliance with the acceptability criteria for the external entities who delivered these HF training courses (see previous section);
- And to check that contents, duration, supporting documents and certificates regarding these HF courses are acceptable.

In all cases, external training courses will not cover the specific elements of the continuing airworthiness organisation (area of activity, history, procedure, incidents, culture, reporting system, etc.). This requires a minimum training module for those new employees already trained in HF.

In the event of a lack of evidence provided by the person or training organisation, it is always possible to validate the knowledge by means of theoretical assessments/MCQ supplemented by an evaluation by operational manager of the person's ability to take into account and apply the HF principles (e.g., communication, teamwork, compliance with procedures, etc.).

If evidence is very clearly insufficient to decide on the level of HF knowledge, further HF training shall be performed.

PART CAMO
As the concept of HF in Part CAMO organisations is new, this principle of recognising previous HF training should not apply by default in the first time.

PART 145
145 organisations may recognise previous HF training courses with all necessary precautions and checks.

2.2.7. Initial training

2.2.7.1. Subject

Initial training should be provided when someone joins the organisation but also when changing job.

Personnel concerned should be trained no more than 6 months after their recruitment, including interim staff, depending on assignment duration. However, it is recommended that initial training be carried out before the personnel is allowed to work not under supervision.

Initial Human Factors training should:

- Address theoretical aspects of HF applicable to any continuing airworthiness activities,
- Target the organisation's domain (maintenance or continuing airworthiness management),
- Be adapted to the organisation's fields of activity (e.g., HF Module for Line Maintenance),
- Be adapted to the jobs / roles of the staff to be trained (certifying staff, Airworthiness Review Staff (ARS), painters, electronic input staff, etc.),
- Take into account risk of errors, the organisation's experience of Human Factors related occurrences posing a risk to flight safety, incidents and significant errors affecting the organisation.

Training contents and duration should be adapted to the company's size and activity, the type of staff to be trained and the functions they perform.

HF expertise level should be adjusted according to the profiles of those directly concerned by the implementation, support and/or use of HF concepts (HF manager, top management, operational managers, trainers, organisation staff, etc.).

Training should not focus too much on the organisation's main activity (e.g., aircraft maintenance) but should also address specific business areas (e.g.: maintenance of equipment).

Overly generic training ('on the shelf training') can quickly show limitations.

Depending on the circumstances, the organisation should consider insisting in initial training on those subjects it considers more important than others from a training perspective. For example, one of the important subjects, which should require sufficient training time, is the proper use of and compliance with procedures by the staff.

PART CAMO

Initial HF training defined in Part CAMO.A.305 includes elements on safety management and on HF.
As HF has an important transverse role, this training proposed in the associated AMC can also be performed in a single or two training courses (HF training and safety risk management training).
CAMO.A.305 (g) specifies that persons in the organisation must have knowledge of the Human Factors principles in relation to their functions and responsibilities, in addition to knowledge of safety management principles.
Initial HF training contents and duration should be adapted to the size and activity of the organisation, the type of staff to be trained and the functions they perform. Training for Part CAMO should therefore be adapted to continuing airworthiness management activities, to activities related to airworthiness review certificates, to activities related to the management of permits to fly if applicable and to related jobs and functions.
For example, HF training for Part CAMO organisations should also cover the specific HF training needs of:

- Airworthiness reviews Staff performing physical examinations of aircraft,
- Part CAMO staff whose function is to represent their Part CAMO organisation and to ensure coordination between their CAMO and the 145 organisations, in the frame of the supervision of aircraft maintenance checks.

PART 145

Initial HF training specified in Part 145 addresses only the Humans Factors related elements.

The French decree date on December 2008 on SMS also requires training on safety management in general. It may be possible to combine HF training with this safety management training or any other training (e.g., Quality system), provided to differentiate between HF and other elements addressed in these training courses.

Training of mechanics in Human Factors in accordance with Part 66 shall be considered as basic training within the framework of the mechanic's licence. It is limited to licensed engineers and not to all technicians. It is justified above all for engineers with a Part 66 licence who become independent mechanics in general aviation and do not work in approved organisations. It does not constitute initial training for Human Factors as defined in Part 145. However, if necessary, the initial training provided to staff who have had this basic Part 66 HF training could be reduced by taking account of previous knowledge. In all cases, additional training must be provided to newcomers before validating their initial training courses, taking account of the specific characteristics of the organisation and of its Human Factors programme.

145.A.30 (e) specifies that the organisation's staff must understand the application of Human Factors and of human performance in their activities.

This initial HF training should be adapted, in terms of contents and duration, to the size and activity of the company, the type of staff to be trained and the functions they perform. Training for Part 145 should therefore be adapted either to base maintenance and/or to line maintenance and/or maintenance of engines and/or maintenance of components as appropriate and to the jobs and functions concerned.

For example, HF training for personnel working on engines/components should not be a standard training for aircraft mechanics but should be adapted to workshop type of works. This also applies to training courses for technical agents and logisticians.

2.2.7.2. Duration

Initial training duration should be adapted to the organisation and personnel concerned. Some topics are more or less important depending on activities and individuals. It is therefore recommended that subject duration be adapted as appropriate (e.g., claustrophobia can be addressed in 2 minutes of explanation for certain jobs such as electronic data entry staff but could require 1 hour of detailed explanations for staff working inside aircraft tanks).

PART CAMO

Training duration depends on the jobs and functions that staff perform within the CAMO organisation. Examples of training durations are provided below for various jobs and functions:

Duration of training	**Profiles**
From 3 to 5 days as appropriate	• HF trainers/coordinators, • Auditors/ Compliance Monitoring System managers, • Safety management system managers, • Investigators.
From 2 to 3 days	• Staff involved in planning/elaboration of the work packages, • Staff involved in complex continuing airworthiness management tasks (development of maintenance programmes, analysis of ADs, assessment of optional modifications, etc.), • Airworthiness review staff, • CAMO representatives/maintenance checks supervision.
From one to 2 days	• Maintenance post holder • Technicians performing not complex tasks of continuing airworthiness management (e.g.: Equipment management, AD status management, repair/modification, Live Limited Parts (LLP) management).
From half a day to one day	• Documentation management officer, • Data electronic entry staff.
From 2 to 4 hours	• Accountable manager

Training duration also depends on jobs and functions that staff perform within the 145 organisations. Examples of training durations are provided below for various jobs and functions:

Duration of training	**Profiles**
From 3 to 5 days as appropriate	• HF trainers/coordinators, • Auditors/Quality managers, • Safety management system managers, • Investigators.
From 2 to 3 days	• Certifying staff and line maintenance mechanics (outdoor work, operational constraints, etc.), • Certifying staff and base maintenance support staff, • Maintenance visits preparation agents
From one to 2 days	• Maintenance managers • Base maintenance mechanics/support staff, • Certifying staff and equipment maintenance mechanics, • Technical Office staff.
From half a day to one day	• Logistics agents, • Documentation Management staff.
From 2 to 4 hours	• Accountable Manager.

2.2.7.3. Initial training and applicable conditions

HF training addresses topics related to human relations and human performance and limitations.

It is therefore quite logical for initial HF courses to be carried out for a large part by trainers with a limited number of trainees between 12 and 15 people (8 to 10 people for active participation).

If it is preferable that the trainings be done face-to-face, distance training is also possible (via audio/video tools such as “Teams”, “Skype”, etc.), providing that it allows for continuous exchanges between trainers and trainees, with trainers having a strong role as facilitators and mentors in the HF approach.

In any case, training cannot be reduced to lecturing (top-down information only) or eLearning.

All formulas are possible. For example, initial training may consist of two parts:

- Face to face training and/or live distance learning run by a trainer,
- And eLearning (not run by a trainer).

By default, eLearning training is likely to be general, not adapted for a particular organisation, except for organisation with the means to define and implement personalised, adapted eLearning training with specific elements (organisation structure, safety policy, internal resources, and methods, etc.).

In all cases, even if a part of the initial training is carried out as eLearning, it is necessary to provide an face-to-face training module to address aspects specific to the organisation and the jobs concerned, to answer questions arising from eLearning, to avoid confusion regarding training objectives, to repeat management commitment in the field, to take into account trainees’ feedback and to exchange on events that occurred in the organisation.

In some cases, it may be useful to organise a part of the HF training with participants from different departments or areas of the organisation. This also enables everyone to become aware of the difficulties of other areas and to raise awareness of jobs and functions interface issues.

PART CAMO
Examples of multi-job participation in HF training in CAMO organisations: - Staff involved in the preparation of work packages and Part CAMO representatives involved in work supervision during the checks. - Analysts of optional modifications and equipment reliability assessment staff.

PART 145
Examples of multi-job participation in HF training in 145 organisations: - Line maintenance mechanics and Line maintenance certifying staff, - Line and base maintenance mechanics, - Mechanics, logisticians, and Technical Office staff.

2.2.8. Recurrent training

2.2.8.1. Subject

Continuing airworthiness organisations shall organise recurrent training on Human Factors for the same personnel.

The purpose of recurrent training is to ensure that staff remain up to date with Human Factors knowledge and to provide them with the organisation's experience on HF subjects.

Recurrent training should be less theoretical and more practical than initial training. These are elements that consolidate and enrich the basic knowledge acquired previously.

Recurrent training should also be an opportunity to exchange views and feedback from trainees. Exchange of experiences in recurrent training is crucial and makes it possible to enrich the training courses.

The programme should therefore include reminders on HF topics addressed in basic training, feedback from experience, actions taken on the subject and any developments in the field. The aim of recurrent training is not to systematically review all the basic initial training subjects in detail, but to recall or develop specific subjects or even to address new subjects.

It also allows staff to be informed of instructive events/incidents with strong HF related components, considering however that recurrent training shouldn't be reduced to describing major HF related events or to compensating for lack of feedback on reported events.

PART CAMO
According to AMC3 CAMO.A.305 (g), staff should receive recurrent training on Humans Factors.

PART 145
According to AMC2 145.A.30 (e), staff should receive recurrent training on Humans Factors.

2.2.8.2. Duration

Human Factors recurrent training for continuing airworthiness organisations should be organised over a 2-year period.

Depending on the maturity of the organisation on HF, type of activity and ongoing HF issues, the organisation may adapt recurrent HF training frequency and scheduling.

If it is not necessarily the duration that determines whether an FH training is suitable or not, it is important to provide a sufficiently suitable duration for these training courses, especially to take account of specific characteristics of jobs and functions and of the organisation concerned.

Training duration should also take account of significant reported occurrences and developments in HF.

Average recurrent training duration could be from 1 or 2 days every 2 years.

PART CAMO

According to AMC3 CAMO.A.305(g) (c), recurrent training in Humans Factors should be organised over a period of 2 years, considering relevant compliance monitoring audit findings and other internal/external sources of information available to the organisation on safety and HF issues.

Frequent recurrent training is recommended as a first step for PART CAMO organisations, considering the recent introduction in Part CAMO rules of new HF principles.

PART 145

According to AMC2 145.A.30(e) 2, recurrent training in Human Factors should be organised over a period of 2 years, considering relevant quality audit findings and other internal/external sources of information on human errors in maintenance available to the organisation.

For example, one recurrent Human Factors training for a duration of 2 hours every 24 months for line maintenance technicians might not be suitable. The organisation may decide for this category of staff for example to conduct a 30-minutes HF briefing every month and to organise a more thorough recurrent training of 8-hours duration every 2 years.

2.2.8.3. Recurrent raining and applicable conditions

As in the case for initial training, recurrent HF training should by nature, considering the subject addressed, also be organised with trainers and in face to face manner as much as possible.

Above all, it is important not to reduce recurrent training solely to top-down communication on HF aspects (publications, videos, notes, e-mails, etc.).

Similarly, “on the shelf” only recurrent training does not properly consider particularities of the organisation, its experience and events and cannot fulfil all the recurrent HF training requisites.

In fact, recurrent training is a combination of elements for acquiring and maintaining various knowledge elements (face-to-face training and/or distance learning and/or eLearning and/or videos and/or publications, etc.).

It is advisable to regularly review recurrent HF training contents to avoid repeating information, thus risking demotivating staff on these subjects, and failing to meet the training objectives.

Recurrent HF training (in its contents) should be reviewed at least every 2 years, considering feedback from significant reported events involving HF.

PART CAMO

It is recommended that Part CAMO organisations organise recurrent HF face-to face training at an initial stage considering the introduction in Part CAMO regulation of the new HF principles.

PART 145

Given their experience in the HF field and ongoing HF issues, 145 organisations should arrange for organising the most appropriate training courses.

Depending on the categories and maintenance activities, at least part of this training should be carried out in face-to-face manner.

Line maintenance technicians could, for example, have face-to-face HF briefings on HF aspects on a regular basis in complement to other recurrent training over a period of 2 years and to HF information memos.

2.3. HF aspects related to means

In the context of continuing airworthiness, means and resources made available to staff to perform their duties shall be compliant and available.

In addition to general technical requirements, it is important to isolate any HF subject associated with the use of the resources needed by staff to carry out their tasks and duties.

2.3.1. Conformity of means

When talking about HF and the organisation's resources, particular attention should be paid to adapting resources to staff, and to measures enabling staff to adapt as effectively as possible to resource-related constraints.

In addition to being compliant, to fulfilling certain needs or functions, means should be adapted to the staff using them. A complex tool with special characteristics (e.g., heavy, noisy, bulky, etc.) should be studied on HF aspects, also considering the contexts in which this tool is used. Using a tool heavy to carry for a long period of time can cause the fatigue of the user, with the risk of making errors in task execution.

It is therefore useful for resource managers, in addition to verifying compliance in the context of standard uses, to check and, if necessary, take additional measures to improve means adaptability to users, in situations not necessarily well anticipated by resource designers. The aim is not to question the means design by default, but to assess whether certain adaptations would be necessary (e.g., lifting systems, special storage, systems adapted to the physical capacities of persons).

Conversely, resource managers should verify whether measures should be taken to better adapt the users to certain means, in certain circumstances.

These are not standard measures necessary for all means, such as properly training users in the use of the means where necessary. Rather, it is about supplementing HF training with specific awareness raising actions or recommendations in the context of certain conditions of use (e.g., recommended physical position of the mechanics for using a particular tool).

PART CAMO

In Part CAMO, there is no requirement explicitly addressing the resources needed by Part CAMO staff to carry out continuing airworthiness management tasks.
The main tools used by the Part CAMO organisations are information management systems needed to ensure continuing airworthiness.

The focus should be on IT systems supporting the management of continuing airworthiness and allowing to record maintenance programmes, to launch tasks, to record the task completion and to produce the associated status and progress reports. These may include particular systems such as engine parameter monitoring, reliability, aircraft data communication systems, and electronic aircraft technical log system
Organisations should take account of Humans Factors when considering this subject. Experience shows that many errors and undesirable events can be explained by systems that work but aren't properly adapted to users.

As in the case of tools for mechanics, in complement to IT systems compliance capability to deliver the expected services, technical agents should be properly trained to use these systems, and these systems should be adapted to users (software adaptability, simplicity of use, data entry control, etc.).
On this subject, it is also useful for the management of critical information to consider introducing specific controls to minimise / detect data entry errors. Controls can be integrated into the systems and/or carried out via control loop procedures (additional checks in the same spirit as checks on critical tasks in Part 145, for example by independent persons or in some cases by the same person).

PART 145

According to Part 145.A.40 and Part 145.A.42, all equipment, tools, and materials shall be compliant and available when necessary.

There is no direct reference to HF in these domains in the regulation. The exercise for organisations therefore consists of to identify/deduce the HF subjects that may concern means used by maintenance organisations.

The regulation focuses on compliance of means. Compliance is generally under the responsibility of the manufacturers and suppliers of means.

The organisation must therefore put in place a control system to verify compliance when means are received and accepted.

In addition, the organisation should pay attention to adapting staff to tools (e.g.: training incorporating HF instructions such as using an anti-noise helmet when using noisy tools to avoid unnecessary fatigue with consequences for the safety of the work carried out) and to adapt these tools to staff (for example: making alternative tools to meet the expected function of the tools but also allow easy and appropriate use of the tool by the technician).

The organisation should also pay particular attention to tools:
- with particular HF aspects (noisy means, means for height access, heavy equipment to be handled, etc.),
- that it manufactures (alternative tools)

2.3.2. Resource availability

Availability and access to these means should also be adapted to frequency of use. As with all means useful to users, these means should be checked, packaged, protected, stored with associated documents, stored in accordance with the conditions laid down by manufacturers, referenced, listed, managed, monitored, maintained, and quarantined or isolated if necessary.

Availability can be seen as availability in general depending on the area of activity, the volume of activities but also as availability needed when carrying out a particular task. One of the HF principles on this subject is to prevent people having to carry out a given task from wasting time searching, retrieving, or carrying the necessary means, to avoid unnecessary fatigue and stress.

HF aspects should encourage managers, preparation staff and site managers to adapt the availability of resources depending on needs and frequency of use.

Means not frequently used by front line operators could be stored by default in a distant store. The principle is to move such means to the site in advance before using them. Depending on the frequency of use, it may be useful to bring storage closer to operational activity to reduce access time. Tools may be stored in areas associated with the activity, temporary storage area associated with the site or local storage facilities (self-service).

PART CAMO

In the case of Part CAMO organisations, IT systems availability, for example, is essential for continuous monitoring.

This concerns number of computers available, screens suitability, access times, etc.

PART 145

By default, standard means must be available quickly to avoid technicians losing time, increasing stress level unnecessarily.

Logically, frequently used means should be located close to the work areas (dedicated stores in production, in addition to the central store).

This concept of resource availability, which is not particularly developed in Part 145, is essential. On the other hand, simple solutions allowing greater proximity should not create risks regarding means conformity (e.g., tool trolleys in production).

It is important that logistics and preparation services be made aware of these issues so that mechanics can easily access to means when necessary and close to work areas.

2.4. Data HF aspects

In the context of continuing airworthiness, the data made available to staff to carry out their tasks shall be up to date and available.

2.4.1. Data conformity

Conformity of technical data is the responsibility of those who produce the data in question, namely aircraft manufacturers, manufacturers of products which are recognised entities including for the secondary activities of publishing technical data relating to the products to be maintained (MRB, MPD, AMM, SRM, IPC, SB, etc.).

These HF aspects relate primarily to maintenance data published externally but also to technical documents created internally by the continuing airworthiness organisations (technical notes, work cards, etc.).

The organisation should therefore set up a control system to verify the documents received and to check their updates, as well as a system for elaboration of the internal technical documents.

In addition to the conformity of documents, the organisation should take a HF approach in particular to adapting these data to staff (e.g., Creation of a working document containing part of manufacturers' data) and the adaptation of staff to data (e.g.: Adapted training in search for specific data).

It is important that these data prioritise the information contained so that staff can easily isolate very important, critical information (warning, critical tasks, etc.).

Copying, translating source data can lead to errors. This should be anticipated as part of the internal document management procedure. Another HF subject relating to data is linked to language aspects (training, ongoing evaluation, etc.) in the case of the use of documents in foreign languages. This point should be assessed in particular in the light of the profile of the persons in question.

Chapter 2.6 on HF in relation to procedures (form and content) may also be applied in part in the context of the creation of technical documents.

Organisations may have to detect errors and ambiguities in the published data. In that case, they should inform the authors of such data, obtain the necessary clarifications, remove the ambiguities in question and, as appropriate, obtain corrections to the data in question.

PART CAMO

According to CAMO.A.325, the data made available to CAMO staff to perform continuing airworthiness management shall be up to date.

The CAMO part covers data in the general sense. It does not formally cover the possibility of creating work cards/technical notes, modifying published data, notifying errors found in published data, although these situations may apply to these organisations.

Each Part CAMO organisation should verify whether it is affected by these possibilities and take the necessary measures to manage them, taking into account the associated HF aspects.

According to 145.A.45(a) and (f), the data made available to maintenance organisation personnel for maintenance shall be up to date and available. Part 145 introduces certain subjects related to maintenance data which can be justified for many of their HF aspects.

The organisation shall use compliant and up-to-date data. It should put in place a system to enable each actor to have the guarantees that the document to be used is in the right version.

The Part 145 Regulation formally introduces the following data subjects:

- changes to maintenance data,
- drafting of work cards,
- reporting of errors observed in maintenance data to organisations that have published these data.

According to 145.A.45(d), in the context of data modification, the procedure should provide for checking that the modified data achieve the same objectives as the original data, such verifications should logically include checks on ground that, if any, the HF aspects have been taken into account.

According to 145.A.45(e), concerning the creation of work cards, the organisation responsible for drawing up technical instructions based on published maintenance data (e.g.: AMM) should ensure that the rules for drafting and presenting technical instructions related to the Humans Factors specified in the chapter on technical procedures are applied. For example, overly complex content of a work card in an unsuitable form can quite easily lead to misapplication. Copying, translating source data can lead to errors. These points should be anticipated as part of the work card management procedure. Staff managing work cards should have special training on this subject.

According to 145.A.45(c), concerning the notification related to maintenance data, the organisation should establish procedures to ensure that all ambiguities, errors observed in maintenance data are recorded and reported to the author of the maintenance data. By default, this notification system according to Part 145 is particularly addressed to manufacturers publishing basic maintenance data (AMM, SRM, CMM, etc.).

Feedback from the use of data by user organisations is therefore useful to correct and improve this data. It is important to set up a simple and rapid system for internal reporting and transmission of such errors to the authors of these data. Staff should be encouraged to report such errors knowing that they should be confident in the usefulness of such notifications.

It is logical that this principle should also apply to work cards and thus to the authors of these data (e.g.: Technical Office).

2.4.2. Availability of data

Availability can be seen as availability in general depending on the area of activity, the volume of activity but also as the availability needed when carrying out a particular task.

One of the HF principles on the subject is to prevent people who have to carry out a given task from losing time to search for, retrieve technical data in order to avoid unnecessary tired and stress. HF aspects should in particular encourage managers, preparation staff and site managers to adapt the availability of technical data taking into account the needs and frequency of use of the data in question.

A manual that is not frequently used can be stored by default in a remote central library. The principle will be to make this manual available on site in advance before the specific need to use this manual. In all cases, given the quantity of documents, volume of these documents, it is also important to check that the information search tools are adapted to the people using them.

Depending on the frequency of use, it may be useful to provide libraries closer to the operational activity in order to reduce access time to these manuals. They may consist of a library assigned to a service or consultation stations, data made available to each person (individual consultation screen, tablets, etc.).

Whether paper or digital manuals are involved, it is important to check that the rules are in place so that data subjects can have the necessary information at the place where the tasks are carried out (photocopies, printouts, tablet consultation, etc.).

PART CAMO

If CAMO.A.325 requests that organisations have the necessary maintenance data, the Part CAMO does not formally cover the concept of near availability data and when needed. This principle also applies to Part CAMO organisations.

For example, a person responsible for the development and updating of a maintenance programme for a given aircraft type should logically have reference manuals (MPD, MRB, etc.) near his office to avoid time losses to search for the manuals in question when needed.

PART 145

If 145.A.45(a) requires organisations to be able to dispose of the maintenance data in question, 145.A.45(f) requires in particular that such maintenance data be readily accessible as soon as the mechanics need it.

Frequently used manuals should be available close to technicians, thus avoiding time losses and unnecessary stress to search for the manuals in question. On the subject, organisations should also have sufficient means of reading digital data (screens, printers, tablets, etc.) close to the maintenance checks areas.

2.5. HF aspects related to facilities and work environment

In the context of continuing airworthiness, organisations shall have adequate facilities and work environments in place.

This refers to work carried out in facilities (offices, workshops, shops, etc.), so the areas protected against external conditions and work carried out outside. In both cases, conditions related to the working space, temperature, brightness and ambient noise have to be considered.

The working environment can have a direct impact on the quality of work. The Human Factors linked to the working environment are certainly the most easily understood subjects in the Human Factors' approach, but not all issues related to facilities and working environments should be considered as HF subjects.

In addition to the general technical requirements, it is important to isolate the real HF subjects associated with the installations and working conditions.

The principle with the HF approach is not to check that the standard facilities are available within the organisation and are technically compliant, but to check that they are properly adapted to staff in all circumstances.

An office of 3 or 4 persons with a correct surface area, functional furnishings, a correct brightness may well prove to be unsuitable due to an area dedicated to meetings in the same space, its situation with a constant passage of staff from other services and thus with a continuous noise level that can cause fatigue, difficulties in concentration and frequent breaks in tasks.

PART CAMO
CAMO.A.215 focuses mainly on workspaces. If this is not specified in the Regulation, organisations should also check other HF aspects such as office temperature, humidity, noise, brightness.

PART 145
Part 145.A.25 refers to certain requirements relating to necessary facilities, working conditions and equipment. This requirement has been very focused on HF since the beginning.

2.5.1. Working space

The working environment should be adapted, and staff should be provided with suitable spaces to carry out all the work they have to carry out, both administrative and physical work. These spaces should be sufficient to enable people to carry out the work properly. They should include offices; work plans and places to store means and data they need to carry out their tasks.

These areas may be located inside facilities with possibilities to monitor the working environment or be located outside.

In the latter case, it is not possible to control the external conditions (temperature, humidity, rain, wind, noise, brightness, etc.). In this case, the organisation should adapt people to these specific outside conditions (e.g.: special clothes) and/or decide to temporarily suspend work until external conditions become acceptable again, decide to work indoors (carrying out line maintenance work in a hangar).

Most of the time is to provide enough space to be able to carry out a given work properly. In some cases, the working space is limited (e.g.: Narrow working area in a cockpit) and is a constraint on which it is difficult to act. In such cases, measures should be taken to adapt to the situation. These may be specific rules (e.g.: Limited duration in the working area), additional adapted means (adapted seating system) to limit the impact on physical fatigue most often.

PART CAMO

According to CAMO.A.215, organisations must have the necessary facilities.

According to AMC1 CAMO.A.215, facilities, offices should be such that staff can perform the tasks assigned to them in a way that contributes to good standards.

This AMC specifies that the Authority can accept that all tasks are performed (implied by several persons) in the same office, provided that it is satisfied that there is sufficient space and that each task can be performed without any particular disruption.

According to the AMC, the offices should also include an adequate technical library and a room for consulting documents.

PART 145

If this is not formally specified, the working space should be adapted so that technicians can have places to store their tools, the components/parts removed /to be installed, and can read the necessary documentation. Such spaces should include temporary storage systems, working tables and other similar means. These subjects are even more relevant when it comes to work to be carried out in narrow places of aircraft.

According to 145.A.25(c)(6), the working conditions for line maintenance must be such that the inspection or maintenance task can be carried out without undue discomfort. It follows that if working conditions deteriorate to an unacceptable level of temperature, humidity, hail, icing, snow, wind, light, dust or any other air contamination, particular inspection or maintenance tasks should be suspended until satisfactory conditions are restored.

The associated AMC specifies that in the context of line maintenance, organisations should also provide for access to hangars. This makes it possible to cover the specific case of line maintenance tasks which require hangar protection, but also the case of deterioration of external conditions requiring the maintenance to be performed within a hangar.

2.5.2. Temperature

Temperatures should be kept at such a level that staff can carry out their work without being excessively inconvenienced.

Individuals should work under acceptable temperature conditions because temperatures that are too low or too high may have direct effects on their performance (fatigue, limiting dexterity under cold conditions, reducing concentration, etc.) or indirect effects (too hot or cold may lead a person to accelerate the completion of a task in order to find better conditions with all the associated risks).

In the context of work facilities, the temperature can be controlled in a fairly traditional way, i.e. via air-conditioning systems and heating systems.

In the context of outdoor work beyond or below acceptable ambient temperatures, when the temperature itself cannot be controlled, it is important to provide suitable clothes for staff, sufficient and regular rest periods for staff in areas with satisfactory temperature levels.

In order to be in a state of thermal comfort, a person should wear a reasonable amount of clothing without feeling being too warm or too cold, without being hampered in their movements, in the actions to be carried out in the course of their work.

Humidity is also a factor that should be taken into account in the HF approach. A person working in an environment with a high moisture content will have to limit his/her exposure time to this environment by providing regular breaks under more suitable conditions (air conditioning).

All organisations in general have offices that should have systems in place to maintain an acceptable temperature level that can work for several hours without suffering too high or too low temperature.

It is important to maintain stable temperature conditions in offices. A deviation from the comfort zone may be a source of stress. The standards recommend an average temperature of 20 to 22 °C in the offices. during summer the optimum temperature may be a few degrees higher.

PART CAMO

The AMCs of the Part CAMO do not specify any particular element concerning office temperatures, but the main principles set out above apply to the offices of the CAMO organisations.

PART 145

As specified in Part 145.A.25(c)(1), temperatures shall be maintained at such a level that staff can carry out their work without being excessively inconvenienced.

The combination of means such as hangars, workspaces, temperature control systems, clothes and associated procedures can enable individuals to work in good conditions.

The AMCs in Part 145 do not specify any particular element concerning office temperatures. The main principles set out above apply to 145 organisation offices.

As part of outdoor work carried out above or below acceptable ambient temperatures, clothing, shoes and gloves used by staff must be adapted.

It is proven that at a temperature of around 10 °C the manual dexterity is reduced by 50 %. Similarly, special precautions should be taken (e.g. supply of caps, drinking water points) in the case of canicular temperatures (above 30 °C).

It is important to provide for sufficient rest times in areas with satisfactory temperature levels for staff during duty vacations with significant negative or positive temperatures.

The specific facilities of the 145 organisations are hangars, workshops and stores.
If studies confirm that temperate temperatures (from 18 °C to 24 °C) are optimal, the comfort temperature in workshops for staff with physical activities may be slightly lower and be between 16 and 18 °C. this may apply to technicians working on aircraft but does not apply to persons who do not have the same physical activities (e.g.: Preparation support staff) as aircraft technicians.

While temperature control systems exist in most cases in the hangars that need it, particular attention should be paid, for example:
- on procedures for opening/closing aircraft access doors to maintain an acceptable temperature inside the hangar,
- in the installation of portable heating/ventilation system in the cabin, more suitable system for works in small areas.

2.5.3. Noise

Noise is a factor that can affect human performance. A very high level of noise may be impossible to bear even for a short period of time and may also have an impact on the future hearing abilities of persons exposed to such noise.

A lower but significant level of noise may interfere in oral communications between operators, reduce concentration, ultimately increase the fatigue of people.

One of the concerns of the organisation is to avoid or reduce as much as possible the noise levels of the working environment. This can be done either by reducing the noise level of the sources itself (source enclosed in a room), by removing the sources of the noise in question (sources outside the installations).

In other cases, certain noise levels cannot be controlled (e.g.: Noise at airport hubs). In this case, it is important to protect in particular the offices, workshops from the noise in question (acoustic insulation) and to provide personal noise protection equipment for staff (line maintenance technician).

Nor is it a matter of suppressing all noises, all sounds, of putting all individuals ‘under glass’. Noise may also be useful in the context of the tasks to be carried out (e.g.: Sign of malfunction of equipment, system alarm, etc.). Moreover, in most cases, people in the organisation work as a multi-team team. They should be able to hear each other, communicate in a noisy environment.

All organisations have offices. According to certain standards, the continuous sound level in offices should be between 35 dB(A) and 55 dB(A) maximum.

In rooms with a lot of verbal communication, the acoustic level should not exceed 50 dB(A) excluding communication. In an open-space, modular insulating partitions are recommended to separate workstations. Offices should be designed or modified taking into account the insulation of ceilings, walls, floors, doors, windows.

Fittings or equipment may also help to combat noise (noise partitions, screen panels between each workstation). In addition, all noise sources in the installations should be reduced (printers, photocopiers with cover or installed in a separate room if possible).

The relaxation and/or catering rooms should also, apart from working spaces, allow people on breaks to discuss without compromising the concentration of their colleagues.

PART CAMO

The CAMO AMCs do not specify any particular element concerning noise levels in offices.

The main principles set out above apply to CAMO organisation offices.

PART 145

As specified in Part 145.A.25(c)(4), noise shall not interfere with staff to prepare, carry out or control maintenance tasks.

The AMCs in Part 145 do not specify any particular element concerning noise levels in offices. The main principles set out above apply to Part 145 organisation offices.

It is recognised that if continuous noise is a fatigue factor even below 65 dB, the acceptable continuous noise level may be between 70 and 75 dB in hangars, workshops. It may exceptionally be acceptable with certain precautions to have a noise level exceeding these values.

In places where it is not possible to control the source of noise, such staff should have at their disposal the personal equipment necessary to prevent any discomfort caused by excessive noise during inspection tasks.

In the context of the maintenance environment, sound is often necessary for carrying out maintenance. The sounds in question include oral communication between persons, communications via dedicated systems (talkie, telephone, Public Address, etc.), sound signals from test benches/tools, sound emitted by aircraft systems in the case of tests.

It is therefore important to protect from important noise but not to completely “isolate” the mechanics from the noise of their environment.

One means of reducing noise is to provide staff with individual noise protection (helmets, ear plugs, etc.) and/or reduce noise sources, if possible, by relocating it (e.g. Placing of compressor units on the outside), by insulating the noise with regard to individuals (e.g. Insulation box...), by noise repair/absorption systems (acoustic panels, etc.).

2.5.4. Lights

The level of lighting should be adapted to the tasks to be performed and to the persons performing those tasks. The Human Factors' approach should make it possible to check that these brightness levels are properly adapted, taking into account human capabilities and limitations. Vision is the sense that is certainly the most widely used by technicians. It is important to look at this point, as the lighting should be sufficient to avoid errors in the tasks to be carried out, but also visual fatigue which could ultimately also lead to errors.

The brightness relates to work to be carried out inside premises (offices, workshops, hangar), in confined places (e.g., inside an aircraft) and also outside.

In a confined location, the whole brightness is overall artificial, no brightness comes from outside. In that case, mobile light sources are needed and must be adapted to the spaces in question, to the tasks to be carried out. It is therefore necessary to find the locations of these light sources which are most suitable to have the best luminosity needed, while avoiding consequences which could lead to errors (glare, shading, shading, etc.).

One of the difficulties concerns the level of brightness required in the case of outdoor work. It is more difficult to illuminate an important area outside. The main issue is the use of mobile light sources, including portable torches.

The brightness level should take into account the need for light depending on the tasks to be performed.

One of the points that need attention is the management of transitional periods linked to brightness. During the night, it is relatively simple and natural to see the need for brightness. This is more difficult when performing the same job from day to night. There may be significant time before seeing the need for artificial lights.

Control of brightness in rooms is easier to implement than in other cases. These are fixed main light sources and additional light sources linked to workspaces (working table). It should be possible to use these light sources and be adapted to take account of the level of light brought from the outside.

Regarding the light in offices, lighting for an office activity is expected to vary between 120 and 200 lux. Where possible, natural light should be promoted. Offices for work should be equipped with windows or glass bays at the height of eyes facing the outside.

PART CAMO

The CAMO AMCs do not specify any particular element concerning brightness levels in offices. The main principles set out above apply to CAMO organisation offices.

PART 145

According to 145.A.25 (c)(3), lighting shall be such as to ensure that each inspection and maintenance task can be carried out correctly.

Visual inspections, which account for approximately 90 % of inspection tasks, must be carried out under satisfactory environmental conditions.

Studies on the subject show that insufficient lighting has a significant impact on visual fatigue and on the quality of inspections.

The AMCs on part 145 do not specify any particular element concerning lights in offices. The main principles set out above apply to Part 145 organisation offices.

While the intensity of lighting is an important element, the type of lighting and the concept of glare should also be taken into account.

The overall intensity in hangar and workshop type facilities should be at least 750 Lux and preferably between 1000 and 1500 Lux.

For visual inspections, a brightness of 1000 Lux is recommended. For detailed inspections and precision interventions, a brightness of 2000 to 5000 Lux is recommended.

In all cases, the quality of the lighting should be adapted by using additional lighting if necessary.

2.6. HF aspects related to procedures

The Regulation requires that continuing airworthiness organisations establish procedures on a number of subjects, processes identified in the Regulation.

It is demonstrated that a significant number of maintenance errors are coming from non-implementation of procedures, incorrect application of procedures or even incorrect procedures.

The reasons for this are different and can be summarised as follows:

- Non-practical procedures (too restrictive, impossible to follow in relation to the time available),
- Unoptimized procedures (not necessarily describing the best way to do the work effectively),
- Poorly presented procedures (too complex, difficult to use and find useful information, too small entries, important information not identified),
- Access to procedures is difficult (difficulties in finding the procedure sought, lack of knowledge of the existence of the procedure sought, etc.),
- Procedures not up to date,
- Policy on the use of inadequate procedures (staff not sufficiently aware of the need to follow the procedures...),
- Incorrect practices of using procedures (experienced staff generally thinking that they do not need them, preferring to use their own expertise and experience, thinking about the procedures in question, etc.).

PART CAMO
CAMO.A.300 require organisations to draft working procedures.

PART 145
According to 145.A.65(b), the organisation shall establish procedures taking into account human factors and human performance to ensure good maintenance techniques and compliance with this Part 145.

2.6.1. Conformity of procedures

Many errors related to the application of procedures come from the procedures themselves. In many cases, by analysing the content and form of the procedures and putting themselves in place for the end user, it can be seen that they are not sufficiently adapted. Interpretations are made due to a lack of understanding of the instructions due to insufficiently precise instructions.

- Presentation of the procedures: The form of the procedures is essential for the proper use of these procedures and to avoid misapplication. The general rules recommended for the proper presentation of the procedures are as follows:
  - Use of standard page (A4),
  - Text in the form of a column,
  - Sentences of 10-12 words ideally,
  - Margins at the left/right sides,
  - Number of pages at the bottom/top right,
  - Justification of text to the left,
  - Numbering of each paragraph (1, 1.1, 1.1.1...),
  - Sufficient space between titles, paragraphs,
  - Fairly large and legible font (e.g.: “Times New Roman”) by avoiding different policies on the same procedure,
  - Police sizes between 9 and 12 with a preference for 11,
  - Emphasis of certain words should be used correctly. The use of bold or underlined is often preferable,
  - Minimise capital letters in the text of the procedures.

- Content of the procedures: The recommended rules for drafting the content and amending the procedures are as follows:
  - Explain the reasons for the procedure,
  - Clear titles at the top of each page or task group,
  - The order of tasks and stages should reflect the right way to do and should follow the logic of the processing.
  - Provide short sentences associated with an idea,
  - Avoid negative sentences and use action verbs,
  - Use precise, unambiguous words for those who need to use these procedures,
  - Writing in a clear, simple, precise and easily understandable form,
  - Procedures should be able to answer questions: What, Who, Where, How, Why.
  - Check that all key points are presented in the procedures and avoid drafting complex procedures,
  - Check that procedures are up to date, suitable, usable and define good practices,
  - Ensure consistency and coherence in the design of procedures and the use of abbreviations, terminology, references. Avoid different terms for the same word,
  - Take into account the environmental aspects in which the procedures should be used,
  - If possible, try to limit each procedure or task group to one page,
  - In the case of procedure revisions, specify changes in content and put the revision date on the page (at the bottom or top of the page),
  - Logic diagrams should be clear and should include all scenarios.
  - Diagrams, tables of data, drawings, images and photos can be very useful and allow a large amount of information to be communicated. Take certain precautions on the subject (presentation, positioning of data, diagrams, pictures, texts, titles, references, etc.),
  - Include information such as “warnings” to highlight specific points and avoid certain errors. Position this type of information, if possible, just above the text to which it refers and on the same page of it,

- Provide boxes in the procedures allowing users to specify tasks or groups of tasks already performed, manage interruptions of tasks,
- In the case of information to be recorded in the procedures, provide sufficient space in the procedures in question to do so,
- Adapt procedures to the levels of end-user expertise,
- Take into account the views of staff having a good knowledge of the subjects covered by these procedures,
- In all cases, check the application of these procedures on the ground, the good understanding of the actors concerned before validating them.

PART CAMO

The Part CAMO does not formally specify (as Part 145 does) that procedures should incorporate the principles of HF.

The general rules for the establishment of procedures as specified above should be followed by Part CAMO organisations in order to ensure that the internal procedures are well drafted and can be understood by the staff who must apply them.

PART 145

According to 145.A.65(b), the procedures must take into account HF. The general rules set out above are basic rules for the establishment of procedures closely linked to HF.

2.6.2. Availability of procedures

As in the case of maintenance data, procedures should be readily available, quickly accessible to those who have to use them and refer to them.

The organisation's documentation and associated procedures should be structured in a simple way so that the procedures sought can be easily retrieved as required.

PART CAMO

The Part CAMO Regulation does not mention the need to have these procedures close to the working places.

In order to have a better assurance that these procedures will be used, organisations should assess this aspect of the availability of procedures.

Similarly, the Regulation does not formally state that any error, ambiguity observed in an internal procedure, should be notified internally in order to have them corrected. This point should also be assessed by the organisation.

PART 145

The Part 145 Regulation does not mention the need to have these procedures nearby.

In order to have a better assurance that these procedures will be used, organisations should assess this aspect of the availability of procedures.

Similarly, the Regulation does not formally state that any error, ambiguity observed in an internal procedure, should be notified internally in order to have them corrected. This point should also be assessed by the organisation.

2.7. HF aspects related to the organisation continuing airworthiness activity

This chapter refers to the actual performance of continuing airworthiness activities and tasks. HF aspects specifically related to the environment (means, procedures, facilities, etc.) are dealt with the other specific sub-chapters of Chapter 2.

Each continuing airworthiness task is potentially affected by HF in a more or less significant way related to the nature of the tasks, the persons involved, the environment, the means, the data needed at the time of carrying out the task in question.

It is important to consider that continuing airworthiness activities should logically include preparation, performance and control phases.

PART CAMO

According to CAMO.A.315, CAMO organisations shall ensure that human Factors are taken into account in continuing airworthiness management.

In addition to the HF training requirement, this CAMO.A.315 requirement is a very general rule.

This requirement applies to the organisation, all processes and means associated with the continuing airworthiness management activity. The Regulation does not specify the details of what is expected on the subject, which is relatively broad.

Continuing airworthiness management activities are diverse and may be associated with several HF topics as appropriate. Example: Data input into the monitoring IT system of due dates of several ADs by one person at the end of a day of 10 hours of work, although he/she must regularly interrupt this work due to phone calls on operational topics.

PART 145

Maintenance activities are quite different and can be associated with several HF subjects depending on the case. Example: A complex maintenance task to be carried out on a steering wheel requiring work by several people and to be carried out at a height, at the end of the afternoon, in the winter season, under rain, on an aircraft already late, which need a component still not available at the time of starting work.

2.7.1. Preparation

The preparation phase is essential for HF.

The purpose of this paragraph is not to explain how planning and preparation should be organised and should work, but rather to highlight certain topics related to the Human Factors related to these functions.

The preparation function makes it possible to anticipate, plan resources, facilitate work and ensure that adequate staff is available at the right place and at the right time to perform the task. It is a coordinating function in relation to all processes of resources and data management.

The organisation of work, one of the main tasks of the preparation, consists of planning and scheduling tasks according to the priorities linked to the tasks and the availability of resources, ensuring that the workload are in adequation with the organisation's staff based on the organisation of work, working hours and working time that comply with the applicable rules in this area, including those linked to human performance limits, thus minimising errors due to fatigue.

. The classical symptoms of significant fatigue are as follows:

- Lack of attention, slow reaction, too limited concentration by losing a general view of the situation,
- Reduced vision, movement faculty,
- Short-term memory problem, inadequate decision or lack of decision...
- Easily distracted by different things, poor judgement, abnormal mood,
- Increase in errors.

It is important to apply the basic rules (ref ICAO document 9824) to minimise the effects of staff fatigue and to define suitable team working hours with:

- acceptable amount of working hours per day (less than 12 working hours per vacation),
- Regular breaks during duty (e.g., less than 4 hours of work without a break),
- Sufficient breaks (e.g., Break of 10 min every hour, 15 min every 2 hours)
- Sufficient rest period between two vacations (e.g., More than 11 hours of rest between two vacations),
- Acceptable scheduled working time for each 7-day period (e.g.: Less than 48 hours per 7 days),
- Sufficient number of days of leave (e.g., More than 21 days a year),
- Limited number of successive night vacations (e.g., Less than 5 nights of 8 hours),
- Sufficient rest after a night work cycle (e.g., More than 2 days + 11 hours of rest between vacations),
- Non-late night duty (e.g. End vacation not later than 6 a.m.),
- Day start time in the morning not too early (e.g. Start of vacation from 6 a.m.).

In addition, the departments concerned must also take account of unforeseen specific situations, with strong operational constraints which may generate errors linked to fatigue.

Studies have identified key principles on which to build a work organisation that takes into account human capacity limitations. In accordance with the hierarchy of norms, the maintenance organisation must reconcile the requirements of labour regulation with the principles related to the Humans Factors and with its operational requirements.

In the context of tasks which should be carried out by several persons over different vacations, it is necessary that the organisation set up a changeover / handover information communication system.

In general, the communication aspect in the frame of continuing airworthiness activities is important given the number of different actors involved. It is demonstrated that communication deficiencies can have serious consequences.

These changeover / handover information systems communication systems can be organised in different formats (meeting, email exchange, specific booklets, etc.). Oral communication makes it possible to clarify the instructions, to focus more easily on certain subjects, simply to be 'connected' and to make teams and people work with each other (motivation, consultation, etc.).

While this oral communication is important, written communication remains predominant in the maintenance activity because of the complexity of the information transmitted, its necessity for the smooth running of the work and a general question of traceability.

Certain rules in the case of changeover / handover information communication between teams should be applied:

- Persons should, if possible, be able to transmit information to each other in writing and/or by oral means and/or by signs. Using only one way to transmit information can lead to misinterpretation or lost information. The use of two axis of transmitting information reduces these risks.
- Two-way communication makes possible to check each other's understanding of the messages before being transmitted,
- The changeover / handover information systems communication systems should also take into account the fact that some people return to work after a certain off period from the organisation, even for a short period of time.
- This system should be adapted to the categories of actors involved (level of experience, speciality, etc.);
- Written communication may be supported by media specifying the type of information, useful for operational actors,
- Translating key points of messages and avoiding unnecessary information to enable this information to be stored and used correctly afterwards,
- The information should be clear, simple and accurate,
- In case of changeover / handover information communication which cannot be carried out in person (in the case of evening teams with morning teams), provide for an appropriate communication system with additional resources enabling certain doubts to be resolved,
- Plan meetings for the changeover / handover information communication between the concerned managers in order to provide significant information on the work in progress and the problems and actions to be planned. This meeting should take place in a place with sufficient space and calm to ensure good communication,
- The time to be foreseen for these meetings should be sufficient (15 to 30 minutes).

The Part CAMO does not refer to the concept of preparation. This does not mean that these phases of work do not exist in the area of continuing airworthiness management.

All work, including administrative/study/project work such as that of the CAMO organisation, should be planned and prepared.

Managing workload is a more difficult exercise in technical and administrative activities such as those of the CAMO organisation compared to traditional production activities.

Organisations should have a working load plan in order to be able to ensure that they have sufficient resources.

The working hours issues for CAMO organisation are easier to deal with, as staff generally work in administrative hours 5J/7.

This does not mean that the concept of fatigue should not be taken into account by the CAMO organisation. As the estimation of workloads and the timing of these workloads are often approximate, there may be risks of punctual overloads to be managed that can generate fatigue for staff at a level that may increase the risk of errors.

In addition, depending on the type of operation, some parts in the CAMO organisation may work on vacation 2X8 or 3x8 (if these activities are not subcontracted to main maintenance organisations).

For example, depending of the type of operation, CAMO organisation of airlines should have operational maintenance control Center (or equivalent) in order to manage the aircraft fleet in operation, be in contact with crews, manage complex breakdowns at stopovers, give instructions to maintenance organisations.

Other persons from CAMO organisations may also be required to work on vacation, in the context of specific tasks such as those relating to the supervision of maintenance checks in maintenance organisations. All these people working in operational activities are affected by the problem of fatigue linked to vacations.

As regards to changeover / handover information communication, if this is not mentioned in the Part CAMO, there are activities in the CAMO organisation which require such systems and in the first place the activities of the CAMO organisation as mentioned above, working in 2x8 or 3x8 vacation.

145.A.47 (a) specifies that the organisation must have a system to plan the availability of all necessary personnel, tools, instruments, equipment, maintenance data and facilities and to prepare the maintenance checks to ensure that maintenance work will be carried out safely.

As stated in AMC 145.A.47 (a), depending on the volume and complexity of maintenance activities, the planning/preparation system may vary from a simple procedure linked to this function to a more complex system, with an organisation structure dedicated to this function.

According to Part 145.A.47 (b), the planning of maintenance tasks and the organisation of the teams must take into account the limitations of human performance. The performance limits in question relate mainly to those which should be taken into account when organising work teams, working hours and vacations and are therefore closely linked to the concept of staff fatigue.

Maintenance organisations are generally very affected by the fatigue aspects of staff as they often combine physical fatigue with mental fatigue, work more often on 2x8 and 3x8 vacation. Specific circumstances to be assessed by maintenance organisations on fatigue aspects include:

- working time for troubleshooting on Nogo aircraft
- complex work or work of long duration at night,
- the last vacations prior to the end of the checks,
- urgent trip with significant jet lags.

While fatigue is an important topic, other human performance should also be addressed in the preparation of the work. It is necessary to detect particular maintenance tasks which may be more difficult to handle not on technical aspects but on HF aspects. For example, a simple maintenance which needs to be done at a height should not be assigned to a person with the vertigo. If visual and auditory abilities, health aspects are assessed on a regular and general basis (e.g. work medicine), the issues on which organisation should be particularly vigilant are those related to alcohol, drugs and self-medication.

As specified in Part 145.A.47 (c), where it is necessary to provide information on the continuation or completion of maintenance tasks for reasons of change of team or staff, the relevant information should be communicated in an appropriate manner between outgoing and incoming personnel.

In general, the communication aspect of the maintenance activity is important in terms of the number of different parties involved, the different specialities, the complexity of the works and the different problems (logistics, resources, techniques, etc.).

In the case of major checks, changes in teams, the changeover / handover information communication often requires the setting up of specific meetings to discuss work in progress, to confirm what action has been taken or has yet to be taken, to underline some directives, to coordinate the actions of several parties involved and to deal with problems of resources.

These meetings may also be supplemented by interventions on aircraft in order to clarify certain technical points. When meetings are difficult or impossible to organise (end of the last vacation several hours before the start of the next vacation), this should be done in written form, via instructions.

2.7.2. Work performance

The performance phase of the works involves a lot of HF constraints, since it is necessary to ensure that staff can actually have at their disposal the appropriate means, human resources and environment when they are restarted and that they are themselves adapted to these elements.

As for all activities, organisations follow procedures but need sometimes to interrupt activities and tasks. The organisation should lay down rules allowing staff to specify the tasks carried out as part of a procedure in order to be able to restart the procedure at a later stage (lunch time, between two working days, as part of an interruption to carry out another more urgent task...).

With regard to the performance of the work, staff should at all times follow to the letter the rules and requirements laid down by the authority, the instructions and standards laid down by manufacturers and the procedures of the organisations themselves. To this end, they should:

- Know what rules and requirements which exist and apply them in situations that require it;
- Be able to understand the intention and interpret such data.
- Be aware that, where normal application is not possible due to specific environmental conditions, appropriate rules should be defined and applied and/or wait until environmental conditions change,
- To be fully aware of the consequences of non-compliance with procedures,
- Distinguish and estimate the importance of the different cases of failure to apply procedures (errors, violation).

With regard to the application of procedures, it is important to make a distinction between general procedures linked to organisational processes on basic functions, which are well integrated by staff and which do not require a particular check list (procedure for issuing a Line maintenance certification) to be followed, and other occasional tasks (e.g.: Issue of one-off certification) and maintenance tasks (e.g. Replacement of an aircraft component) which should require staff to have the procedure nearby, a checklist to follow it step by step to carry out the tasks in question.

PART CAMO

The Part CAMO does not include any specific requirement focusing on the performance of continuing airworthiness management tasks.
On the other hand, the principle of recording the status of the tasks performed also applies to continuing airworthiness management tasks.
Basic rules should be applied by CAMO organisation staff when tasks are interrupted or/and at the end of a task group.
For example, it is useful to be able to make a distinction at any time between the information already entered in the monitoring IT system and the information still to be entered.
The CAMO organisation has to follow procedures and should put in place rules to ensure that these procedures can and are properly applied.

The performance of maintenance is covered by requirement 145.A.48.

The concept of coordination in the context of construction sites is slightly described in the texts, but the organisation should assess their coordination needs, see the entities to be set up and the resources to be put in place in order to coordinate all those involved in the process of work. The role of category B support staff in the context of the basic maintenance should be specified in this context. This coordination function should logically have a role of checking throughout the maintenance check that HF has been properly taken into account.

In this context, the organisation should lay down specific rules applicable during the maintenance checks and directly linked to HF, such as:
- Policy on non-interruption of tasks or conditions for accepting the task interruption,
- Policy on the use of personal and professional mobile phones within the organisation,
- Rules in the case of maintenance with major changes during the maintenance checks (e.g.: Changes in weather conditions, unforeseen punctual understaffing, etc.).

GM 145.A.48 presents the 'sign off' principle, which is an important element linked to HF. This principle requires that maintenance tasks have to be signed after they have been carried out. This principle mainly makes it possible not to forget to carry out work task among a whole set of tasks to be carried out and to clearly distinguish the tasks already carried out in relation to the tasks still to be carried out. Since the aim is to know the situation of the tasks (or group of tasks) carried out and still to be carried out, it is important that these tasks performed are subsequently signed off after completion of the tasks and, of course, not before or at the end of the work card (if important) or at the end of the checks. The need to sign off a task (or task group) should be specified to the technicians on the working documents. There should be a clear obligation to sign off on the working document (sign, specific box, etc.). This principle of signing off basic tasks (or group of tasks) allows a person to interrupt a work card (end of vacation, meals, rest, reassignment, etc.) to be taken back by that person or by another person knowing precisely what work remains to be done.

Staff should be trained in the use and recording associated with these instructions:
- Raise awareness among staff of the need to complete a group of specific tasks before stopping work.
- Encourage staff to specify on the procedure each task or task group already carried out.
- Stress the importance of drafting the information correctly and legibly so that it can subsequently be processed by other persons (capital letters, black pen, avoiding abbreviations, precise information, etc.).

At an early stage, rules should be laid down by the organisation to enable the drafters of work cards to know in which cases (nature of the work, risks to airworthiness in the event of errors, complexity, duration of work, etc.) it is necessary to provide specific blocks for intermediate signature on such work cards.

Similarly, procedures linked to the recording by technicians of the progress of the works (intermediate signatures) by using either work cards or directly technical instructions for manufacturers (e.g., AMM, CMM...) should be developed and made available to technicians.
While Part 145 is required to follow procedures and should put in place rules to ensure that these procedures can be and are properly applied, the performance of maintenance tasks mainly involves monitoring and applying published maintenance data.
These two cases are not comparable. In the first case, the staff may not need to be close to the procedure (example: Process of issuing an aircraft release) as it is considered simple and well-integrated.
This is generally not the case for maintenance data which must be followed up to the letter and therefore be available at the time of completion of the task in question in order to be applied.

2.7.3. Control

The control phase is essential for HF as it makes possible to finalise and certify the work performed.

All tasks should be analysed to verify the consequences of errors and their severities in order to classify some as critical and thus provide appropriate future controls.

PART CAMO

The Part CAMO does not mention any particular control in the context of continuing airworthiness management.

However, several continuing airworthiness management processes correspond to tasks that could be considered as critical. The organisation should identify these tasks in order to provide appropriate controls. Examples of critical tasks:

- Analysis of the application of an AD,
- Decision implementing an optional modification,
- Continuous analysis of engine trend-monitoring,
- Creation and publication of a technical note,
- Approval of deferred works at the end of the checks.

Some processes such as the renewal of airworthiness review certificates that include several HF related aspects can be somehow assimilated to controls.

In this area, organisations should in particular take into account the specific HF constraints related to the responsibility of airworthiness review staff. With regard to the HF aspects in question, it is important that these qualified persons, in addition to be technically competent, have the human capacity to cope with the constraints associated with the issue of airworthiness review certificates (stress resistance, ability to deal with several difficulties at the last moment, ability to listen, ability to refuse to sign an ARC when necessary despite significant operational and commercial consequences, etc.).

Since the concepts of monitoring critical tasks set out in 145.A.48 are not easy to integrate, it is important that the organisation focus in particular on this subject and develop even more explanations on these controls within the organisation, organise training of technicians and inspectors on the subject, and be able to provide for appropriate procedures and forms.

It is important to distinguish between:

A) Upstream, the principle of avoidance of errors (145.A.48 (c)):

- in order to minimise the risk of errors in quantity in the context of maintenance, including to prevent the risk of non-performance of tasks. This should be done by defining clear rules linked to the “sign off” of tasks (“sign off” per task or task group, “sign off” after completion of the tasks, “sign off” of tasks performed by staff under supervision, etc.).

- in order to minimise the risk that the same error is repeated in relation to identical tasks on identical systems by avoiding that the same persons carry out those tasks on all the identical systems in question and, in the case of unforeseen situations, by accepting the same person to act on identical systems under the condition of re-inspection/self-control.

With the agreement of the CAMO organisation, it may also be decided to allocate the same tasks by the same persons to several identical systems over different fixed ground time of the aircraft in question (e.g.: Completion of a complex modification on an engine X during a first A visit and the same modification on the other engine Y of the aircraft during a second B visit.

B) Downstream, the principle of error detection, the methods of capture errors following critical tasks (145.A.48 (b)) by adding additional inspections by independent persons or by the principle of re-inspection by the same person in the case of unplanned critical tasks.

In addition, there are HF aspects directly associated with these controls. For example, the introduction of controls by independent persons should not relieve those involved in carrying out the work to be checked.

Moreover, errors found in the context of these critical task checks should be treated in the same way as other errors to be reported internally. This also makes it possible to envisage certain improvement actions where necessary.

In the case of the impossibility of control by an independent person, the lack of independence of the control by the person who carried out the critical task himself should be a factor to be taken into account in the way the check is carried out. The organisation should specify basic rules to help mechanics to self-inspect (e.g.: Wait some time before undertaking a self-check, ‘set up’ to check the task as if it had been carried out by another person, specify the purpose of the check, repeat or not, the means to be used, etc.).

In addition to the checks to prevent or detect errors related to the performance of maintenance tasks, two areas of attention relating to HF in the final phase of the maintenance must be formally taken into account in accordance with 145.A.48 (a). These are the following risks of error:

- Forgotten of tools, parts, appliances in the aircraft or a product

- Forgotten open access closure as part of maintenance.

The first regulatory point cannot be reduced to an inventory of tools at the end of the works. This is a continuous process during the construction process, covering both tools and equipment.

To this end, the organisation should put in place simple rules for technicians in order to be able to ensure that the tools and equipment are removed from the intervention areas at the end of the work and that there have been no tools, which have been forgotten by mistake.

This process is more difficult to put in place especially for component, as it may include the loss or forgotten of new parts, consumables before they are installed, parts removed awaiting to be reinstalled and used parts removed and replaced by other serviceable parts.

The final stage of maintenance is the maintenance certification or release to service described in 145.A.50 and its AMC. This phase includes several aspects related to HF.

In particular, organisations should take into account the particular constraints associated with the responsibility of certifying staff and support staff in order to be able to anticipate as far as possible any difficulties which may arise at the time of such certification.

- Time pressure,
- Technical complexity,
- Management,
- Logistical aspects.

Considering the HF aspects, it is important that certifying staff after being technically competent have the human capacity to cope with the constraints associated with the certification (ability to withstand stress, pressure of any order, ability to deal with several difficulties at the last moment, ability to listen, ability to take decisions that may have significant operational, commercial consequences, etc.).

This certification process should be developed by taking into account these HF elements in order to assist as much as possible the staff authorised to perform their roles.

2.8. Human factors aspects related to subcontracting

Where an organisation uses a subcontractor under its quality system for specific tasks, a verification is needed to ensure that all HF elements are taken into account.

First and foremost, human factors training is required, but also a consideration of other relevant subjects. This should consider the HF aspects at the subcontractor as if it is a single and same entity.

Organisations must verify through audits that their subcontractors working under their approvals correctly apply the applicable rules, procedures and thus also the principles related to HF.

The fact that they are different entities should not make any difference to how the human factors aspects are applied. In addition, the following aspects relating to the interfaces need to be addressed:

- Compatibility of the approved organisation's procedures with the subcontractor's internal procedures,
- Communication between the approved organisation and its subcontractor (location, time differences, language, culture, etc.),
- Transparency in notifications of occurrences, quality of investigations and corrective actions taken.

The approved organisation should specify what is expected but also put in place a process to verify that HF is properly integrated in all contracted subcontractors.

PART CAMO

According to CAMO.A.205, organisations may qualify non-approved subcontractors. In this case, those external entities performing continuing airworthiness management tasks for the CAMO organisation shall work under the approval of the CAMO Organisation in question.

According to CAMO.A.315, CAMO organisations shall ensure that human Factors are taken into account in continuing airworthiness management. This requirement therefore also covers the application of HF by non-approved subcontractors.

PART 145

According to 145.A.75, organisations may qualify non-approved subcontractors. In this case, these external entities must work under the approval of the relevant Part 145 organisation.

Non-approved subcontractors must operate as part of the 145 organisation. As a result, the Part 145 requirements applicable to the approved organisation also apply to non-approved subcontractors, including HF aspects.

2.9. Human factors aspects related to records

This chapter covers HF topics related to records, archiving and classification of continuing airworthiness information. These are records to be kept within the organisation as well as those to be transmitted to customers.

These elements have particular HF aspects. Archiving is sometimes seen as a secondary function that is less important than the others. Organisations should recognise the importance of this function and apply these HF aspects in order to maintain the integrity and security of the continuing airworthiness documents and records.

This can be done through different measures and firstly by raising awareness among all staff of the importance of this function for the organisation and also for each person making and generating records.

PART CAMO

CAMO.A.220 deals with record keeping.

In the context of continuing airworthiness management and occurrences management, staff are required to refer regularly to the records related to the aircraft they manage. It is therefore essential that such records are legible, correctly classified and easily accessible.

A heavy and complex document storage system could cause staff to make errors and make it difficult to analyse certain occurrences.

PART 145

Part 145.A.55 deals with record keeping.

As part of the management of occurrences, organisations may be required to review maintenance records as part of the investigation. It is therefore essential that such records are legible, correctly classified and easily accessible.

A heavy and complex document storage system could cause staff to make errors and make it difficult to analyse certain occurrences

2.10. Human factors aspects related to compliance monitoring and quality management

While human factors apply to all organisational processes, HF has very important significance for the organisation's compliance monitoring (quality management) function.

The human factors requirements should be audited in the same way as any other requirement. Although human factors are not always specifically referenced in each requirement it is important to recognise when a requirement has an associated HF aspect. It is therefore necessary for auditors to be looking for any HF aspects associated with their audits. Organisation should also develop a strategy to ensure that HF topics are properly covered by internal audits.

It may be useful to define specific oversight activities on human factors on specific subjects (e.g.: How human factors principles are applied in the preparation of the organisation's procedures) or how human factors are applied in general (audit of all processes focusing on the associated human factors aspects).

It is important that auditors apply good human factors practices when carrying out audits:

- Auditor's attitude and behaviour.
- Communication style.
- Short and succinct questions.
- How the auditor and auditees' listen and respond.
- Taking into account the stress of the auditees.

Human factors aspects should also be applied when notifying discrepancies to those concerned, closing discrepancies, and giving feedback.

Human factors should also be considered in analysing the root causes of findings.

PART CAMO

While HF concerns all processes, they are of a significant concern for the quality management function of the Part CAMO organisations, particularly referred to in this Regulation as 'Compliance Monitoring' (CAMO.A.200 (a) (6)).

According to AMC2 CAMO.A.200 (a) (6) and AMC4 CAMO.A.200 (a) (6), CAMO organisations should have an independent audit system and a quality feedback system. This should look at all aspects of the organisation and its activities.
So, although there is no specific requirement in the Part CAMO providing information on the role of HF in monitoring compliance it is important that it is considered by auditors.

PART 145

While HF concerns the whole process, they are of a significant concern for the quality management function of the 145 organisations (145.A.65 (c)).

According to AMC 145.A.65 (c) (1), 145 organisations should have an independent audit system and according to AMC 145.A.65 (c) (2)), the organisations 145 should have a feedback system in place.
So, although there is no specific requirement in Part 145 providing information on the role of HF in monitoring compliance it is important that it is considered by auditors.

2.11. Human factors aspects related to risk management

If the HF concern all the processes, the associated means of the continuing airworthiness organisations, they of course also concern the risk management function. The identification of hazards and risks in a reactive way is widely linked to internally reported occurrences, a topic discussed in the chapter “occurrence reporting”.

The HF approach is essential in identifying hazards and risks in a proactive and predictive way. Risk control is done by setting up actions, detection and protection barriers, a large part of which is often justified by HF. As with quality, the risk management processes themselves are also closely linked to HF. For example, a working group tasked with determining possible risks and dangers within an organization might not be effective if the participants have certain fears in what they can say and/or if the organizer is too manager, does not listen enough. The safety manager should also take HF into account in the organization of the safety management system, its operation and its procedures.

PART CAMO

Human factors need to be considered as part of the risk management function of the organisation (AMC1 CAMO.A.200 (a) (3)).

As reported in GM1 CAMO.A.200, aviation is a complex system with many organisations and individuals interacting together, the primary focus of the key safety management processes is on organisational processes and procedures, but they also rely on humans in the system. The organisation and the way it operates can have a significant impact on human performance.

Therefore, safety management must address how humans contribute both positively and negatively to the organisation’s safety outcomes, recognising that human behaviour is influenced by the organisational environment.

The same GM points out that the effectiveness of safety management depends to a large extent on the degree of commitment of the management to create a working environment that maximises human performance and encourages staff to actively contribute to the management processes of the organisation.

AMC1 CAMO.A.200 (a) (3) confirms that hazard identification should include those generated by Human Factors problems that affect human performance

PART 145

Human factors need to be considered as part of the risk management function. (French Decree of 22 December 2008 on the implementation of safety management systems for public air transport undertakings and maintenance organisations and associated instructions).

As stated in the Practical Guide (P-50-11) on safety management systems for continuing airworthiness activities and the chapter on risk analysis, “Human Factors should be taken into account as a matter of priority (communication in the team, relationship with management, level of pressure associated with such actions, stress, fatigue of staff, behaviour of each other, adaptation of skills with the particular tasks in question, adaptation of the environment, interfaces between the personnel concerned and the means and data of maintenance)”.

3. IMPLEMENTATION OF THE HUMAN FACTORS APPROACH

3.1. General considerations

This chapter is dedicated to the implementation of the human factors approach within organisations.

As indicated in the first part of this guide, the regulatory texts referring directly to the human factors are relatively limited in number compared to all the domains and procedures where human factors need to be considered.

People need to have a detailed understanding of human factors in order to be able to implement this human factor approach as effectively as possible. This should recognise that our understanding of human factors and human performance continues to evolve.

The regulatory texts detail certain measures directly related to human factors (e.g.: human factors training, organisation of teams and shift patterns taking into account human performance limitations...) or indirectly to human factors (e.g.: Working environment, reporting of errors found in the documentation).

These human factors guide also proposes other possible measures (e.g.: Use of a decision tree linked to errors/infringements, internal reporting of errors related to internal procedures, etc.).

It is the responsibility of the organisation to identify the possible human factors measures they wish to adopt and to identify any other specific measures they consider appropriate for their organisations.

The implementation of human factors must be suitably organised to demonstrate compliance with the requirements for obtaining the desired approval (s) and subsequently as part of the continuing process of maintaining the organisation's compliance, including all of the human factor aspects.

The initial process is to identify and put in place all of the necessary measures related to HF as part of the organisation's compliance. It is then necessary to ensure that human factors aspects are continuously monitored and assessed to ensure they remain effective. This includes identifying new actions as a result of this monitoring, error investigations and internal changes (changes to activities, extension of facilities, organisational changes, changes in working patterns, etc.).

In general, it is the responsibility of all persons working directly or indirectly (support functions) in continuing airworthiness activities to be aware of and apply human factors aspects.

Human factors is primarily implemented in an organisation at two levels:

1. The implementation of the human factors rules by managers and supervisors (Accountable Manager, nominated persons, department managers human factors coordinator, supervisors, team leaders, etc.) on the processes, means and relevant resources (e.g.: providing sufficient resources, organisation of human factors training, planning of work and task allocation, adaptation of premises, etc.),

2. The implementation of the human factors rules at an individual level. Each person takes the initiative on the basis of human factors training and experience in this field to apply the human factors rules in the context of the tasks assigned to them and with regard to their environment (e.g.: Detection and reporting of ambiguous data, reporting of a personal problem such as fatigue, detection of an insufficient level of brightness for a particular task to be performed.).

While the first level of human factors implementation corresponds mainly to practical measures, concerning how the organisation creates the right environment for people to work. The second level is also linked to the organisation's human factors measures put in place but is closely linked to each individual and their understanding of human factors.

Human factors can be easily monitored and assessed at the organisation level. The same is not true for the assessment of the level of competence of each person in respect of their understanding and application of human factors. This is the responsibility of managers, supervisors, and team leaders to monitor and assess on a daily basis.

3.2. Initial implementation process of human factors in an organisation

This chapter proposes a generic approach to setting up a human factors programme within an organisation. Organisations have the flexibility to choose an alternative approach depending on its experience with human factors and its size, nature and activities.

3.2.1. Preparation of the launch of the programme

As the concept of human factors is incorporated into the Regulation, the Quality Manager (or Compliance Monitoring Manager) should first inform the Accountable Manager of the need to launch the human factors programme within the organisation. It is also important to convince key business leaders, key players and staff representatives of the value of an effective programme.

3.2.2. Commitment of the Directorate

Once management involvement is obtained, the Accountable Manager and nominated persons should draw up a document setting out its commitment and support for this HF programme and publish it as widely as possible in order to inform everyone in the organisation.

3.2.3. Establishment of the structure and appointments of managers

The regulations do not require the designation of a specific manager linked to the HF programme. Management should define and assign roles and responsibilities for the programme and how actions will be coordinated.

These responsibilities may be assigned to the Quality Manager (or Compliance Monitoring Officer), the Safety Manager or to another person or persons in the organisation (e.g.: “HF coordinator”, “department HF focal point”).

3.2.4. Training of persons responsible for implementing the HF programme

All persons involved in the implementation of the HF programme must be trained as a matter of priority in this field.

In general, the use of external training is necessary in this first phase (unless HF already exists within the organisation).

The organisation may also rely on HF expertise from outside the company to launch the first phases of this HF process within its company.

3.2.5. Analysis of the situation of the company in the field

The organisation should conduct an initial assessment of the human factors already in place in its organisation (e.g.: Assessment of the company’s safety culture, effectiveness of communication, management of errors/infringements, experience of the staff of the organisation in HF, quality and usability of procedures, management priorities towards human factors etc.).

This study should cover all the organisation’s continuing airworthiness activities, including support services, and should be carried out through questionnaires, interviews, group discussions and audits focusing on HF aspects.

The results of this evaluation should strengthen the need to implement the human factors programme within the organisation by raising awareness among the various actors on the subject and enable an implementation action plan to be drawn up.

3.2.6. Definition of an action plan for the implementation of the initial HF measures

This plan should specify the specific measures to be taken in terms of organisation, resources, infrastructure, working documents and staff, specifying the planned deadlines. This action plan should include the steps in this chapter (3.2.1 to 3.2.13).

3.2.7. Putting in place the necessary resources

The organisation should assess the workload associated with the HF programme in order to provide sufficient resources to implement the programme effectively. As a first step, this should consider the work related to the actions in the HF implementation action plan. These resources should be monitored and adjusted to ensure continuous compliance with the HF rules within the organisation.

3.2.8. Definition of HF training

The implementation of HF should include a first phase in defining and organising HF training for the persons concerned. This phase should make it possible to define the content of the HF training courses, to designate instructors competent in this field, to define training materials, to establish training priorities, to define a training schedule and to inform participants of these future training courses.

This training should also include, when appropriate, information relevant to staff related to initial human factors measures taken on procedures, means, data, working environments (e.g.: Training on the rules for the use of new equipment, training on the use of new forms, etc.).

3.2.9. Preparation/adaptation of procedures

The implementation of human factors should include a first phase in assessing all procedures on how easy to read and understand they are and whether they have been written considering human factors principles.

3.2.10. Adaptation of data and working environments

The implementation of human factors should include a first phase of assessing, data and working environments, which should be adapted taking into account human factors principles (e.g. Installation of a tool shop close to a noisy environment, improvement in work card design so that they are easier to use, adaptation of aircraft access.).

3.2.11. Performance of training for all staff

The first phase of initial human factors training should be launched before, in parallel or after the implementation of the first phase human factors actions. It is important for staff to come out of the training and seeing that the human factors programme is already up and running.

3.2.12. Follow-up and verification of actions taken

Once the human factors implementation action plan has been carried out, a new assessment at the end of this process should make it possible to verify that the HF programme is effectively launched and operational.

3.2.13. Review and communication on the progress of the human factors approach

It is useful to communicate the actions taken and eventually meet all staff to ensure that all of the actors feel fully involved in this process. A communication should be issued when the organisation considers that the first part of the implementation of human factors has been completed.

3.3. Continuous operation of the human factors programme

The Quality system (or compliance monitoring system) should monitor the regulatory compliance of their organisation including compliance with the human factors rules.

3.3.1. Human factors process audits

Monitoring of the human factors programme can be carried out through process audits (e.g.: Audits of the reporting process including the feedback to staff).

This may also be done through audits dedicated to human factors and transverse (e.g.: Verification of compliance with the human factors rules in one part of the organisation, with regard to the procedures applicable, the means used, the training of persons assigned to that department, etc.).

3.3.2. Other audits that consider human factors

Monitoring of human factors can also be achieved during audits of ongoing continuing airworthiness activities. This type of audit may verify that when performing the continuing airworthiness tasks, the human factors rules are in place and compliant (e.g., Assessment of the working conditions of a mechanic performing maintenance tasks in a small workspace, audits of maintenance activity at night, etc.).

3.3.3. Staff interviews

The proper implementation of the human factors programme can also be monitored through questionnaires, interviews with operational staff, local managers, designated managers, human factors instructors and support staff. These factors make it possible to take greater account of feelings and staff's expectations and perceptions of the human factors programme.

3.3.4. Analysis of Human factors

It may also be interesting for organisations to regularly review and analyse the human factors related causes and contributing factors of reported occurrences and deviations observed by the quality system during the monitoring of the organisation.

3.3.5. Continuous improvement

According to the results of HF audits of processes, product audits, interviews, studies of HF-related causes, but also because of the organization's new knowledge in the field of HF, the organization must set up a loop continuous improvement in this area. This improvement loop may be part of the overall improvement process of the organisation within the quality system or be subject to a dedicated process to target human factors actions if necessary.

The integration of knowledge on human factors into management systems aims to enhance flight safety within an organisation and to optimise its performance. This approach is characterised by a number of features:

- It is not the case of a few specialists but concerns the whole organisation and hierarchical and functional levels.
- It does not result from a single key compliance action but is broken down into numerous approaches to be adapted to the specificities of the organization.

It is not acquired all at once but must be the object of cultural evolutions and a process of continuous progress. It can therefore be difficult to manage such progress, to identify the lines of progress and to measure the impact of these efforts. However, the management of the organisation should have relevant information to feed into their Safety Management System.

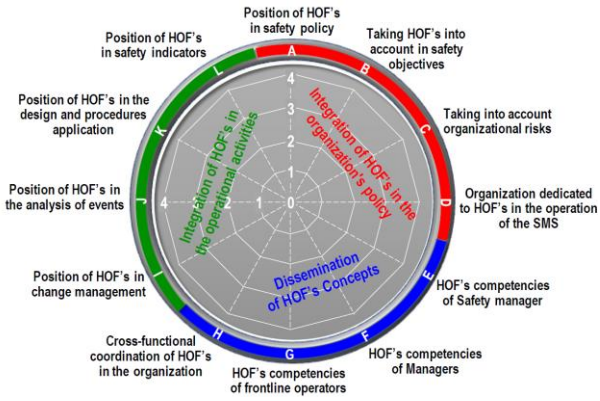
Regardless of the size and activities of the organisation, the use of indicators makes it easier to report on human factors integration and to assist significantly in steering the integration of human factors. A tool with 3 indicators, for example, can be composed of:

- A first indicator expressing the lines of ownership of human factors within the organisation:
  - Integration of human factors into the safety policy of the organisation (human factors principles included in the safety policy, consideration of organisational risks, etc.),
  - Dissemination of human factors concepts and knowledge in the organisation (human factors skills of managers, managers, safety actors, coordination between departments),
  - Integration of human factors into the business (change management, event analysis, design of procedures, safety indicators).
- A second indicator showing the degree of ownership within the organisation for each of the axes: Since 0: Lack of knowledge of human factors, 1: Distant interest, 2: Documentation acquired on human factors, 3: Effective implementation, up to 4: Integration and verification of the actions undertaken),
- A third indicator resulting from the self-assessment of the degree of human factors ownership by the organisation and aimed at placing the organisation on the scale for each of the axes.

The result of the use of these three indicators can be formalised into a “radar” on a concentric scale. Each radius shows the relevant degree of maturity for the axis in question according to the scale of this indicator.

This makes it easier for the company to fix, on a given date, the integration of human factors and to set out the lines of progress based on the scores recorded for each progress axis of the first indicator.

This “Radar Human factors” tool can explain the steps taken in a process of continuous improvement and can be useful in the process of continuous improvement.



3.4. Changes in the organisation

All significant changes related to the organisation should be defined and implemented taking into account human factors principle. Those responsible for these changes should pay particular attention to the human factors aspects of ongoing projects and define any additional human factors actions required to ensure an efficient and effective change.

4. LIST OF REFERENCES / PRACTICAL TOOLS

This chapter proposes complementary practical tools that can help organisations to develop and enrich the humane Factors approach.

DGAC Sites:

- DGAC Site – "Human Factors": https://www.ecologie.gouv.fr/en/human-factors
- DGAC Site – "Civil Aviation Just Culture Observatory" : https://www.ecologie.gouv.fr/observatoire-culture-juste-laviation-civile

EASA Sites:

- EASA – "Safety management and safety promotion": https://www.easa.europa.eu/domains/safety-management/safety-management-system/sms-easa-rules

Other authorities' sites:

- FAA Site – "Human Factors in Aviation Maintenance": https://www.faa.gov/about/initiatives/maintenance_hf/
- TCCA Site – « Human Factors - Brochure » : https://tc.canada.ca/en/aviation/publications/human-factors-brochure
- CASA Site – "Human Factors": https://www.casa.gov.au/safety-management/human-factors/safety-behaviours-human-factors-engineers-resource-kit
- CAA UK Site – "Human Factors": https://www.caa.co.uk/Safety-initiatives-and-resources/Working-with-industry/Human-factors/Human-factors/

Guides:

- DGAC – "Just culture guide": https://www.ecologie.gouv.fr/sites/default/files/guide_culture_juste.pdf
- ICAO – "Human Factors Guidelines For Aircraft Maintenance Manual (Doc 9824)" : https://store.icao.int/en/human-factors-guidelines-for-aircraft-maintenance-manual-doc-9824
- FAA – "Human Factors Guide for Aviation Maintenance and Inspection": https://www.faa.gov/about/initiatives/maintenance_hf/training_tools/media/HF_Guide.pdf
- CASA – "Resource guide for Engineers": https://www.casa.gov.au/sites/default/files/_assets/main/lib100215/hf-engineers-res.pdf
- CAA UK – "CAP 716Aviation Maintenance Human Factors": https://publicapps.caa.co.uk/docs/33/CAP716.PDF

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