United Kingdom Overseas Territories Aviation Circular

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Human Factors in Aviation Organisations

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Issue 2
July 2020

Effective on issue

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GENERAL

Overseas Territories Aviation Circulars are issued to provide advice, guidance and information on standards, practices and procedures necessary to support Overseas Territory Aviation Requirements. They are not in themselves law but may amplify a provision of the Air Navigation (Overseas Territories) Order or provide practical guidance on meeting a requirement contained in the Overseas Territories Aviation Requirements.

PURPOSE

This Circular provides basic guidance on the consideration of Human Factors (HF) in aviation organisations as an integral part of their Safety Management System (SMS). More comprehensive material is available through the sources listed at the end of this document.

RELATED REQUIREMENTS

This Circular relates to OTAR Parts 39, 43, 119, 121, 125, 135, 139, 140, 145, 172, 173 and 176.

CHANGE INFORMATION

Second issue removes association to OTAR Part 178.

ENQUIRIES

Enquiries regarding the content of this Circular should be addressed to Air Safety Support International at the address on the ASSI website www.airsafety.aero or to the appropriate Overseas Territory Aviation Authority.

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1   Introduction

HF is recognised by ICAO as increasingly important in the drive to improve aviation safety. HF occurs in virtually all aspects of civil aviation including, for example, design/operation of aircraft and equipment, aircraft maintenance and provision of air traffic services. Areas which are receiving increased attention include organisational issues, safety management concepts and learning from incident data. A number of OTARs require that HF is considered within the operation and the purpose of this OTAC is to provide general guidance on specific areas where HF may be of significance and how it may be integrated into the SMS.

HF is a complex subject and many models have been produced to help break it into easier to understand areas. One such model is PEAR[1] which we will use as an example:

P stands for people, with all our capabilities and limitations. It includes our senses, physical characteristics and capabilities, such as memory, communication styles, decision making, supervision and teamwork skills. It also includes our interactions with other people. People need to be suitable to complete a particular task. Suitability includes technical training, but also includes HF considerations such as fatigue, stress and physical abilities to be in the work environment. Considering HF should be part of any review of people's competence, supervisory abilities, briefing needs, leadership skills and the requirements of individuals as they complete their work.

E stands for the environment in which the work is done, not just the physical environment, but also the organisation itself. The physical environment includes lighting, temperature, noise levels, and time of day. The organisational environment covers issues such as supervision, pressure (time, commercial etc), organisation and safety culture and existing organisational norms and how these will affect individual and team performance and potential for error. The organisation's environment also covers the leadership shown and the effectiveness of management in supporting positive safety behaviours.

A represents the actions people perform that are necessary to complete the job efficiently and safely. The actions required for a job need to be understood to help identify any specific areas that might increase the risk of error, such as ambiguous information, or complex tasks that need specialist skills and knowledge. A list of actions can be aligned with a Job Task Analysis (JTA) process which identifies the knowledge, skills and attitudes necessary to perform each task in a given job. The JTA also helps identify what training, instructions, preparation and task management are necessary.

R is for the resources needed for the job. They can be defined as anything that personnel need to get the job done and can be physical items such as spares and technical manuals, as well as less tangible elements such as time and availability of training. An important aspect of considering resources is identifying the areas where they are deficient, including design, application and lack of resource.

When considering HF within an aviation organisation, the four topic areas may be of relevance or not, depending on the nature of the assessment and, when they are present, they are likely to be inter-connected rather than standing alone.

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[1] Dr Bill Johnson, Dr Michael Maddox. 'A Model to Explain Human Factors in Aviation Maintenance' – Aviation News April 2007.

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2 Integrating HF into SMS

As all organisations work in accordance with an SMS, integrating consideration of HF into these existing processes and procedures ensures that a methodical identification and analysis of relevant HF issues is undertaken, and that the application of appropriate tools, methods and measures to address such issues is achieved. It also provides the means by which an organisation can adequately document, monitor and demonstrate that HF has been considered.

HF should be considered in the following elements of the SMS, for example:

- risk management

- management of change

- job and task design

- systems design

- selection and training of safety critical personnel

- safety reporting and incident investigation

3 Risk Management

Including HF within risk management allows an organisation to determine where it is vulnerable to human performance limitations and SMS documentation should clearly demonstrate how human factors have been considered in the management of risk.

Various aspects of human performance including the potential for human error should be considered when identifying, assessing and controlling hazards. Consideration of the following HF aspects may assist in identification of issues:

- Identifying **all** the people who interact with the system, not just the obvious ones

- Recognising reasonably foreseeable non-compliances with standard operating procedures (are there opportunities for taking shortcuts?)

- Paying particular attention to abnormal or infrequent modes of operation (how will people cope?)

- Solutions that support the detection, correction and management of errors

- Fatigue, especially if change is involved

Control measures for managing potential and actual human error may include modifying aspects of the following areas:

- Equipment design and usability

- Task and job design

- Workplace design

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- Procedures and training

- Communication

- Team work

- Supervision and monitoring

4   Management of Change

The purpose of integrating HF into the management of change is to minimise potential risks by specifically considering the impact of the change on the people within the system. Change has the potential to introduce new, or exacerbate pre-existing, HF issues. For example, changes in equipment, procedures, work organisation or work processes are likely to affect human performance as people adapt to a new environment.

The potential impact of a change on human performance should be assessed including consideration of any transition period. Any HF issues identified should be clearly documented and the management of these issues should be integrated into the change management plan.

Consideration of the following may assist:

- Identification of all those affected by the change who have the potential to impact safety

- Identification of how roles and tasks will be affected by the change:

  - o If the task is to be replaced by automation, consider the effects of this on the other people within the system
  - o How the people involved will now interact with the new process or equipment
  - o What trialling of the process, if appropriate, has been completed
  - o How the service provider will monitor and check the effectiveness of the change in actual operation

- Identification of the risk to human performance associated with the change – including resistance to change

Control measures for managing HF within the change process may include:

- Amending equipment design/layout

- Revising task and job design – completing new JTAs

- Alterations to the workplace – which may be physical and/or procedural changes

- Introducing new procedures and delivering training

- Communications – involving staff in the change planning and keeping people informed

- Adequate transition planning and time allowed for the transition

- Supervision and monitoring

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5   Job and task design

Job and task design can contribute to system safety. Improving the design of jobs and tasks, and the workspaces in which they are performed, can significantly improve human performance and reduce the potential for human error.

Task design is essentially about matching the person and the task – making sure that tasks and activities are appropriate and suited to the human operator's or team's capabilities, limitations and personal needs. For example, tasks that involve excessive time pressure, complex sequences of operations, reliance on memory, are physically or mentally fatiguing etc are likely to have a negative impact on performance.

Consideration of the following may assist:

- Identification of safety critical tasks, and those who perform them

- Looking at the task objectives, sequences and actions to be performed

- Structuring the task so it supports safe performance by the individual or team

- Looking at the working environment to ensure that it supports safe performance of the task

Control measures for managing HF issues within job and task design may include:

- New procedures and rules

- Different equipment, tools and materials

- Suitable Human Machine Interfaces (HMI)

- Information and communication requirements

- Manning and workload

- Workspace changes

- Capability and skill requirement changes

- Changes to team structures

- Different rostering of staff

6   Systems Design

The design of safety-related systems should consider human capabilities and limitations, both physical and cognitive, and be suitable for the tasks assigned to staff. Systems can include organisational structures, such as a new SMS, just as much as a new physical system, such as a replacement ATC tower.

Many aspects of a physical system or equipment design are already established when introduced within an organisation. However, HF can still be considered by:

- Assessing the usability and practical applications of systems prior to procurement to ensure the "right fit" early on

- Identifying, where possible, all the ways that people may potentially interact with the proposed system then making a procurement that will be tolerant of errors that operators may be likely to make

- Understanding the likely training that will be required for staff who will interact with the new system

Prior to installation/implementation, the following HF aspects should be considered:

- Accommodation of people's physiological needs and physical constraints eg being able to reach equipment easily

- Ability to function effectively within the actual work environment to achieve the task objectives

- Ensuring that information is available and clearly communicated to support people in gaining confidence in the new system eg what training they will receive and familiarisation opportunities

- Positioning of new equipment to facilitate ease of use and, in the case of electronic displays, be unaffected by glare

7 Selection and training of safety critical personnel

It is important to identify and assure the adequacy of training and competency of staff performing critical functions directly affecting safety.

Consideration of the following may assist:

- Defining the competencies for a role in a Job Description (JD) so that suitable staff can be selected and trained based on these competencies

- Where staff are already in post and there is a change of role competency requirements completion of a Training Needs Analysis (TNA) to identify any training needs

- Creation of training plans that are objective-based and allow staff to become, or retain competence

Control measures for managing HF issues through training and selection could include:

- Making people aware of their likely performance variability, capabilities, limitations, and biases

- Providing methods by which people can then optimise their fitness for duty, and manage their performance in the workplace

- Supporting the development of peoples' abilities to assess and analyse risks, and to make decisions in situations that require trade-offs between conflicting goals

- Supporting people in acquiring the understanding and means for effective communication, coordination and leadership required for optimal performance in group settings

- Conducting training in environments designed to promote knowledge and skill acquisition and adapted to the learning needs of the individuals

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- Focussing on learning and building expertise and understanding, rather than on simply following a procedure and avoiding mistakes

- Ensuring regular refresher training tailored to learning needs, role and level of experience Practising the operational application of knowledge and skills under different realistic and relevant work scenarios

8   Safety reporting and incident investigation

The primary objective of safety reporting and incident investigation is to try and understand not only what happened but also why it happened, in order to prevent similar occurrences in the future. Understanding how or why personnel responded in the way they did is necessary to be able to identify and accurately describe any systemic issues, as well as to be able to make relevant recommendations.

It is important that the SMS reporting system incorporates the identification of any human performance issues so that any failure to accommodate human limitations in a design or operation is recognised and addressed. Staff should be trained and encouraged to identify and report human performance issues when reporting hazards or occurrences.

Some examples of HF issues that may contribute to an incident and should be considered in an investigation are:

- cognitive failures

- problems in decision making

- communication breakdowns

- distractions

- fatigue

- equipment failures

- design deficiencies of equipment and/or infrastructure

- inadequate procedures

- procedures not followed correctly

- lack of training

The list is not exhaustive and, where it is possible that some significant HF issues are present in an incident, it may be prudent to seek professional support for the HF component of an investigation.

9   Further information

The following websites all contain documents, guidance material and reports that may be useful:

http://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=list&type=subcat&id=22

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https://www.casa.gov.au/safety-management/human-factors

https://www.hf.faa.gov/

https://www.skybrary.aero/index.php?title=Special:Search&search=Main+Page+-+human-performance

http://www.eurocontrol.int/articles/human-performance-atm

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Appendix A - Example of a Change Management Procedure with HF Considerations

Introduction

This guidance gives an example of how HF could be considered and documented during a change management process to ensure that human performance issues have been adequately addressed. A construction project is used as the example (eg a new maintenance hangar or ATC Control Tower); however, the principles apply to any form of change to an operating environment that may impact upon human performance. The methodology described can be adapted and applied, as appropriate, to ensure that HF is considered throughout the change process with the aim of achieving a smooth transition.

A major aspect of successful change management with HF in mind is based upon a communication plan to reduce resistance. This communication plan requires the participation of all workers within the area(s) potentially affected and the output should support the risk assessment process.

The communication plan revolves around answering three basic questions:

- Why – the core reason for the change, how it will benefit the people doing the job
- What – the *general* end state that will accomplish the "Why"
- How – the details (project plan) at this point

The project is likely to have several phases which *could* break down as follows:

- Phase 1 - Preliminary
- Phase 2 - Construction
- Phase 3 - End state

In each of these general phases there may be a multitude of "change points". A change point is any:

- Physical change that may alter the worker's:

  o ability to see, hear, reach, needed items (improvement or degradation)
  o ability to respond in a fixed amount of time (slow down or speed up)
  o understanding of the situation (alteration in the gathered information)
  o comfort level (sit/stand/operate/relax/climate control/exposure to elements)
  o access to work environment (route from different task areas/changed parking)

- Change in some other department/area's work practices that may impact the Standard Operating Procedures (SOPs) of the worker

At each change point the three basic questions need to be considered again (Why, What, How), and a matrix of the impact on the worker can be filled in (see Appendix A).

Phase 1 - Preliminary

Includes things like:

- drafting and design
- budgeting and approval
- bid processes
- contractor awarding
- building the construction time line

Consider:

- **Why** are we making the change? Always start here (this is the heart of the matter and will get people on board with the programme)

By starting with the "Why" we recognize people's core needs for Status, Certainty, Autonomy, Relatedness, and Fairness (S.C.A.R.F. – a basic overview is at Appendix C)

- **What** is it going to look like at the end (compared to now)?

At the beginning of the project a matrix can be used (example at Appendix B) to find out the pros and cons of the current state, then walk through the "envisioning" of what the pros and cons will be at each subsequent anticipated change point and record them.

- **How** are we going to go about it?

For example, there may be mitigations to be identified, changes to SOPs to be made and training required. Time frames and communication plans for the next phases may also be created now to help keep staff informed.

Phase 2 – Construction

Includes things like:

- Changes to the original plan
- New issues identified as the project progresses
- Delays to the project and their impact upon staff

Phase 3 – End State

Includes things like:

- Transition plans
- Familiarity/Training
- Commencement of operations
- Review of project*****

*I t may be that after the introduction of the change there are issues identified that may require this process to be applied again to the proposed solution.

In each phase work again through the "why, what and how" involving all the relevant departments and staff.

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Appendix A – HF Assessment Matrix

Specific Worker/Job Function _____

Phase of Project: _____ Change Point Description _____

Date Completed: _____ Personnel Involved _____

Consideration	Pros	Cons	Other Notes
SOPs			
- Normal			
- Abnormal			
- Emergency			
Physical			
- Sight			
- Hearing			
- Vibration			
- Smells			
- Weather			
- Comfort			
- Other			
Tool Access			
- Power			
- Lighting			
- Computer			
- Phone			
- Vehicle			
- Other			
Workplace Access			
- Parking			
- Response time			
- Privacy			
- Water / meals			
- Washrooms			
- Other			
Other Departments			
- Altered location			
- Altered SOPs			
- Other			

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Appendix B – The Human Brain's Performance When Threatened (Physical or Social) is Diminished

Research with brain scans has proven that the brain's interpretation of danger is not limited to physical threats but includes real or perceived social threats or fears. By monitoring brain activity researchers have determined that those areas of the brain affected by the threat of physical danger are equally affected when the threat is of a social nature. As humans we instinctively want to "Minimize Danger and Maximize Reward" and so when threatened our response is to move away from the threat (thus reducing productivity).

So how do we avoid inadvertently developing a hostile or unfavorable social environment?

The answer lies in understanding how we react when confronted by a threat. When threatened, our brains instinctively revert to survival mode. While our brains are engaged in this "back brain" activity, the "fight or flight" syndrome, we seriously diminish our ability to access our frontal lobe, the "thinking and reasoning" area of our brain. This inability to access that portion of the brain can and often will negatively impact one's performance or reactions.

The question then is, what are these "social" threats or fears and how can we overcome them?

S.C.A.R.F.[2]

The SCARF model, developed by neuroscience researcher Dr David Rock, suggests that the source of these threats or fears will fall into one or more of these five categories;

- **S**tatus
- **C**ertainty
- **A**utonomy
- **R**elatedness
- **F**airness

Status

In this instance, status refers to how an individual sees themselves in the work group or team. While in most situations status is evident (manager, doctor, supervisor, captain, etc.) there is a need to ensure that everyone sees and understands that they make a contribution to the team.

Imagine that during discussions concerning your workplace a manager or supervisor says to you:

> "You should go, this information doesn't concern you".

How would that make you feel? How important to the team would you feel?

Interestingly the exact same thing could be done and yet still feel inclusive. Imagine instead the phrasing:

> "I know you may have other tasks to complete so if you would like to go you can, but you are welcome to stay."

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[2] Dr David Rock, SCARF: A Brain Based Model for Collaborating With and Influencing Others (2008).

Certainty

Uncertainty in any situation, whether in the workplace or in our personal lives, can be very stressful. Following standard operating procedures (SOPs) or job norms can help establish that certainty within the team.

Members of a work group or team need certainty to function effectively even if the certainty is that when information becomes available, it will be shared. This,in itself, is providing a degree of certainty.

Autonomy

While micro-management may be accepted and even appreciated by beginners of a new task or assignment, for an experienced and competent work group or team member, it can and often is, interpreted as a lack of confidence in their knowledge, skills and competencies. While the manager remains responsible for the overall performance of the team, knowing when and how to intercede (and when not to) is critical.

Relatedness

Relatedness refers to whether an individual feels accepted by the group, both personally and professionally. Personal issues among team members, when known or identified, should be managed (resolved) as early as possible. A manager may wish to examine how they behave towards staff as a lack of relatedness may be the result of failing to address the factors of Status and Autonomy.

Fairness

In any work or social environment, the idea and feeling of fairness within the work group is critical to the group members' motivation and pride in workmanship (performing their duties). This fairness must not only appear to be genuine but, in fact, be fair. For example, continually assigning the desirable tasks to a particular individual (or certain individuals) within a team may foster a feeling of unfairness or favouritism which, in turn, may negatively affect an individual's or team's performance. If these tasks are being assigned based upon competency, knowledge or experience the rest of the team needs to be advised of this so that they understand the rationale for the decision.

Conclusion

Though it may not be possible, or in fact necessary, to incorporate each of these components (SCARF) into your discussions or work, knowing and understanding how they can affect a team's performance will allow you to tailor your interactions with your work groups and circumstance.