

CAP716 (pre-publication copy - extract only)
Aviation Maintenance Human Factors
(EASA / JAR145 Approved Organisations)

Guidance material on the UK CAA interpretation of Part-145 human factors and safety management requirements

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Explanatory note

This document is aimed primarily at organisations approved in accordance with Annex 2 (Part-145) of the Commission Regulation (EC) No. 2042-2003 "Continuing airworthiness of aircraft - previously JAR145. It is aimed at organisations approved by UK CAA Aircraft Maintenance Standards Department (AMSD), to help them meet the error management and human factors requirements within EASA Part-145 (originally introduced as NPA12 to JAR 145, and subsequently as amendment 5 to JAR145). It contains guidance material which, if applied appropriately within maintenance organisations, should help reduce the risks associated with human error and human factors, and improve safety.

References throughout the document will primarily be to "Part-145", which is the requirement, "AMC-145", which is the acceptable means of compliance, and "GM-145", which is guidance material. References will also be made to Part-66, Part-147 and Part-21, which are the parts of the EASA Implementing Rule (IR) equivalent to JAR66, JAR147 and JAR21. Occasional references are made to JARs for historical purposes, or where JARs are still current (eg. JAR-OPS). There are no fundamental differences between the JAR and EASA requirements, as far as the human factors elements are concerned.

This is a living document and will be revised at intervals to take into account changes in regulations, feedback from industry, and recognised best practices. This document was originally issued as the CAA Maintenance Human Factors Handbook, and subsequently published, in support of NPA12 to JAR145, as CAP 716 issue 1. It has now been up-issued to Issue 2, incorporating additional and revised guidance material based on industry experience obtained since JAR 145 amendment 5 was implemented on 1st January 2003. It is envisaged that the document will eventually be up-issued to Issue 3, once further best practice emerges with long term experience of working with the new human factors requirements.

Updates to this and other documents will be notified via the CAA website. You may register to receive automatic notifications of any updates by accessing www.caa.co.uk/publications and selecting "human factors". The document is free to download from the website, or printed copies may be purchased.

If you have any comments concerning this document, or any proposals for Issue 3, please pass them back to the CAA Aircraft Maintenance Standards Department, the address of which can be found on the website, or direct to the editor at osdhf@srg.caa.co.uk.

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Additionally, many documents and studies are referenced in this CAP, and acknowledgement is given to the authors. Many of these studies were funded by the FAA, and thanks is due to the FAA for making the information freely available from <http://hfskyway.faa.gov>.

Finally, acknowledgement is given to all those reading and applying the information and guidance contained in this document in order to improve safety in aviation maintenance, within the UK and elsewhere.

Foreword

CAP 716 provides guidance material for Part-145 approved organisations on how to apply human factors best practice in organisational processes and procedures.

A separate document, CAP715, written primarily from the perspective of the individual licensed engineer, addresses human performance and limitations, and is in support of Part-66 (module 9).

CAP 712 addresses safety management from an organisational perspective and describes the elements of a Safety Management System. The emphasis within CAP 716 is upon a human factors and error management programme which should form a significant part of an organisation's Safety Management System. Readers are encouraged to read CAP 712 in conjunction with CAP 716.

CAP 716 is written primarily for large aircraft maintenance organisations (Part-145 'A' rated organisations). The principles and practices described within this document are also likely to apply to engine and component maintenance organisations (Part-145 'B' and 'C' rated organisations), and other Part-145 approved organisations (category D). However, it is recognised that some of the guidance within this CAP will not be applicable to, or practical to apply in, some companies, particularly 'D' rated organisations and small Part-145 approved organisations. Companies should, therefore, be prepared to tailor the guidance material to suit the size of the organisation and nature of their business.

This CAP is structured around the main syllabus topics in EASA GM-145.A.30(e). However, the CAP is not written as a training text. It concentrates upon the elements of the human factors and safety management programme required by Part-145 and AMC-145, rather than the detailed human factors training requirement subject matter. The document could be used as a basis for training Module 10 of the GM-145.A.30(e) syllabus, and some of the other modules, but further source material would be needed in order to train the remaining syllabus topics. Potential sources of further information, including videos, are given in Appendix Z.

Chapter 11 Human Factors Training for Personnel involved in Maintenance

1. Introduction

This chapter provides details of the UK CAA interpretation of the Part-145.A.30(e) requirement and associated AMC-145.A.30(e), and guidance as to how this requirement might be met. However, there is no 'one size fits all' solution, so the guidance in this chapter would need to be tailored according to the size and type of organisation to which it is applied. The emphasis is upon practical human factors training as part of a company human factors and error management system. This sentiment is echoed in the ICAO manual "Human Factors in Aviation Maintenance" Doc 9824-AN/450.

2. Origin of the requirement

Knowledge of human performance and limitations (HPL) has been an ICAO SARP for many years now in ICAO Annex 1. This has been addressed in the UK and JAA by including, within the basic license requirements, examinations in HPL for pilots (JAR FCL) and licensed engineers (JAR 66/Part-66). However, these are not *training* requirements. The human factors initial and recurrent training requirement for pilots is known as Crew Resource Management (CRM) and is required by JAROPS; the human factors recurrent training requirement for certifying engineers is required by JAR145/Part-145. There was, until recently, no requirement for initial human factors training.

More recently, amendment 5 to JAR145 expanded the training requirement to extend to all staff as well as certifying staff, and to include initial as well as recurrent training. The justification for this change is explained in the section dealing with the Requirement.

This change has now been incorporated into the EASA requirements, virtually unchanged from JAR145 apart from compliance dates. The compliance date for JAR145.30 (e) was 1 July 2005; the compliance date for the EASA equivalent requirement (Part 145.30(e)) is 28 September 2006. The compliance dates indicate the date by which all 145 approved organisations should have in place a procedure for human factors training, and by which all appropriate staff should have received initial human factors training.

3. Context of Human Factors Training

Maintenance human factors training is part of a total system in managing human error, and discouraging procedural violations, in a maintenance organisation. It is an essential part of this system aimed at individuals engaged in 'hands-on' maintenance, support or management. Without proper training, other initiatives related to error management and safety improvement (such as error reporting and investigation, better shift and task handover procedures, improvements in procedure design, etc.) will probably not be effective in the long term. An integrated approach, linking human factors training with organisational safety management and error management initiatives, is essential.

Human factors training should not be something radically new - it covers basic safety principles and practices which should already be incorporated within a safety management and quality system, and how to ensure that work is carried out in a professional manner such that aircraft are released to

service in a safe and airworthy condition. However, evidence from accidents, incidents and studies indicates that some of the processes and training which ought to achieve this are weak or non-existent. The rest of CAP 716 describes how some of these processes should be improved; Chapter 11 describes the training required to enable staff to work with these *organisational* processes, or even help design them, as well as being aware of *individual* human performance and limitations and how to avoid and manage errors. It should also be closely integrated with the company Maintenance Error Management System (MEMS), staff being fully conversant with the company just culture/ disciplinary policy and how they are expected to interface with MEMS.

Various terms are sometimes used to describe the training mentioned above. Within CAP 716 we refer to "human factors training". It may also be described as "error management training". "Maintenance Resource Management" training is a term, originating in North America, to describe human factors training where the primary emphasis is upon teamwork and communication. It doesn't really matter what you call it, as long as it is done!

4. Aims and Objectives

The objectives of Human Factors training, within a human factors and error management programme, should be to

- improve safety
- decrease organisational exposure to risk,
- reduce errors,
- capture errors,

These objectives may vary in detail from company to company, but should cover the key points listed in Reason and Hobbs CAIR checklist (see Appendix M).

The aim of human factors training should be to help achieve these objectives by means of:

- imparting knowledge on human factors and safety, and details of how the company human factors programme works,
- developing skills (where appropriate),
- influencing people's attitudes and
- influencing behaviour.

5. Requirements

The Part-145.A.30(e) requirement (previously NPA12 to JAR145) was introduced as a result of the work of the Training sub-group of the JAA Maintenance Human Factors Working Group (MHFWG). Further details concerning the composition of this group, and the rationale for expanding human factors training from only certifying staff, to all staff within the organisation "whose error or poor decision could affect safety or compliance with JAR145/[Part-145]", are contained in the JAA MHFWG report (Appendix A).

Part-66 already includes a requirement to demonstrate knowledge of Human Factors elements which are included in Part-66 Module 9. However, this only applies to licensed engineers and is *not* a requirement for training. The knowledge may be acquired by several means, one option being self-study, and is tested by means of examination. A good appreciation of the *practical application* of human factors can only be obtained by training, ideally within the context of the organisation within

which the people work. Furthermore an examination in isolation cannot really assess certain aspects such as “skill” and above all “attitude”, which are two of the training objectives discussed above. Training in human factors is, therefore, important in order not only to help people understand what the issues are, but how to adopt good human factors practice in all aspects of work. Such training is appropriate for all staff who have an impact upon safety and airworthiness, not just for engineers or certifying staff.

Part-145.A.30(e) requires that "the organisation shall establish and control the competence of personnel involved in any maintenance, management and/or quality audits" where "competence must include an understanding of the application of human factors and human performance issues appropriate to that person's function in the organisation".

AMC-145.A.30(e) proposes human factors training as an acceptable means of compliance with the requirement in Part-145.A.30(e) to have an appropriate understanding of the application of human factors, and gives further details as to how this training should be implemented. The JAA MHFWG report expands on this, and whilst not a part of the Part-145 requirement, is nevertheless interpreted by the CAA as JAA guidance material. At the time of writing this CAP, the JAA MHFWG report was published on the JAA website (www.jaa.nl) and has been included in CAP716, complete with the expanded human factors training syllabus, as Appendix A.

6. Who should receive human factors training?

6.1 Personnel to receive human factors training

AMC-145.A.30(e)6 lists the personnel for whom human factors training is applicable:

"This should include, as a minimum:

- Post-holders, managers, supervisors
- Certifying staff, technicians, and mechanics.
- Technical support personnel such as planners, engineers, technical records staff
- Quality control/assurance staff
- Specialised services staff
- Human factors staff/ Human factors trainers
- Store department staff, Purchasing dept. staff
- Ground equipment operators
- Contract staff in the above categories"

To this list should be added¹:

- Human factors programme managers
- The person doing the TNA
- Competence assessors
- Accident/ incident investigation personnel
- Technical trainers (where relevant)
- Health and Safety staff
- Human resources personnel

Ideally, this list should also extend to the customer with whom the Part-145 organisation interfaces, since the customer ought to be aware of the human factors and safety implications of the demands

¹ Additional categories of staff recommended by ICAO Doc 9824-AN/450, and CAP 716

which they place upon the maintainer. However, the requirement for human factors training is restricted to Part/JAR-145 approved organisations and their staff (and contractors), and does not extend to JAROPS.

Also included are personnel who work for organisations which are not approved under Part-145, but which are working under sub-contract. AMC-145.A.75(b) states that " subcontractor's personnel involved with the maintenance organisation's products undergoing maintenance should meet Part-145 requirements for the duration of that maintenance and it remains the organisation's responsibility to ensure such requirements are satisfied". This includes human factors training, but with the caveat 'as appropriate'. For instance, it would probably be applicable to ensure that subcontractors dealing with NDT on critical components are aware of human factors issues in visual inspection, but probably not necessary for subcontractors dealing with IFE to have human factors training. It would be up to the contracting company to determine what human factors training was necessary.

The requirements include a need for regulators to be appropriately trained, and, although not explicit in Part 145, the implication is that this training would therefore include human factors. Indeed, the recently published ICAO document 9824-AN/450 (Human Factors Guidelines for Aircraft Maintenance Manual) states that "In addition to having suitable background, experience and qualifications, the maintenance inspectors from the State aviation regulatory body should have human factors training to a level at least comparable to their counterparts in industry".

6.2 Why train everyone in the organisation?

Evidence from incidents and accidents shows that human error and human factors problems are not limited to 'hands-on' maintenance staff (whether certifying or non-certifying), but may extend to planners, technical records staff, etc. In addition, it is often organisational decisions and policies made by managers that are at the root of some incidents (eg. to ensure adequate resources). Senior management commitment to, and support of, the company human factors programme is essential to the success of such programmes. Staff need to be convinced of this commitment by management. Managers attending the human factors training themselves is one way of showing this.

Whilst managers may think that they understand what the human factors problems are, informal feedback from various human factors conferences indicates that some have previously been unaware of the extent and nature of the problems that exist in industry. Training for managers, including the accountable manager, is considered important to raise awareness of problems both in the industry as a whole, but also within their own company.

As stated in para 5, the training should be "appropriate to that person's function in the organisation". Thus technical records staff, for instance, should be aware of the types of problems which occur, or may occur, due to human error, especially those which have arisen from poor manuals and procedures, but may not need to have an in-depth knowledge of human performance and limitations or error theories. Certifying staff within an aircraft maintenance organisation would need a reasonable understanding of all the syllabus items, whereas support staff (eg. stores/supply) may not.

An organisation should carry out a Training Needs Analysis (TNA) in order to determine what training (and to what level) is appropriate for the various categories of staff.

7. Stages of Implementation

Training will not be successful in the long term unless what it teaches is supported within the organisation on a day-to-day basis. Therefore the human factors training requirement within Part-145 should not be considered in isolation. The training should be a part of the total package of measures within a Part-145 approved organisation to assure safety and airworthiness.

The following stages of implementation should be completed to ensure the success of the human factors training. Where organisations have already embarked on some of the stages below, they should give consideration to revisiting earlier stages in case they have not been covered properly.

1. **Genesis.** Ensure the person or people responsible for putting in place the human factors training and programme, are appropriately trained. External training will be necessary since the company human factors training programme will not yet have started. It may also be useful to seek views or even assistance from other similar organisations.
2. A company **Human Factors and Safety Management Programme** needs to be designed and the structure in place (including a process for error management). The introduction of human factors training, particularly Module 10 of the syllabus, should be timed such that the key elements of the company human factors and safety management programme, in particular the error management process, are already in place before training starts.
3. **Measurement of Competence** - Identify current levels of competence and methods for monitoring and managing competence. Part-145.A.30(e) requires that "the organisation shall establish and control the competence of personnel involved in any maintenance, management and/or quality audits" where "competence must include an understanding of the application of human factors and human performance issues appropriate to that person's function in the organisation".
4. Conduct a **Training Needs Analysis (TNA)** - An organisation should carry out a Training Needs Analysis (TNA) in order to determine what training (and to what level) is appropriate for the various categories of staff. Please note there is no 'one size fits all' solution for training. The findings from a TNA are used to tailor the scope of the training provided to ensure the training is suitable for the needs of your particular company.
5. **In house, or contracted out?** - Determine whether the organisation is able, or willing, to run the training in-house. If in-house training is not an option, organisations are advised to carefully consider the options for contracting out, or compromises, such as a joint training programme with other similar companies in the vicinity.
6. Develop Tailored **Training Material** - There is a wealth of material from which human factors trainers may draw when developing their training course, varying from off-the-shelf packages which may suit their needs, to generic² training material which may be customised, to source information from which trainers can develop their own training material. Many of these sources are referenced in Appendix Z.

² The Proceedings of the 15th HFIAM symposium, 2001, contain a set of slides and notes which may be customised and used, at no charge.

7. Provide **Initial Training** in Human Factors - This is described in greater detail later in this chapter.
8. Provide **Continuation Training** in Human Factors - This is described in greater detail later in this chapter.
9. **Review and update** training, on a regular basis. This includes the need for the human factors trainer to keep up-to-date with current thinking and best practice on human factors.

7.1 Timing of the introduction of human factors training

The timing of human factors training with respect to the introduction and implementation of the key elements of the company human factors and error management programme, is important. The key people involved in the introduction of such a programme should have received fairly comprehensive human factors training beforehand. The introduction of such a programme should ideally be timed to coincide with human factors training for the staff, particularly module 10. One could even argue that basic human factors concepts ought to be taught beforehand, so that the staff understand the rationale behind such initiatives as Maintenance Error Management, or more formalised shift handover procedures, and don't reject them out of hand. On the other hand, one could argue that if training takes place too soon before the introduction of the supporting elements of a company human factors programme, staff will become disillusioned that they cannot implement what they have been taught. This is particularly important in the case of maintenance error reporting and the disciplinary policy.

Different approaches will work for different organisations, but careful thought should be given to the relative timing of all the elements of the company human factors programme, in particular module 10. Training staff on something which doesn't yet exist is likely to be ineffective at best, and may even cause future problems once the elements of a human factors and error management programme have finally been introduced.

8. Measurement of Competence

Organisations should have a mechanism for determining competence of staff, not just with respect to human factors, but for all areas (both technical and non-technical) in which staff are required to be competent.

Demonstration of competence applies to all staff within an Part-145 organisation, not just the hands-on technical staff, or even just the licensed engineers. Management competence and human factors competence should be closely linked. A manager may be highly competent in day-to-day management and making money for the company, but not particularly supportive of human factors principles and policies, despite the fact that he understands what they are all about.

There are many different mechanisms available that may be used as evidence of competence. These include:

- Examination - a good mechanism for assessing knowledge, but not necessarily competence of applying knowledge in a work context;

- Interview;
- Qualifications - a good source of evidence, if the training course or other method used to gain the qualification are directly relevant and practical for application in the workplace;
- Completion of training courses is a good way of providing information, but not sufficient to prove individual competence in applying the knowledge gained from the course;
- On-the-job assessment - a good way of determining competence, however its effectiveness relies heavily on the competence of the supervisor or manager conducting the assessment as it relies on their subjective judgement;
- Tailored assessments – staff are asked what they would take into account when doing particular tasks, e.g. a planner explains that he would give consideration to the effect fatigue may have and schedules critical tasks to be completed during the day shift or at the start of the night shift rather than in the early hours of the morning. This explanation shows the planner understands how some human factors issues are applicable to his job.

Assessing competence in the practical application of human factors is difficult, therefore it may be appropriate in your organisation to apply a selection of the above methods. Please note, that the pervading culture within the company may be contrary to good human factors principles (eg. the culture might be that errors are not tolerated, and are regarded as signs of incompetence). If this is the case, it is likely that judgements of competence will be biased towards that company culture. It is important, therefore, that staff are trained in how to assess competence, and that independent checks are carried out of the competence assessment process.

An organisation may decide that it is going to limit its assessments to competence in the "understanding of the application of human factors" as specified in Part-145.A.30(e), ie. if people know what they should be doing, they are considered competent in human factors, even if they don't actually do it. However, the UK interpretation of this particular requirement extends to the *actual* application, as opposed to just the *understanding* of the correct application, of human factors and safety principles. No matter how good your training might be, unless it results in appropriate behaviour, its aims have not been achieved. However, it should also be recognised that human factors training is not *always* the solution to lack of competence in the application of human factors. There may be instances where individuals would like to apply what they know to be good human factors practices, but are unable to do so due to limitations in the company processes. In such cases, appropriate solutions should be sought.

Using the argument in the paragraph above, whilst the manager(s) concerned may have competence in an understanding of the application of human factors, the fact that they fail to support the application of such principles within the company means that the intent of the Part-145.A.30(e) requirement has not been met. The extension of understanding of human factors, to its effective application, should be the ultimate aim for all staff, particularly senior managers, if safety is to be improved.

For further information concerning mechanisms for determining competence, readers are referred to the paper "Proving the Competence of the Aircraft Maintenance Engineer", presented at the International Air Safety Seminar, November 2003. In addition, readers are referred to CAP 737, which contains methods of assessing the competence of personnel in CRM skills, there being many useful parallels.

More work is needed on the subject of competence assessment, both in its wider context and also in the more specific context of human factors. In the meantime, this limited guidance has been included in CAP 716 on competence assessment. Note: until the guidance on competence assessment is more mature, organisations are strongly advised against using 'lack of competence in human factors' in the context of any decisions concerning an individual's position within an organisation (with the possible exceptions of the roles of human factors trainer, and human factors programme manager). Competence should be assessed initially with a view to determining how best to bring individuals up to an appropriate level of competence, by training.

The ICAO document "Human Factors in Aviation Maintenance" (Doc 9824-AN/450) acknowledges that there is a need for better understanding of how best to assess competence in human factors, adding "such an understanding will help prevent premature moves to assessment and testing in circumstances where they could prove counterproductive to long-term learning needs".

9. Course versus other methods of training

A 'course' is not obligatory, but it is felt that it is by far the best way to teach practical maintenance human factors, whether initial or recurrent. Part of the value of the training is to compare views and experiences between course attendees, and between trainer and attendees. The importance of a skilled and knowledgeable trainer cannot be overestimated. Much of the emphasis of the human factors training should be upon reinforcing or changing attitudes, rather than imparting knowledge, and a good trainer/ facilitator is key to this.

9.1 Computer Based Training

Some Computer Based Training (CBT) or internet based human factors training packages are available. Whilst these may be appropriate for some of the more knowledge based elements of GM-145.A.30(e) syllabus (or, indeed, Part-66 module 9), they are not appropriate *in isolation* to meet the intent of AMC-145.A.30(e), especially the syllabus elements dealing with error, communication, safety culture and teamwork. CBT is best used in conjunction with a training course to reinforce syllabus elements, or to cover the more knowledge based syllabus elements (eg. human performance and limitations), allowing more time on the course to address the more complex organisational and safety culture elements. Two way interaction is important to human factors training, especially where attitude change or reinforcement is necessary, and this can only be accomplished by the presence of a good trainer-facilitator in a classroom situation.

9.2 Videos

Videos may also be used for training purposes but, as with CBT, they will be of limited effectiveness unless incorporated as part of a training course with a good trainer. Appendix Z includes details of some videos which might be suitable for inclusion within a maintenance human factors training course.

9.3 Facilitated training

CBT or video in isolation are unlikely to be suitable for continuation training because (i) video or CBT tends to be fairly generic in nature whereas continuation training is intended to address issues and problems specific to each particular organisation, and (ii) CBT and video do not allow for two way communication which is an important element of continuation training. As with initial training, a

combination of CBT/video and 'live' facilitation may be appropriate for continuation training, but it should be remembered that the emphasis should be upon company specific issues. If it is discovered that staff still have a poor understanding of some generic human factors issues, then it may be necessary to address this, whereupon use of video and/or CBT may be appropriate. These tools may also be appropriate for continuous reinforcement of human factors 'messages', eg. by running through examples of accidents or incidents and what can be learned from them. What must be avoided is for companies to require all staff to run through a possibly inappropriate CBT course, or sit through a video, just to get the 'tick-in-the-box' for recurrent human factors training.

The best option, for both large and small organisations, for both initial and continuation training, is still considered to be a facilitated course, ideally combining various training methods and media, such as 'chalk and talk', team exercises, video, multi-media, etc., such that all learning styles are catered for.

10. Training Needs Analysis (TNA)

A TNA should be carried out before any major decisions are made concerning human factors training. A TNA is a crucial stage in putting together a human factors training programme, and should not be omitted unless all staff are to receive full training on all syllabus topics. Even then, a TNA would be a valuable tool in helping to design the training and tailor it for the needs of the company and its staff.

10.1 Who should conduct the TNA?

The person doing the TNA should have a reasonable level of competence in human factors, and be aware of the needs of the company and the different roles of its staff. The TNA may either be carried out by one person within the Part-145 organisation, or jointly between one person from the organisation and a specialist who is familiar with TNA principles and the practical application of human factors.

10.2 What does a TNA involve?

The following section provides a summary of the key stages of a TNA. An example TNA is included in Appendix U.

- 1) **Stage 1** - Categorise all the various jobs within the company according to the different needs for human factors training - an example is given in Table 1 below.

Table 1

Technical Certifying staff (ie. those doing hands-on maintenance or overhaul)	Permanent staff
	Contract staff
Technical non-Certifying staff (ie. those doing hands-on maintenance or overhaul)	Permanent staff
	Contract staff
Management and technical support staff	Post holders/ senior managers
	Managers/ QA

	Supervisors
	Planners/ production control
	Tech records/ tech services/ design
	Purchasing/ supply chain
	Stores
Other staff	Trainers
	Human factors trainers
	Human resources/ personnel
	Loaders/ drivers/ etc

2) **Stage 2** - For each category of staff, identify what level of human factors competence is required for each of the various syllabus elements. This may vary from none (eg. loaders may not need to know anything about error models) to high (eg. supervisors need to know a lot about task/shift handovers).

TNA should consider the nature of the work, as well as the different staff roles, and other issues such as whether staff work shifts. Many different aspects should be taken into account when considering who needs what training, to what level of detail and with what emphasis. For instance, if your staff do not work shifts, shiftwork need not be covered in detail. On the other hand, if you do work shifts, it is particularly important that your planners are aware of the effects of fatigue on human performance, in order to comply with AMC-145.A.47(a).

Safety critical tasks should be a prime consideration when doing a TNA, especially for staff working nights, or on the line in all weathers. The TNA should also take into account the intrinsic vulnerability of the aircraft you are maintaining, and the circumstances under which they may be operating (eg. a TNA for maintainers of helicopters operating in the North Sea might differ from a TNA for passenger shuttle operations using new, easy to maintain modern aircraft, and would definitely differ from a TNA for a company whose business is component overhaul).

3) **Stage 3** - Once the TNA has been reviewed and agreed as appropriate, determine what level of competence in human factors the individual staff members have, compared with that required. E.g. managers may have already attended courses that cover teamwork and assertiveness, and most staff will have undertaken health and safety training, therefore the syllabus element dealing with 'hazardous situations' may have already been covered.

Determining existing levels of competence in human factors may be difficult. Licensed engineers may have successfully passed an examination in Part-66 Module 9, for instance, but only possess some theoretical knowledge concerning human factors, as opposed to competence in its practical application. The organisation should not give any credit for such training unless they have an acceptable method for determining competence in the subject.

4) **Stage 4** - Determine what level and duration of training to provide to staff, based on the TNA and staff competence assessments. Companies may find it easier to provide the one comprehensive course to all staff as initial training. Others may tailor their training according to suit the different categories of staff.

Ultimately, the duration of both initial and continuation training should be determined by the TNA. Whilst in practice key factors affecting the duration of training tend to be the cost and whether staff

can be released, companies should endeavour to make staff available for whatever time is necessary, determined by the TNA, if training is to be effective in meeting its aims and objectives.

It should be remembered that a TNA is not static - it may need to be altered according to the changing nature of the company's business over time, and will be different for initial and continuation training. It may also change based on feedback from the company's occurrence reporting/ Maintenance Error Management System (MEMS) - for instance, if a series of problems are experienced during night shifts, then planners and staff working shifts may need to be given additional training on circadian rhythms and how to minimise fatigue. In particular, human factors continuation training should reflect particular problem areas that the company has experienced recently.

Realistically, it is not expected that organisations will have to run numerous variations of a human factors course for different groups of staff. In some cases, it may be easier to put all staff on the same course, and in others one core course plus two or three tailored modules may suffice. A TNA should be used as a tool to help design training, not an additional 'requirement' to complicate the issue. However, a TNA is a crucial stage in putting together a human factors training programme, and should not be omitted unless all staff are to receive full training on all syllabus topics. Even then, a TNA would be a valuable tool in helping to design the training and tailor it for the needs of the company and its staff.

11. Training Material

11.1 Syllabus

The human factors syllabus in GM- 145.A.30(e) is a compromise that was developed by the JAA MHFWG, in order to introduce practical elements of human factors whilst not diverging markedly from the existing Part-66 Module 9 human factors syllabus. This compromise was agreed in recognition that many organisations had already been training personnel in human factors for JAR66, and the introduction of a significantly different syllabus for 145, also entitled "human factors" would have caused confusion and unnecessary duplication of training effort. In addition, in order to enable the possibility of future cross-credits between 145 and 66, the syllabi needed to be fairly similar. Note: the UK is not offering such cross-credits.

The main distinction between Part- 145 and Part-66 human factors, apart from the content, is in terms of how the syllabus elements are taught, and the relative emphasis upon knowledge, skills, attitude and behaviour. As stated earlier, the Part-66 (module 9) requirement concentrates upon theoretical knowledge of the Module 9 human performance and limitations elements, whereas GM-145.A.30(e) concentrates upon the practical application of human factors in a work context, with the emphasis upon skills, attitudes and behaviour, as opposed to simply knowledge.

The expanded GM- 145.A.30(e) syllabus is in Appendix A, attachment 7, Table 1. This contains pointers as to where the emphasis on each syllabus item should lie (ie. knowledge, skills, attitude) and examples of source material which instructors may wish to use when teaching the various syllabus elements.

11.2 Module 10 of the syllabus

Module 10 of the human factors training syllabus in GM-145.A.30(e) is company specific, and is intended to inform staff what elements of a HF programme/ SMS programme exist within the company (and what doesn't exist) and in what form. This module is what ties the MHF training together with the processes within the company that will (hopefully) enable the principles taught during the course, to be applied within the organisation.

Module 10 should describe (where present):

- Relevant aspects of the company safety and quality policy
- The company hazard reporting/ occurrence reporting/ MEMS system
- The company occurrence/error investigation system / MEMS system
- The company disciplinary policy, and its interface with the MEMS system
- The company process for identifying and reporting errors and ambiguities with maintenance data
- The company policy on working hours and fatigue, and a reminder of an individual's personal responsibility to obtain adequate rest during time off.
- Company shift/task handover procedures
- Company feedback mechanisms (eg. a magazine or website)
- Details of the company health check system (eg. for night shift workers)/ eyesight testing programme/ hearing testing programme

Ideally, Module 10 of the syllabus should take the form of a presentation by a senior manager within the company, in order to demonstrate senior management support of these policies (although if such support is not present, a presentation by a manager who is obviously not committed can be self defeating). Module 10 may be covered entirely separately from the main initial MHF training (although preferably after the main MHF training has taken place, so that staff better understand why such policies and processes are necessary).

Module 10 should be given to both permanent and temporary staff very soon after joining the company, ideally as part of induction training.

Human factors training in isolation is unlikely to be effective. The training should be just one part of an overall human factors and error management programme. Module 10 is probably the most important element of the human factors syllabus in that it shows staff how the organisation has put in place the mechanisms to support them in applying the human factors practices and principles learned in modules 1 to 9.

12. Initial and continuation training

AMC-145.A.30(e) refers to both initial and continuation training. Initial training and continuation training may be quite different. Note: The AMC- has been written assuming everyone has already undergone initial training, and it is only necessary to ensure that new personnel receive such training (or that they have received it elsewhere to a standard which meets the needs of the company).

12.1 Initial training

The initial training may be generic, but not to such an extent that it is unrelated to the task of aircraft maintenance (or component overhaul, or NDT, etc). However, the more closely it is related to the work of the organisation, the more effective it is likely to be with resulting benefit to the organisation.

Whilst a syllabus is provided in GM-145.A.30(e), organisations may adapt this to best fit their particular needs. The JAA Maintenance Human Factors Working Group Report (Appendix A) expands upon the syllabus and gives examples of subject matter that trainers might wish to call upon, but should only be taken as guidance, there being many other sources of information available in addition to this report. The TNA should provide a clear guide as to what level of training is appropriate, for each group of staff, for each topic.

The recommended form of initial training is a formal training course, following a syllabus, although recognising that the length and content of the course should be tailored to the size and type of organisation, the nature of its business and individuals' jobs.

12.2 Duration of initial training

The recommended form of initial training is a formal training course, following a syllabus, although recognising that the length and content of the course should be tailored to the size and type of organisation, the nature of its business and individuals' jobs. The duration should be determined by the TNA. If an organisation elects not to carry out a TNA, it is advised that the course duration should reflect best practice.

Experience³ indicates that 3 days is an optimistic estimate to cover the whole syllabus to an adequate depth. Courses in existence range from 2 to 5 days. Less time may be needed for staff who do not need to address all the syllabus items in detail, or where issues have already been covered in other training courses. Longer may be needed for certain groups of staff, eg. human factors programme managers, MEMS investigators, and human factors trainers. (One well-known training programme developed as part of an EC sponsored project, for instance, trains trainers over two staggered 1 week courses, with coursework and practical experience between the two weeks). Additional training in facilitation skills is likely to be needed for human factors trainers.

Exercises and discussion during the training can lengthen the course but can be valuable to reinforce learning points and generate discussion and debate. Human factors courses benefit very much from facilitation and two-way exchange of information, rather than instruction and one-way exchange of information.

It may be possible to have a short core course (eg. 2 days) covering key syllabus items relevant to all staff, with additional modules (eg. fatigue and shiftwork) which can be pitched at an appropriate level for particular groups of staff where relevant. The ICAO Human Factors Training Manual suggests a duration of 2 days for human factors training, but it should be remembered that this is in the context of a basic understanding of human factors and human performance and limitations based upon Annex 1 standards, and not specifically expanded to include the practical application of human factors in a work context, and the skills which may be required to be competent in human factors. The more recently published ICAO "Human Factors in Aviation Maintenance Manual" (Doc 9824-AN/450) suggests that between 15 and 30 hours will be needed for a course meeting the objectives described in that document.

³ Feedback from the CAA/Air Safety Services International (ASSI) human factors course (www.caa.co.uk/srg/intsd) indicates that 3 days is either just right, or not quite long enough.

12.3 Continuation training

The AMC- states that "The purpose of continuation training is primarily to ensure that all staff remain current in terms of human factors and also to collect feedback on human factors issues". In order to be most cost effective, continuation training should concentrate upon those areas within the company where problems and errors are occurring, and where human factors training is most necessary. These may be identified from the quality system, occurrence reporting/ MEMS system, or other mechanisms (see Chapter 10).

The continuation training itself may be used as an opportunity for two way feedback: (i) for the trainers to hear what problems the staff are encountering with respect to human factors and safety, and to pass these on to the quality department and senior management for appropriate action, and (ii) for the staff to be advised of what problems are current, recent incidents from which they can learn, any new safety initiatives, as well as refresher training on topical human factors areas.

Continuation training is an important means of keeping staff involved in the ongoing human factors and error management programme. Without staff 'buy-in', such programmes are destined to fail. Feedback to staff, based on issues they have raised during previous continuation, is important, and helps with the 'buy-in' process.

Continuation training for human factors trainers, human factors programme managers and those staff who may not be able to attend company continuation training sessions for some reason (such as contract staff), may take the form of attendance at conferences, seminars and workshops on maintenance human factors, where appropriate. However, it should be remembered that such presentations, whilst useful for keeping up-to-date on human factors, are unlikely to address specific company problems, so should be looked upon as additional, rather than alternatives, to in-house company continuation training.

Continuation training may take place throughout the year in the form of a company safety magazine, website or other mechanism for communication. However, this does not guarantee that staff will read the information given to them, nor does it easily allow for two-way feedback, therefore an occasion where staff can get together and discuss the issues, is recommended, in addition to on-going feedback.

Continuation training should not take the form of repetition of syllabus items just for the sake of it - the opportunity should be used to address real, topical issues which are of concern. These issues will often be linked to technical issues, in which case the continuation training opportunity could be used to address both human factors and technical problems. While there are still human factors problems to be resolved and maintenance errors occurring, continuation training is key to maintaining staff buy-in year on year.

12.4 Duration of continuation training

The duration and frequency of continuation training is whatever is appropriate to address the objectives of (i) ensuring that all staff remain current in human factors, (ii) addressing topical issues where training is required (particularly lessons learned from MEMS) and (iii) collecting feedback on human factors issues from the workforce.

In a large company, the minimum duration would probably be at least 1 day every 2 years, with longer if necessary where human factors related problems are being experienced. This does not mean to say that a 1 day course is necessary every 2 years - information fed back to staff during the year, in the form of a staff magazine, for instance, could count as continuation training, as could feedback from staff via hazard and occurrence reporting systems. However, a specific time set aside for continuation training once a year ensures that time is made available for two-way feedback, should it be needed. If everything is working well and continuous feedback throughout the year is effective, specific annual continuation training may not be necessary, but an organisation would have to be very certain that this was the case before dispensing with the formal biennial continuation training opportunity.

12.5 Human factors training duration for smaller organisations (initial and continuation)

For organisations not engaged directly in maintenance of commercially operated aircraft (or their engines), in particular small companies, the nature and duration of human factors training may be significantly reduced, and that which takes place concentrated mainly upon tasks, work and activities which are likely to have safety implication. For example, a company maintaining aircraft seats would not be expected to put its staff through a 3 day human factors course - a short introduction to human factors, plus module 10 would probably suffice for initial training, and continuation training would cover problems which might have arisen (if any) within the company, with respect to human factors. If it is reasonably certain that no problems exist, human factors continuation training might not be necessary.

Ultimately, the duration of both initial and continuation training should be determined by the TNA. Whilst in practice key factors affecting the duration of training tend to be the cost and whether staff can be released, companies should endeavour to make staff available for whatever time is necessary, determined by the TNA, if training is to be effective in meeting its aims and objectives.

13. Who should provide the training?

Good instructors are crucial to effective human factors training, especially where the emphasis is upon attitude change. Whilst the skills required to impart knowledge are fairly common across most subjects, whether technical or more esoteric, the skills to influence people's attitudes and behaviours are different, and are key to successful human factors training.

It is essential that the human factors trainer (or facilitator) believes in what they are teaching, and has enough credibility, enthusiasm and knowledge to pass on this belief to his students. A good human factors trainer should be able to positively influence his trainees' safety behaviour, which, ultimately, should reflect positively upon the organisation's safety culture, and even its commercial profitability.

The JAA MHFWG report (appendix A) recommends certain criteria for instructors providing human factors training to meet the Part-145.A.30(e) requirement, namely that the instructor:

- has attended an acceptable Human Factors training course that covers the 145 training syllabus
- has received additional instruction in training and facilitation techniques

- has worked for at least 3 years for⁴ a maintenance organisation⁵.

13.1 Training the trainer courses

An "acceptable" course is one that provides the trainer with the depth of knowledge, and supporting material, to enable him/her to teach the factual elements of human factors, but also addresses how the various syllabus elements should be taught, and how they might relate to practical work contexts. A course that concentrates purely on the theoretical aspects of human factors would not be acceptable. It is also recommended that the person within the organisation doing the TNA and/or making key decisions regarding the training (such as whether to do it in-house, or to contract out) attend such a course, so that they are making the decisions on an informed basis.

Whilst training/facilitation skills are important, it is not necessarily vital to attend a course to acquire these techniques. What is more important is to have an appropriate feedback system, and occasional quality audits, to ensure that the instructor's training/facilitation techniques are achieving the desired results. This applies to all forms of instruction, but is particularly vital in the case of human factors facilitation, where two-way interaction is more important. Some guidelines in facilitation techniques are included in Appendix V.

The third recommendation from the JAA MHFWG report arose because it was felt that it was more important to have someone teaching the subject who was aware of the practicalities of the job, and who would be able to call upon his/her own experience (particularly errors) to illustrate points. This experience was felt to be more important than formal qualifications in human factors or training skills (although ideal if an instructor could combine experience and skills in all three areas). Ideally, the instructor should have several years experience in aviation maintenance (or work application area of the engineers and technicians they will be teaching). Whilst being a Licensed Aircraft Engineer is not a prerequisite, it is felt that it would be valuable. Companies should consider seeking enthusiastic volunteers from among the workforce, to teach human factors - ideally someone who is respected by his/her colleagues, although not someone who is afraid to admit their own fallibility!

If those training human factors are part-time engineers- part-time trainers, this will probably ensure that they are up-to-date with everyday problems; if those teaching human factors are full-time trainers, it would be beneficial for them to keep up-to-date with maintenance tasks and problems by visiting the workplace frequently, and learning from their 'students' at every opportunity. This also helps maintain credibility, which is vitally important to a human factors trainer.

13.2 Training MEMS investigators

Training of MEMS investigators is not covered in this chapter, but it may be worth considering whether similar skills are needed for both human factors training and MEMS incident investigations, and merge the two roles (and their training). Careful thought should be given to the advantages and disadvantages of doing this, however, especially in terms of protecting the confidentiality of the MEMS scheme. It is possible that, if the roles were to be combined, the human factors trainer might inadvertently use details from an incident he has investigated, to illustrate a point in training, and unwittingly compromise the confidentiality of the scheme. In addition, a MEMS investigator needs to

⁴ CAP 716 interprets "working for a maintenance organisation" as "within the aviation industry, where a good knowledge of maintenance (or subject area being trained) has been obtained".

⁵ The JAA MHFWG report distinguishes between initial and recurrent training; CAP 716 does not make this distinction, considering the criteria applicable to both contexts.

be available to investigate an incident at short notice, which may clash with scheduled human factors courses.

13.3 External trainers

Human factors training may be provided by either a trainer employed by the organisation or by trainer(s) outside the organisation, although training is likely to be most effective if it is tailored to the specific needs and problems of one's own organisation and the instructor is someone familiar with the needs and problems of that organisation.

In cases where organisations cannot provide their own in-house training, it is acceptable to contract out as long as the main trainer has a good background in aviation maintenance, and meet the criteria mentioned earlier. It is not enough simply to present a set of slides on the syllabus topics without having adequate knowledge to illustrate points using practical examples, or to answer questions. The quality of the trainer is key to the success of human factors training, remembering that Part-145.A.30(e) human factors training is more about changing attitudes and less about imparting knowledge.

Organisations should be wary of inappropriate adaptations of Crew Resource Management (CRM) training being offered as a means to comply with the Part-145.A.30(e) human factors training requirement. Whilst some of the principles may be common to flight operations and maintenance, such courses would need to be specifically tailored to maintenance in order to be applicable. If the course is to be delivered by a CRM instructor (CRMI), it is strongly recommended that this instructor team up with a maintenance engineer so that the latter can assist where practical examples are required to illustrate points.

13.4 Accreditation of human factors trainers

At the time of writing this document, no formal accreditation existed for maintenance human factors instructors, nor do other accreditations (whether CRMI, or Part-147 for individuals, courses or training schools/organisations) apply to Part-145.A.30(e). Organisations are encouraged to train their human factors trainers to an appropriate standard to meet the training needs of the company, or, if contracting out, to seek an instructor and course appropriate to their needs. The best way of doing this is by recommendation, bearing in mind that there is no 'one size fits all' solution, and that what might be appropriate for one company may not be appropriate for another.

13.5 Cost effective training

It may be possible for organisations to meet the letter, but not the intent, of the human factors training requirement by placing their staff on the shortest, cheapest course available. However, organisations are strongly encouraged to investigate the intrinsic quality of the training courses and trainers, and not necessarily to judge by cost, duration or course content. There is evidence to suggest that good quality human factors training makes commercial sense, as well as safety sense. Several studies have been carried out in the USA on Return on Investment (ROI) of human factors training. The reader is referred to the ROI studies, on <http://hfskyway.faa.gov>.

If an organisation is looking for the cheapest way of meeting the requirement, it should first consider the following points:

- Not all human factors courses are the same - they will differ in terms of quality and applicability
- Has the company considered the benefits of the training, as well as the costs?

- Is the management deliberately seeking a course that addresses human factors only superficially, because they do not want the behaviour of their workforce changed? In which case, might they be condoning unsafe practices?
- Is the choice of course dictated by what the company thinks will most likely meet the requirement? Have they talked to their CAA surveyor about the options?
- Has the person making the decision done so on an informed basis? - or are they allowing their own preconceptions about human factors to influence their judgement? - consider the benefits of that person attending a human factors course prior to making a decision concerning the company human factors training.
- Does the course adequately address Module 10 of the syllabus?. If not, how will Module 10 be covered?

Organisations are encouraged to seek recommendations from other similar companies which have undergone human factors training, before making a decision. They are also reminded of the long term benefits of training one of their own staff to teach human factors, and to retain and develop this expertise in-house for continuation training purposes. If contracting out, a good quality course meeting the needs of the organisation, based on the company TNA, is what is recommended.

14. Human factors training for contract staff

The guidance in this chapter applies equally to contract staff as well as permanently employed staff, but there were, at the time of writing issue 2 to CAP 716, still some unresolved questions as to the practicalities of how human factors training for contract staff would be effectively achieved and checked. The responsibility is ultimately upon the employing organisation to ensure that "all maintenance...personnel should be assessed for the need to receive initial human factors training, but in any case all maintenance...personnel should receive human factors continuation training" (AMC-145.A.30(e)5).

In addition, the requirement states that "temporary staff [including contractors] may need to be trained shortly after joining the organisation to cope with the duration of employment" (AMC-145.A.30(e)6). This was specifically included in the requirement in order to avert the situation whereby employers and contract staff might be tempted to avoid human factors training by keeping durations of employment under 6 months. This puts more pressure upon contract staff to have received initial human factors training in modules 1-9 before joining an organisation. If a contractor has attended an HF course which is reasonably comprehensive, there is a greater likelihood that the employing organisation will accept this training as meeting AMC-145.A.30(e). This will minimise the need to repeat training. Employing organisations should then ensure that module 10 training, covering the more individual company aspects, is given to contract staff at an early stage, ideally as part of induction training.

Continuation training for contract staff is more difficult, but it is anticipated that employing organisations will be willing to include contract staff, particularly those who are to be authorised to certify for work, when they run such training. This would serve the interest of organisations that use contract staff by ensuring that available staff remain current.

The CAA has implemented and promotes the use of an aircraft maintenance engineers' logbook. This is recommended as suitable mechanism to record human factors training received, along with

other training and experience (Part-145 and/or Part-66), although it will still be up to employing organisations to determine whether this training meets their particular needs.

15. Further guidance

The appendices provide much information which may be of use to human factors trainers and those involved in making decisions within each organisation as to how best to meet the Part-145 requirements concerning human factors and error management programmes and human factors training. In particular, the books, videos, websites and other sources of information described in Appendix Z should be of interest, as should the various conferences, seminars, workshops, roadshows and presentations which take place both in the UK and elsewhere, on maintenance human factors.

Appendix A JAA Maintenance Human Factors Working Group Report - extract on training only

The text in Appendix A is a direct copy of the JAA Maintenance Human Factors Working Group (MHFWG) report, 8 May 2001, as published on the JAA website.

3.2 Training issues

3.2.1 General

The Working Group considers that the development of human factors related skills, knowledge and attitudes in the maintenance organisation should be achieved through the training of all concerned maintenance personnel on the subject.

The Working Group proposes to add new JAR and AMC paragraphs on Human factors training. These paragraphs would identify the maintenance staff concerned and would address the need for both initial and continuation training.

3.2.2. Personnel to be trained

The Working Group proposes that all personnel whose error or poor decision could affect safety or compliance with JAR 145. More specifically, the Working Group identified personnel in the following functions:

- Post-holders, managers, supervisors
- Certifying staff, technicians, and mechanics
- Planners, engineers,
- Quality control/assurance staff
- Specialised services staff
- Human factors staff/ Human factors trainers
- Store department staff, Purchasing dept. staff
- Ground equipment operators
- Contract staff in the above categories

3.2.3 Initial training

The Working Group developed a syllabus on Maintenance Human Factors training to be included in an Appendix to JAR 145

Contrarily to JAR 66 Appendix 1, this syllabus does not include knowledge level requirements (see Attachment 6). The intent is at a first stage to give the maintenance organisation the flexibility to adapt the training syllabus to the size and work scope of the organisation.

The Working Group also developed more detailed information on Human Factors training. The intent of this material is to provide additional support to those organisations that will develop training courses. This guidance material identifies training objectives in term of skill, knowledge and attitude, and includes examples and references on subjects to be taught. This draft guidance material is included in Attachment 7.

3.2.4 Continuation training

The Working Group considers that the implementation of Maintenance Human Factors principles in an organisation can only be successful if concerned personnel are regularly fed back and retrained on the issue. The experience shows that an initial human factor training without continuation training proves inefficient after a few years. The Working Group therefore proposes that continuation training on Human Factors be performed every 2 years and include a feedback element on Human Factors issues identified in the organisation.

3.2.5 Training Syllabus of JAR 66 Module 9

JAR 66 already includes a requirement to demonstrate knowledge of Human Factors elements, which included in Module 9 of the syllabus. This applies to certifying staff only and is not a requirement for training: it is only tested by means of examination.

However the Working Group's experience is that an appreciation of human factors can only be obtained by training, ideally within the context of the organisation within which the people work. Furthermore an examination only cannot really assess certain aspects such like "skill" and above all "attitude", which are 2 training objectives identified in the draft guidance material (see attachment 7): training is the way forward.

The Working Group understands that it is not the intention of either JAR 66 or JAR 145 to have unnecessary overlap in terms of human factors training, therefore it explored various possibilities to ensure the consistency between JAR 145 Human Factors training and JAR 66 Human Factors examination.

In the information material (see attachment 7), the Working Group proposes the solution of cross credits –under specific conditions- between JAR 145 training and JAR 66 examination on Human Factors.

Another possibility would be, if the Working Group proposed rule changes are adopted, to take Human Factors out of JAR 66, because the Working Group proposal would in practice supersede the JAR 66 requirement (the WG proposal includes all functions of maintenance personnel and is deemed to address the issue at a higher level)

Attachment 6 - Syllabus for Initial Maintenance Human Factors Training

General / Introduction to human factors

Need to address Human Factors
Statistics
Incidents

Safety Culture / Organisational factors

Human Error

Error models and theories
Types of errors in maintenance tasks
Violations
Implications of errors
Avoiding and managing errors
Human Reliability

Human Performance & Limitations

Vision
Hearing
Information-Processing
Attention and Perception
Situational awareness
Memory
Claustrophobia and physical access
Motivation
Fitness/Health
Stress
Workload management
Fatigue
Alcohol, medication, drugs
Physical work
Repetitive tasks / complacency

Environment

Peer pressure
Stressors
Time pressure and deadlines
Workload
Shift Work
Noise and fumes
Illumination
Climate and temperature
Motion and vibration
Complex systems
Hazards in the workplace
Lack of manpower
Distractions and interruptions

Procedures, Information, Tools and Practices

Visual Inspection
Work logging and recording
Procedure – practice / mismatch / Norms
Technical documentation – access and quality

Communication

Shift / Task Handover
Dissemination of information
Cultural differences

Teamwork

Responsibility
Management, supervision and leadership
Decision making

Professionalism and integrity

Keeping up to date; currency
Error provoking behaviour
Assertiveness

Organisation's HF Program

Reporting errors
Disciplinary policy
Error investigation
Action to address problems
Feedback

Attachment 7 Detailed Guidance on Human Factors Training

1. Introduction

1.1 The JAA Maintenance Human Factors Working Group proposed to include in JAR 145 a Human Factors training syllabus intended for all maintenance organisations. This syllabus was left intentionally very general in order to provide the necessary flexibility to the maintenance organisation to adapt it to its own size and scope of work. Furthermore it was considered that training on human factors being a new subject for the biggest part of the maintenance industry, experience should be first gained on the issue before making a prescriptive requirement. On the other end, it is acknowledged that additional guidance is certainly needed to develop an effective maintenance human factors training programme. This document includes such a guidance, but it is recommended to use it with the necessary flexibility during the first years of implementation of the requirement. This means that deviation from this guidance material should be accepted if appropriate justifications (size, scope of the organisation, etc..) are provided.

1.2 JAR 66 already includes a requirement for examination on Human Factors for applicant to a JAR 66 Aircraft Maintenance Licence (AML). It should be noted that while JAR 66 does not include any training requirement but only examination requirement on Maintenance Human Factors, those applicant to a JAR 66 AML trained by a JAR 147 approved training organisation would have undergone a training course on Maintenance Human Factors. This document includes a proposal on possible credits against JAR 145 Human Factors training that could be granted to JAR 66 AML holder. The Working Group proposes that examination credits against JAR 66 Appendix 1 Module 9 be granted to those applicant already trained on Maintenance Human Factors in accordance with this Guidance Material.

1.3 Finally this document provides additional guidance on which categories of maintenance personnel should undergo Human Factors training, training methods, training duration and requirements for trainers

2. Aim and objectives of Maintenance Human Factors training

2.1 The aim of Human Factors training is *to increase safety, quality and efficiency in aircraft maintenance operations by reducing human error and its impact in maintenance activities*. This is obtained through the integration of appropriate categories of maintenance personnel's technical knowledge and skills with basic human factors knowledge and skills and promotion of a positive attitude towards safety.

2.2 The objectives of Human Factors training are:

- To enhance maintenance personnel's awareness of individual and organisational human factors issues, both positive and negative, that may affect airworthiness.
- To develop human factors skills (such as communication, effective teamwork, task management, situational awareness, writing of procedures) as appropriate to the job, in order to make a positive impact on the safety and efficiency of maintenance operations.
- To encourage a positive attitude towards safety, and to discourage unsafe behaviour and practices.

3. Categories of staff to be trained on Maintenance Human Factors.

3.1 Categories of staff to be trained on Maintenance Human Factors include all personnel of a JAR 145 approved maintenance organisation whose work has a direct or indirect affect on the safety of the aircraft or compliance with JAR 145; this means, but not exclusively, the following categories of personnel:

- (a) Post-holders, managers, supervisors
- (b) Certifying staff, technicians, and mechanics.
- (c) Planners, engineers,
- (d) Quality control/assurance staff
- (e) Specialised services staff
- (f) Human factors staff/ Human factors trainers
- (g) Store department staff, Purchasing dept. staff
- (h) Ground equipment operators
- (i) Contract staff in the above categories

4. Duration of training

4.1 The duration of training will vary depending on the category of personnel involved, for example a typical training course duration would range from 1 day for managers and up to 2-3 days for certifying staff.

4.2 Although training courses may be tailored for certain categories of personnel, consideration should also be given to the benefits of having combination of personnel from different functional groups during training sessions.

5. Continuation training

Continuation training may take the form of a dedicated course or, alternatively, may be integrated into other training or company processes.

The aim of the continuation training is to:

- (a) Refresh those topics of the Human Factors Training Syllabus that are most significant for the organisation;
- (b) Further develop skills (communication, team work, task management, situational awareness, etc) as appropriate to the job;
- (c) Make staff aware of human factors issues identified from internal or external analysis of incidents/ occurrences, including instances where staff failed to follow procedures and the reasons why particular procedures are not always followed, reinforcement of the need to follow procedures and the need to ensure that incomplete or incorrect procedures are identified to the company in order that they can be corrected. This does not preclude the possible need to carry out a quality audit of such procedures.

6. Requirements for trainers.

6.1 Human Factors training shall be conducted by at least one Human Factors trainer nominated by the Approved Maintenance Organisation, who may be assisted by experts in order to address specific areas. Trainers should meet the following requirements:

- (a) Have attended an acceptable Human Factors training course that covers the JAR 145 initial training syllabus,
- (b) Have received additional instruction in training and facilitation techniques,
- (c) Have worked for at least 3 years for a maintenance organisation, in the case of continuation training.

6.2 Training could be provided by either a trainer employed by the organisation or by trainers outside the organisation, although training is likely to be most effective if it is tailored to the specific needs and problems of one's own organisation and the instructor is someone familiar with the needs and problems of that organisation.

7. Training methods

7.1 Consideration should be given to the use of different training methods and tools including classroom training, group discussions, accident/ incident analysis, case studies from one's own organisation, video, role-play exercises, teamwork exercises etc

8. Training credits

8.1 A requirement already exists within JAR 66 to demonstrate knowledge of the elements included within the Module 9 (human factors) syllabus. This is tested by means of examination.

8.1.1 The concern is that the emphasis within JAR 66 Module 9 will be upon those aspects of human factors which can be examined, rather than upon the organisational and safety culture aspects of human factors which are more important to safety in a maintenance organisation.

8.1.2 Accordingly it is considered that an appreciation of human factors can only be obtained by training, ideally within the context of the organisation within which the people work.

8.1.3 It is not the intention of either JAR 66 or JAR 145 to have unnecessary overlap in terms of human factors training, therefore 'credits' should offered whereby:

- (a) personnel having been certified under a JAR66 license incorporating Module 9 (human factors) only after having received human factors training within a JAR147 organisation, are exempted from those modules common to the JAR66 module 9 syllabus and the JAR145 Human Factors training syllabus.
- (b) personnel having been certified under a JAR66 license incorporating Module 9 (human factors) who have not received human factors training within a JAR147 organisation, are required to complete JAR 145 initial human factors training, without any exemptions.
- (c) personnel having completed a JAR 145 human factors course meeting the criteria of this Guidance Material, are exempted from the JAR 66 Module 9 examination.
- (d) personnel having completed a human factors course below the criteria of this Guidance Material, are not exempted from the JAR 66 Module 9 examination.

9. Training Syllabus for Human Factors

9.1 Introduction

9.1.1 Taking into consideration the general training objectives, the Training Syllabus table identifies the topics and subtopics to be addressed during the Human Factors training (Appendix T, column 2 & 3).

9.1.2 For each training topic specific objectives are defined (Appendix T, column 4). These objectives are specified in term of knowledge (to know), skills (how to do), attitude (how to be) according to the principle that effective Human Factors training, besides improving the knowledge of the trainees, should foster behavioural skill developments and attitude changes:

- a) Knowledge objectives (K), knowledge and understanding of factual information that should be acquired during the training;
- b) Skill objectives (S), development of skills which may be applied in the workplace, eg., problem solving, decision making, communication, team-work, stress coping strategies, workload management.
- c) Attitude objectives (A), development, change or re-inforcement of a safety conscious attitude, eg., following procedures, using reference data rather than relying upon memory, checking work rather than assuming that it has been done properly, resisting pressure to cut corners when under time constraints, etc.

9.1.3 The last column (Appendix T, column 5) gives examples related to the objectives which organisations may wish to incorporate in their human factors training.

9.1.4 The Training syllabus refers to Initial Human Factors training .For continuation training, Topics and related Objectives can be selected taking into consideration the criteria given in the AMC.

9.1.5 The maintenance organisation may combine, divide, change the order of any subject of the syllabus to suit its own needs, so long as all subjects are covered to a level of detail appropriate to the organisation and its personnel.

9.1.6 Some of the topics may be covered in separate training (health and safety, management, supervisory skills, etc.) in which case duplication of training is not necessary.

9.1.7 Where possible, practical illustrations and examples should be used, especially accident and incident reports

9.1.8 Topics should be related to existing legislation, where relevant (JAA/NAA/EU)

9.1.9 Topics should be related to existing guidance/ advisory material, where relevant (eg. ICAO HF Digests and Training Manual, UKCAA AWN47)

9.1.10 Topics should be related to maintenance engineering where possible; too much unrelated theory should be avoided.

Attachment 7 cont'd. Detailed Guidance on Human Factors Training

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
1	General / Introduction to human factors		<p>K: Achieve a basic understanding of the meaning of the term “human factors”</p> <p>K: Recognize the contribution of human factors to aviation accidents</p> <p>K: Understand the goal of human factors training</p>	<ul style="list-style-type: none"> • See ICAO HF Digests, including ICAO circular 253 • Definition(s) of human factors • ICAO SHELL model • ”Dirty dozen” as a concept. • Well-known accidents where maintenance human factors has been the cause • Company incidents where HF has been the cause
1.1		Need to address Human Factors	A: Appreciate the need to understand and address human factors	<ul style="list-style-type: none"> • The statistic that 80% of accidents are due to human error • US statistics which indicate that 50% of recent accidents have featured maintenance HF problems • Human factors within the control of the individual, and those which are not.
1.2		Statistics	<p>K: Become reasonably familiar with some of the well-known incidents and studies of incident data, where human factors have contributed. Understand why these incidents occurred</p>	<ul style="list-style-type: none"> • See ICAO Circular 253 • Boeing, Pratt & Whitney in-flight shut-down causes, Reason/Continental - 89-91, UKCAA 1992, etc.
1.3		Incidents		<ul style="list-style-type: none"> • See ICAO Circular 253 • Accidents and incidents where maintenance human factors has been the cause: <ul style="list-style-type: none"> • Aloha, 1988 • BAC1-11 windscreen, 1990 • A320 locked spoiler, 1993 • B737-400 oil loss, 1995 • B747 engine drop, Narita, 1994 • NTSB accident reports as referenced on the <i>hfskyway</i> website
2	Safety Culture / Organisational factors		<p>K: Achieve a good understanding of the concept of “safety culture”</p> <p>K: Understand what is meant by the “organisational aspects” of human factors</p> <p>A: Appreciate the vital importance of a good safety culture,.</p> <p>K: Identify the elements of a good safety culture</p>	<ul style="list-style-type: none"> • Definition of “culture” and “safety culture” • Reason, J: The elements of a good safety culture: <ul style="list-style-type: none"> • ·Commitment from senior level • ·A just culture • ·A good error reporting scheme • ·An effective Maintenance Error Management Scheme (MEMS) • ·Flexibility • ·Training investment • ·Willingness to learn and to change if necessary • ·Respect for the workforce

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
3	Human Error		<p>K: Appreciate that human error cannot be totally eliminated; it must be controlled</p> <p>K: Understand the different types of errors, their implications, avoiding and managing error</p> <p>K: Recognize where the individual is most prone to error,</p> <p>A: Guard against error</p>	<ul style="list-style-type: none"> • Definition of human error • Types of errors in maintenance engineering - Accidents and incidents to illustrate. • Causes of errors • How to reduce errors and mitigate their consequences
3.1		Error models and theories	<p>K: Achieve a reasonable practical knowledge of the main error models and theories</p>	<ul style="list-style-type: none"> • A reasonable practical knowledge of the main error models (SRK, GEMS, Reason's slips, lapses, mistakes & violations), and how this knowledge can help in a practical context (eg. investigation of incidents)
3.2		Types of errors in maintenance tasks	<p>K: Understand the main error types (eg. slips, lapses, mistakes) and how these differ from violations</p>	<ul style="list-style-type: none"> • Types of errors which have contributed to accidents and incidents in the past. Well-known analysis studies, eg. Boeing, Pratt & Whitney in-flight shut-down causes, Reason/Continental - 89-91, UKCAA 1992, etc. • Types of errors in maintenance engineering - Accidents and incidents to illustrate. • Causes of errors • MEDA categories
3.3		Violations	<p>K: Understand the different types and causes of violations</p> <p>A: Avoid violating procedures and rules</p> <p>A: Strive towards eliminating situations which may provoke violations</p>	<ul style="list-style-type: none"> • Types of violations (J Reason) • The different types of violations, eg. routine, situational, optimising. • Violation provoking situations, eg. poor procedures which do not reflect best practice, inadequate time to do the job, inadequate manpower, etc
3.4		Implications of errors	<p>K: Achieve a good understanding of well-known incidents in terms of errors leading to the incidents</p> <p>A: Appreciate that it is not errors themselves which are the problem, but their consequences if undetected or uncorrected</p>	<ul style="list-style-type: none"> • Accidents, incidents, learning opportunities; errors detected/ not detected • Accidents, incidents, learning opportunities; errors detected/ not detected • What <i>could</i> have happened...
3.5		Avoiding and managing errors	<p>K: Understand the different ways of reducing errors and mitigating their consequences</p>	<ul style="list-style-type: none"> • Error management = error containment + error reduction. • Error management techniques • Practical methods for error reduction

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
3.6		Human Reliability	K: Basic understanding of the main human reliability concepts, and how these relate to risk assessment Note: this may only be applicable to managers	<ul style="list-style-type: none"> • Concepts of human reliability • Human Reliability Techniques, eg. HAZOP, MORT, HTA, THERP, etc. • Quantitative and qualitative techniques • Human reliability in the context of risk assessment
4	Human Performance & Limitations		K: Recognize the effect of physical limitations and environmental factors on human performance A: Appreciate that humans are fallible K. Achieve basic knowledge of when and where humans are vulnerable to error A: Recognize where self or others suffer, and ensure this does not jeopardize personal or aviation safety	<ul style="list-style-type: none"> • Many texts have been written on human performance & limitations for pilots - some of this material will also be relevant for maintenance personnel
4.1		Vision	K: Understand how vision, and visual limitations, affects your job A: Recognise the need to have adequate (corrected) vision for the task and circumstances	<ul style="list-style-type: none"> • Practical guidance on vision standards associated with jobs/ tasks (eg. avionics, driving on airports, close visual inspection, etc), and in certain conditions (eg. low light conditions)
4.2		Hearing	K: Be aware of the health and safety best practice regarding noise and hearing A: Appreciate that hearing is not necessarily understanding	<ul style="list-style-type: none"> • Practical guidance on the dangers of exposure to loud noise, and its effect on hearing, both temporary and permanent
4.3		Information-Processing	K: Obtain a basic familiarity with the key terms used to describe information processing (ie. perception, attention, memory)	<ul style="list-style-type: none"> • An overview of the information process – perception, attention, memory
4.4		Attention and Perception	K: Achieve a basic understanding of the meaning of attention and perception	<ul style="list-style-type: none"> • Models and theories of attention; single channel theory, cocktail party effect, etc. • Expectation - dangers of “seeing what you want to see” & “hearing what you want to hear” • Boredom and attention
4.5		Situational awareness	K: Understand the dimension of situational awareness S: Develop ways of improving situational awareness	<ul style="list-style-type: none"> • Concept of situational awareness in a maintenance engineering context. • Stages of situational awareness “Perception, understanding of the significance of what you see; determination of future implications.”

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
4.6		Memory	K: Achieve a basic understanding of the different types of memory (sensory, short term, working, long-term) and how these may affect you at work. A: Appreciate that memory is fallible and should not be relied upon.	<ul style="list-style-type: none"> The fallibility of human memory - sensory, short term, working, long-term. Accidents and incidents where individuals have relied upon memory, rather than consulting written information.
4.7		Claustrophobia and physical access	A: Appreciate that claustrophobia, fear of heights, etc., may affect the performance of some individuals.	<ul style="list-style-type: none"> Concepts of claustrophobia & fear of heights Difficult physical access and awkward working positions - what can be done to help (eg. Boeing work, design for better access, etc.)
4.8		Motivation	K: Understand what motivates people and what de-motivates people, in a maintenance engineering context A: Appreciate the need to avoid misdirected motivation	<ul style="list-style-type: none"> Main theories of motivation, eg. Maslow, Herzberg Accidents/ incidents where someone has failed to apply correct procedures, but with good intentions Misdirected motivation - the desire to cut corners in order to get things done
4.9		Fitness/Health	A: Develop willingness to admit when feeling unwell, and taking steps to ensure this does not affect safety	<ul style="list-style-type: none"> How can illness, poor health, poor fitness adversely affect work performance and affect safety. Practical guidance as to what an individual can do if feeling unwell, eg. ask to swap to a less demanding task, ask a colleague to check performance, take medication (but be aware of its effects), stay at home, etc
4.10		Stress	K: Recognize the basic concepts and symptoms of stress S: Develop different techniques and positive attitudes to cope with stress	<ul style="list-style-type: none"> The difference between stress and stressors Effects of stress on human performance; individual differences Concepts of arousal; Yerkes-Dodson curve; one person's -ve stress is another person's +ve stress Signs of stress Reactions to stress - denial, dealing with minor tasks instead, deferring, etc
4.11		Workload management	K: Recognise the need to manage workload S: Develop methods to manage workload	<ul style="list-style-type: none"> Accidents or incidents illustrating the consequences of poorly managed workload

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
4.12		Fatigue	K: Understand how fatigue can affect your performance, especially during shiftwork or when working long hours S: Develop ways of managing fatigue A: Develop a personal integrity not to work on safety critical tasks when unduly fatigued	<ul style="list-style-type: none"> • Concepts of sleep, fatigue and circadian rhythms • Effects on performance of sleep deprivation, interrupted sleep, inadequate REM sleep, poor placement of sleep, etc. • Equating fatigue to alcohol intake (see work by Drew Dawson) • Incidents where fatigue has been cited as a factor, eg. CHIRP reports
4.13		Alcohol, medication, drugs	A: Appreciate that alcohol, drugs and medication can affect your performance	<ul style="list-style-type: none"> • Guidance on the effects on performance, after taking alcohol, medication or illicit drugs (see UKCAA AWN47)
4.14		Physical work	K: Understand the effects of sustained physical work on overall performance, especially cognitive performance, in a maintenance engineering environment	
4.15		Repetitive tasks / complacency	K: Be aware of examples of incidents where repetitive tasks and complacency have been a factor S: Develop ways of avoiding complacency	<ul style="list-style-type: none"> • Types of repetitive tasks where complacency might be a factor; possible reasons; how to avoid it (eg. by having breaks, by increased probability of detecting a problem, by training, by selection, etc) • Accidents and incidents involving repetitive tasks (eg, visual inspection of rivets) • Techniques of developing to deal with complacency
5	Environment		K: Achieve a basic appreciation of how the physical and social environment can affect on human performance	<ul style="list-style-type: none"> • Introduction to how the physical and social environment can affect work performance, & personal and aviation safety. • Examples of accidents/ incidents where the environment was a factor (eg. Narita 747 engine drop)
5.1		Peer pressure	A: Appreciate the <ul style="list-style-type: none"> · importance of sticking to the rules, procedures and documents even if others aren't · importance of personal integrity · importance of avoiding placing peer pressure on others S: Develop assertive behaviour appropriate to the job	<ul style="list-style-type: none"> • Concepts of peer pressure and conformity; concept of norms Examples of accident/ incidents where a bad norm was a factor, e.g. <ul style="list-style-type: none"> (i)Unwillingness to use written information because it is seen as a lack of technical knowledge, (ii) Lack of individual confidence, (iii) Not following safe operation procedures because others don't follow them

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
5.2		Stressors	K: Achieve a basic understanding of the concepts of stress and stressors, as related to the work environment	<ul style="list-style-type: none"> • What types of environmental stressors are there • Causes of stress; work, domestic, environmental, etc
5.3		Time pressure and deadlines	K: Recognise the dangers of <ul style="list-style-type: none"> • cutting corners • applying inappropriate deadlines • self-imposed, supervisor and management time pressures S: develop assertive behaviour appropriate to the job	<ul style="list-style-type: none"> • Accidents/ incidents where time pressures have been a factor, eg. BAC1-11 windscreen accident in 1990. • Recognition that commercial pressure exists in some areas. Stress the importance of not letting this interfere with the job, or doing things properly.
5.4		Workload	K: Understand the basic contributors to workload S: Develop planning and organising skills.	<ul style="list-style-type: none"> • What constitutes workload; relationship between workload and stress; relationship between workload and arousal; overload and underload • Causes of high workload (eg. unrealistic deadlines, undermanning) and how these might be dealt with
5.5		Shift Work	K: Understand the basic concept of circadian rhythms as this relates to shiftwork. K: Be familiar with best practice regarding working hours and shift patterns S: Develop strategies to manage shiftwork.	<ul style="list-style-type: none"> • Circadian rhythms, sleep and shift work - relationships and effects on performance. • Circadian 'dips', and how to combat them • Shift patterns - pros and cons • Research concerning shiftwork and shift patterns • Good practices for shiftworkers - guidance concerning sleep, meals, etc. • EU Working Time Directive, and how it affects maintenance staff & shiftworkers
5.6		Noise and fumes	K: Be aware of the health and safety guidance concerning noise and fumes	<ul style="list-style-type: none"> • General effects of noise on performance (the issue is complex; do not go into too much detail) • Effect of noise on hearing - temporary or permanent damage • How to reduce noise (eg. noise insulation) and how protect hearing against noise (eg. ear muffs) • Effects of fumes on performance
5.7		Illumination	K: Be aware of the effects of lighting upon performance, especially visual performance	<ul style="list-style-type: none"> • Guidance as to what illuminations are appropriate for various tasks
5.8		Climate and temperature	K: Be aware of the effects of climate and temperature upon performance	<ul style="list-style-type: none"> • Effects of extremes in temperature and humidity upon performance; practical guidance as to what can be done to help, where such extremes are unavoidable

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
5.9		Motion and vibration	K: Be aware of the health and safety guidance concerning motion and vibration	<ul style="list-style-type: none"> • Examples where motion and vibration affect performance e.g. engine ground running, riveting, use of moving platforms.
5.10		Complex systems	A: Be aware of the implications of your actions upon other parts of the system	<ul style="list-style-type: none"> • Examples that steps in procedures which may not seem particularly important, may have implications elsewhere in the system of which you are not aware.
5.11		Hazards in the workplace	K: Be aware of the health and safety guidance concerning hazards in the workplace	<ul style="list-style-type: none"> • Overlap areas between Health and Safety principles and National legislation, and Human Factors. • The need to remain calm and collected in a difficult situation. Examples may include engine fires, surges during ground runs, personal injury or danger when operating aircraft systems.
5.12		Lack of manpower	K: Understand how take into consideration the available manpower when (i) scheduling/planning work. (ii) performing a task Note: this topic may not be applicable for all staff	<ul style="list-style-type: none"> • Accidents and incidents where lack of manpower was a contributing factor. • Importance of reviewing the manhour plan
5.13		Distractions and interruptions	S: Develop ways of managing distractions and interruptions	<ul style="list-style-type: none"> • Recognition that distractions and interruptions will always exist • Stress the importance of recording work as you do it, just in case you are interrupted. • Go a few steps backwards in a checklist after returning to a job

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
6	Procedures, Information, Tools and Practices		<p>A: Appreciate the importance of having available the appropriate tools and procedures</p> <p>A: Appreciate the importance of following the procedures and using the appropriate tools.</p> <p>A: Appreciate the importance of checking work before signing it off</p> <p>A: Appreciate the need of reporting irregularities in procedures or documentation.</p>	<ul style="list-style-type: none"> • Identify the dangers of people cutting corners if tools are not available, procedures are difficult to use, information difficult to access, etc • Stress that perceived short-term benefits are usually outweighed by actual long-term dis-benefits. • Formal practices vs 'custom and practice' - stress that the two should be the same • Accidents/ incidents where problems have occurred due to unavailability of information, poor procedures, lack of appropriate tools, etc. • Keeping maintenance information up to date: <ul style="list-style-type: none"> • Looking for updates, rather than assuming all changes have been incorporated into one source • Notifying the appropriate person/ department of any inaccuracies/ ambiguities in maintenance information • Sign-Offs: <ul style="list-style-type: none"> • The responsibilities for sign-offs • Accidents/ incidents where work was signed off without being properly checked • Principles of good planning; the importance of good communication and feedback between planners and 'front-line' maintenance staff.
6.1		Visual Inspection	<p>K: Understand the factors that affect visual inspections.</p> <p>S: Develop skills to improve visual inspections.</p>	<ul style="list-style-type: none"> • Definition; differences between visual inspection and NDI/NDT, and human factors implications - awareness • Vision requirements for NDI - overview • What is meant by type 1 errors and type 2 errors • Accidents and incidents caused by poor visual inspection - eg Aloha Airlines • Factors affecting visual inspection, eg. age, vision standard, lighting, torch beam, task repetitiveness & monotony, task breaks, probability of detecting a fault, attitude, training, visual search pattern, etc.
6.2		Work logging and recording	<p>A: Appreciate the importance of correct logging and recording of work</p>	<ul style="list-style-type: none"> • Good practices concerning work logging and recording, and job aids/ good task card design, which can help • Accidents/ incidents where poor logging was a cause - plenty to choose from

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
6.3		Procedure – practice / mismatch / Norms	<p>A: Be aware that norms exist and that it can be dangerous to follow them.</p> <p>K: Be aware of instances where the procedures, practices or norms have been wrong.</p>	<ul style="list-style-type: none"> • The concept of norms; differences between a norm and a habit. • Positive and negative norms • Formal practices & policies vs ‘custom and practice’ - stress that the two should be the same • The importance of providing the technician with usable procedures; the dangers of people cutting corners if procedures are difficult to use. • Accidents/ incidents where problems have occurred due to poor procedures, procedure/ practice mismatches or bad norm.
6.5		Technical documentation – access and quality	<p>A: Appreciate the importance of having a good standard of technical documentation in terms of access and quality.</p> <p>.S: Learn how to write good procedures which reflect best practice (note: this may not be applicable to all staff)</p> <p>S: Learn how to validate procedures (note: this may not be applicable to all staff)</p>	<ul style="list-style-type: none"> • Overview of good and bad examples of technical documentation • Use of standardized English where appropriate • Importance of commonality of terms and abbreviations, especially where technicians are working on different types of a/c, eg. Boeing and Airbus. • Formats of information (eg. paper, photocopies, microfiche, computerised, etc) and their pros and cons. • Accidents/ incidents involving poor access to technical documentation, eg. Narita 747 engine drop.
7	Communication		<p>K: Recognize the need for an effective communication at all levels and mediums.</p> <p>K: Understand the basic principles of communication.</p> <p>S: Develop skills for correct verbal and written communication appropriate to the job and context.</p>	<ul style="list-style-type: none"> • Principles of good written communication; need for important information (eg. on shift handover) to be communicated both verbally and in writing. • OJT + classroom exercises, eg. domino exercise • Communication within and between teams
7.1		Shift / Task Handover	<p>K: Detailed knowledge of some incidents where a poor handover has been a contributory factor</p> <p>A: Appreciation of the importance of good handovers</p> <p>S: Learn how to carry out a good handover</p>	<ul style="list-style-type: none"> • Principles of good shift/task handover; verbal and written information exchange - built in redundancy; clear, thorough communication; need for shift overlap; etc. • OTJ + classroom exercises, eg. domino exercise • Accidents/ incidents involving shift handover deficiencies, eg. A320 locked spoiler incident, 1993.

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
7.2		Dissemination of information	A: Appreciate the importance of information being kept up-to-date, and being accessible by those who need it; important/urgent information getting to the people who need it	<ul style="list-style-type: none"> Accidents/ incidents caused by poor information management
7.3		Cultural differences	A: Appreciate that cultural differences can affect communication.	<ul style="list-style-type: none"> Cultural differences between countries; between companies; between types of maintenance (line & base); between shifts; between individuals, between pilots and maintenance personnel Hofstede's work – differences between National cultures - but try to relate this to maintenance engineering.
8	Teamwork		<p>K: Understand the general principles of teamwork.</p> <p>A: Accept the benefits of teamwork.</p> <p>S: Develop skills for effective teamwork .</p> <p>A: Believe that maintenance personnel, flight crew, cabin crew, operations personnel, planners etc should work together as effectively as possible.</p>	<ul style="list-style-type: none"> Concepts of Maintenance Resource management (MRM) Where human factors and teamwork relate to maintenance Effective work relationships Motivation Running meetings Conflict management
8.1		Responsibility	A: Encourage a team concept, but without devolving or degrading individual responsibility	
8.2		Management, supervision and leadership	<p>K: Understand the role of managers, supervisors and leaders in teamwork.</p> <p>S: Develop management skills for appropriate personnel.</p>	<ul style="list-style-type: none"> Difficulties associated with doing both a management/ supervisory job, and 'hands-on' engineering Incidents involving supervisors, and reasons why, eg. B737-400 oil loss incident. Delegation, prioritisation of tasks Leadership styles – use of authority or assertiveness
8.3		Decision making	S: Develop decision making skills based on good situational awareness and consultation where appropriate	<ul style="list-style-type: none"> Explain the different phases of the decision making process.

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
9	Professionalism and integrity		<p>K: Understand what is expected from individuals in terms of professionalism, integrity, and personal responsibility.</p> <p>A: Understand one's own responsibility to keep aviation safety standards high, and put this into practice at all times</p>	<ul style="list-style-type: none"> The general characteristics of a professional and how these fit to the aircraft maintenance profession The contribution of aviation maintenance personnel to aviation safety Abiding by rules and procedures, refusing to succumb to pressure, etc Responsibilities of individuals, (eg. signing off work, inspecting tasks, reporting non-conformities, etc.) Examples where cooperation between different aviation trades has contributed to the avoidance of incidents/accidents
9.1		Keeping up to date; currency	A: Accept the personal responsibility to keep up to date with necessary knowledge and information	<ul style="list-style-type: none"> All personnel should read the applicable information from the organization such as revisions, memos, etc.
9.2		Error provoking behaviour	<p>K: Achieve a good understanding of what constitutes error provoking behaviour.</p> <p>A: Appreciate the importance of avoiding the type of behaviour which is likely to provoke errors</p>	<ul style="list-style-type: none"> Give examples of error provoking behaviours (eg. cutting corners, failing to consult information, relying upon memory, working when fatigued, etc.) and strategies to avoid them.
9.3		Assertiveness	A: Appreciate the importance of being assertive.	<ul style="list-style-type: none"> Give examples of assertive behaviour, e.g. refusing to sign off a job if it has not been completed properly, despite pressure from more senior people to do so.
10	Organisation's HF Program		<p>K: Achieve an depth understanding of the structure and aims of your company's HF programme.</p> <p>Note: if your organisation does not have all the elements of a HF programme, explain in general terms what these elements might be, ie:</p> <ul style="list-style-type: none"> Maintenance Error Management System Links with Quality System Links with Safety Management System Disciplinary reporting and just culture Top-level support HF training for all staff Action to address problems Good safety culture 	<ul style="list-style-type: none"> Overview of the elements of your organisation's HF programme: ·Commitment from senior level ·Practical support from management ·HF training for all staff ·A just disciplinary policy ·A good error reporting scheme ·An effective Maintenance Error Management Scheme (MEMS), including (i)error investigation scheme (ii)analysis of problems; identification of improvements; acting upon recommendations (iii)feedback concerning problems and improvements <p>(for guidance, see UKCAA AWN71)</p> <ul style="list-style-type: none"> ·Learning from accidents/ incidents/ previous occurrences; warning technicians of common errors/ problems so that they can guard against these; writing in warnings into the procedures

No.	Topic	Subtopic	Objectives for initial Training	Examples for initial training Contents
10.1		Reporting errors	A: Appreciate the importance of reporting incidents, errors, problems K: Understand what type of problems should be reported K: Understand the mechanisms of reporting	<ul style="list-style-type: none"> Describe the reporting procedure.
10.2		Disciplinary policy	K: Understand the organisation's disciplinary policy, and the circumstances under which disciplinary action may be appropriate, and when not A: Appreciate that you will not be unfairly penalised for reporting, or assisting with investigations	<ul style="list-style-type: none"> Give each employee a copy of the company's disciplinary policy. Use case studies to illustrate the policy. Encourage group discussions concerning the policy
10.3		Error investigation	K: Understand the mechanisms of incident investigation	<ul style="list-style-type: none"> Explain what process your organisation uses, eg. MEDA Consider using a worked example Stress the importance of having trained investigators
10.4		Action to address problems	K: Understand the mechanisms of action to address errors	<ul style="list-style-type: none"> Ensure staff are aware that reporting incidents will result in action
10.4		Feedback	K: Understand the mechanisms of feedback	<ul style="list-style-type: none"> What feedback employees might expect from the MEMS. eg. company magazine, feedback to individuals involved in incidents, etc

Appendix B Training Needs Analysis Example

The examples given in this Appendix are by no means definitive, and should merely be used as guidance to illustrate how to put together a TNA, not necessarily what number to put in it for your company. The structure is not fixed - Example 1 happens to be based on the JAA MHFWG report (Appendix A) syllabus topics; Example 2 illustrates how those topics have been adapted by a trainer, and for a particular company; Example 3 shows how a very small organisation might put together a TNA, loosely based on the syllabus items in GM-145.A.30(e).

You may decide that it is easier to put all staff on a full version of human factors training, in which case a detailed TNA may not be needed, although you will still need a statement to the effect that this effectively constitutes your TNA. Organisations are encouraged to put together a TNA, since it should help them not only with determining what they need in the way of initial human factors training, but also what will be appropriate for recurrent training, taking account of changes over the years. It may also help determine what training may have been covered already, elsewhere, and therefore not need to be repeated.

1. Example TNA for a large aircraft maintenance organisation.

No actual example from industry was available at the time of writing Issue 2 to this CAP, therefore a hypothetical example was compiled. This is shown in Table 1, and is based on the JAA MHFWG expanded syllabus items (Appendix 1, Attachment 7, Table 1. This is an extract only - the full TNA would cover all the expanded syllabus items.

Key: 0 = don't need to know 1 = basic appreciation 2 = standard 3 = in-depth * = specific to job/ context
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Table 1a. TNA hypothetical example for a large aircraft maintenance organisation - module 1

	HF trainers	Training Needs Analysts	HF/ Safety Programme managers/ coordinators	MEMS investigators	Health & safety manager	Tech certifying staff	Tech non-certifying staff	Post holders/ senior managers	Managers/ QA	Supervisors	Planners/ production control	Tech records/ tech services/ design	Purchasing/ supply chain	Stores	Tech trainers	HR/ personnel	Loaders/ drivers/ etc
General / Introduction to human factors																	
Need to address Human Factors	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Statistics	3	2	3	3	2	2	1	2	2	2	2	1	1	1	1	0	0
Incidents	3	2	3	3	2	2	1	2	2	2	2	1	1	1	1	0	0

Table 1b. TNA hypothetical example for a large aircraft maintenance organisation - module 2

	HF trainers	Training Needs Analysts	HF/ Safety Programme managers/ coordinators	MEMS investigators	Health & safety manager	Tech certifying staff	Tech non-certifying staff	Post holders/ senior managers	Managers/ QA	Supervisors	Planners/ production control	Tech records/ tech services/ design	Purchasing/ supply chain	Stores	Tech trainers	HR/ personnel	Loaders/ drivers/ etc
Human Error																	
Error models and theories	2	0	2	2	0	1	0	1	1	1	0	0	0	0	0	0	0
Types of errors in maintenance	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
Violations	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
Implications of errors	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
Avoiding and managing errors	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
Human Reliability	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1c. TNA hypothetical example for a large aircraft maintenance organisation - module 3

	HF trainers	Training Needs Analysts	HF/ Safety Programme managers/ coordinators	MEMS investigators	Health & safety manager	Tech certifying staff	Tech non-certifying staff	Post holders/ senior managers	Managers/ QA	Supervisors	Planners/ production control	Tech records/ tech services/ design	Purchasing/ supply chain	Stores	Tech trainers	HR/ personnel Loaders/ drivers/ etc	
Human Performance & Limitations																	
Vision	3	2	2	2	3	2*	2	0	1	2*	1	1	1	1	1	0	1
Hearing	3	1	1	1	3	1	1	0	1	1	0	0	0	0	0	0	1
Information-Processing	3	1	1	1	0	1	1	0	1	1	1	1	1	0	0	0	0
Attention and Perception	3	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	2
Situational awareness	3	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	1
Memory	3	1	1	1	0	1	1	0	1	1	1	1	1	0	0	0	0
Claustrophobia/ physical access	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0
Motivation	2	1	1	1	0	2	2	0	0	2	0	0	0	0	0	0	0
Fitness/Health	2	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0
Stress	2	1	1	1	2	1	1	1	1	1	0	0	0	0	0	1	0
Workload management	2	1	1	1	0	1	1	0	0	1	1	0	0	0	0	0	0
Fatigue	3	2	2	2	3	2	2	1	1	2	3	1	1	1	1	2	1
Alcohol, medication, drugs	2	1	1	1	2	1	1	0	1	1	1	1	1	1	1	2	1
Physical work	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Repetitive tasks / complacency	1	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0

Table 1d. TNA hypothetical example for a large aircraft maintenance organisation - module 10

Organisation's HF Program	HF trainers	Training Needs Analysts	HF/ Safety Programme managers/ coordinators	MEMS investigators	Health & safety manager	Tech certifying staff	Tech non-certifying staff	Post holders/ senior managers	Managers/ QA	Supervisors	Planners/ production control	Tech records/ tech services/ design	Purchasing/ supply chain	Stores	Tech trainers	HR/ personnel	Loaders/ drivers/ etc
Reporting errors	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Disciplinary policy	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Error investigation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Action to address problems	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Feedback	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1

2. Example TNA for a large component maintenance organisation.

The following example of an extract from a Training Needs Analysis was developed by BainesSimmons Ltd on behalf of Smiths Aerospace Customer Services, and has been reproduced with permission. The detail is proprietary to BainesSimmons Ltd., and applicable only to Smiths Aerospace, but the principles may be freely used and adapted to context.

The [EASA GM-145.A.30(e)] syllabus may be adjusted to meet the particular nature of the organisation. The syllabus may also be adjusted to meet the particular nature of work for each function within the organisation. For example:

- Small organisations not working in shifts may cover in less depth subjects related to teamwork and communications
- Planners may cover in more depth the scheduling and planning objective of the syllabus and in less depth the objective of developing skills for shift working.
- Personnel being recruited from another JAR 145 approved maintenance organisation and temporary staff should be assessed for the need to receive any additional Human Factors training to meet the new JAR 145 approved maintenance organisation's Human Factors training standard.
- The following table is the high-level generic tool that will help you complete a training needs analysis. Depending of the result of this evaluation, initial training should be provided to personnel within 6 months of joining the maintenance organisation, but temporary staff may need be trained shortly after joining the organisation to cope with the duration of employment.
- The training syllabus identifies the topics and subtopics to be addressed during the Human Factors training.
- The maintenance organisation may combine, divide, change the order of any subject of the syllabus to suit its own needs, so long as all subjects are covered to a level of detail appropriate to the organisation and its personnel
- Some topics may be covered in separate training (health and safety, management, supervisory skills etc.) in which case duplication of training is not necessary. In other words cross credits may be claimed for other complementary training such as management teamwork training if the content meets the general syllabus requirement.
- The duration of training will vary depending on the category of personnel involved, for example a typical training course duration would range from 1 day for managers and up to 3 days for certifying staff.
- Although training courses may be tailored for certain categories of personnel, consideration should also be given to the benefits of having combination of personnel from different functional groups during training sessions

For each training topic specific objectives are defined. These objectives are specified in term of knowledge (to know), skills (how to do), and attitude.

Depth of knowledge criteria , as listed below, have been entered into the TNA Tables as applicable to Smiths Industries.

Level 0 - Not applicable to this functional group or company does not require it (e.g. don't work shifts).

Level 1 - General appreciation of theory and basic principles appropriate to job role.

Level 2 - In-depth knowledge and the ability to apply to other people under their control.
Level 3 - Full theoretical knowledge and competence to apply in their job role.

High-level syllabus for human factors in aircraft maintenance

The syllabus is included in GM-145.A.30(e), and expanded in the JAA MHFWG report (see Appendix A). The BainesSimmons Ltd modules equate to those of the requirement as listed in Table 1 below.

Table 1. Syllabus Modules coverage.

Human Factors syllabus module titles	Baines Simmons Ltd Module number	EASA GM-145.A.30(e) syllabus module number
Introduction to human factors	1	1
Human error	2	2, 9
Human Error – slips and lapses	3	3, 9
Human Error - violations	4	3, 6, 9
Avoiding and managing error	5	3
Human performance and limitations	6	4
Environmental factors	7	5, 6
Teamwork	8	8, 9
Communication and handovers	9	7
Organisation's HF Program	10	10

Table 2. Module 1 TNA - General / Introduction to human factors

	Accountable manager	Senior Managers	Managers & Supervisors	Certifying staff.	Non certifying	Planners & production control staff	Tech. services & Design	Human factors staff/ instructor	Quality assurance Engineer/ surveyor	Technical record staff	Purchasing staff	Store department	Ground equipment operators/
The need to address Human Factors	1	1	1	1	1	1	1	2	2	1	1	1	1
Affects of Human Factors on airworthiness	1	1	1	1	1	1	1	1	1	1	1	1	1
Statistics and incidents	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 2 Module 2 TNA - Human Error

	Accountable manager	Senior Managers	Managers & Supervisors	Certifying staff.	Non certifying	Planners & production control staff	Tech. services & Design engineers	Human factors staff/ instructor	Quality assurance Engineer/ surveyor	Technical record staff	Purchasing staff	Store department staff	Ground equipment operators/
Types of errors in maintenance	1	2	2	1	1	2	1	3	3	1	2	0	0
When we are most prone to error	1	2	2	1	1	2	1	3	3	1	0	0	0
Organisational accidents	2	2	2	1	1	2	1	3	3	1	2	0	0
System defences	2	2	2	1	1	2	1	3	3	1	2	0	0

Table 2 Module 10 TNA - Organisation's HF Program

	Accountable manager	Senior Managers	Managers & Supervisors	Certifying staff inc.	Non certifying staff	Planners & production control staff	Tech. services & Design engineers	Human factors staff/ instructor	Quality assurance Engineer/ surveyor	Technical record staff	Purchasing staff	Store department staff	Ground equipment operators/
All elements to be covered by all staff	3	3	3	3	3	3	3	3	3	3	3	3	3

3. Example TNA for a small maintenance organisation.

No actual example was available from industry, therefore a hypothetical example was compiled and is shown in Table 3. It should be stressed that this is only an example to illustrate that a complex TNA is not necessary for a small organisation, and that it is not necessarily critical to cover all syllabus items (if agreed by the company CAA surveyor). It should not be taken as a template.

Table 3. Hypothetical TNA for a small organisation

Topic	All staff will undergo this training at a similar level, including the Accountable Manager
General / Introduction to human factors	Show the "Every Day" video to give staff a feel for what human factors is all about, and talk about a few relevant incidents
Safety Culture / Organisational factors	Facilitate a discussion about the company's safety culture, and what people think
Human Error	Discuss some examples of human error as relevant to our business and work
Human Performance & Limitations	Remind staff of their personal responsibilities, as per AN47
Environment	Give some examples of where poor lighting can affect performance, and ask staff what they think of the working conditions here.
Procedures, Information, Tools and Practices	Give some examples of where poor procedures can affect safety, and ask staff what they think of the procedures, information and tools they are using, and where improvements could be made
Communication	N/A - not considered necessary due to the small size of the company, absence of task and shift handovers, and the fact that the company has a good incident reporting system where communication has never been cited as a problem
Teamwork	N/A
Professionalism and integrity	N/A
Organisation's HF Program	Describe the mechanisms within the company for reporting incidents, errors, problems, potential hazards, poor procedures, etc - discuss if necessary. Stress that fact that staff will not be inappropriately penalised for reporting problems - put this in writing if necessary. Describe any other company processes relating to human factors

Appendix C Guidelines for trainers

1. Introduction to Facilitation Skills

The following text was produced by LMQ Ltd, for CAP 737 (Crew Resource Management), and has been included in CAP 716 issue 2, with permission, since the principles are applicable to maintenance human factors trainers as well as to CRM instructors. The text has been slightly modified to refer to "human factors" as opposed to "CRM" throughout.

The following aims to explain why there is a need for facilitation, what facilitation is and some of the skills required to use this training technique, plus some general guidelines.

To be competent in any job a person requires a certain amount of knowledge, an adequate level of skills, and the right set of attitudes. This is true for doctors, hotel receptionists, lawyers, footballers, soldiers, artists and of course flight crew, air traffic controllers and maintenance engineers. The role of a trainer in any discipline is to help people develop their knowledge, their skills and their attitudes so that they are able to do their jobs well. In many of the professions the formal training emphasis is often on developing knowledge and skills, with the examination of competence almost exclusively concerned with measuring knowledge and skills against a set of standards.

In aviation it is no different. The vast majority of training resources and all formal examination have been aimed at ensuring people have the appropriate knowledge and skills, rather than the right attitudes. The fact that attitudes are fundamental to competence has not been officially recognised, even though incorrect attitudes are suspected to have contributed to many of the major accidents - the ultimate consequence of a lack of competence. The reason for this omission is uncertain, but a reasonable assumption may be because training and examining 'attitudes' have been less precise and more difficult to carry out successfully.

Human factors training has attempted, with variable success, to try and redress the imbalance. Most experts and practitioners are in agreement that the variability in the effectiveness of human factors training is largely linked to the quality of the delivery and not the content, and that training with a high degree of facilitation has been more successful.

This can be explained by exploring the two main techniques that are available to trainers, namely instruction and facilitation. Instruction can be described as being primarily a telling activity, where knowledge and skills are developed in trainees through either direct communication or demonstration, with questioning primarily used to check understanding or reinforce key messages. Facilitation on the other hand, can be described as a technique that helps trainees to discover for themselves what is appropriate and effective, in the context of their own experience and circumstances.

Both techniques are useful and have their place. In order to transfer knowledge and many skills, instruction is the most efficient technique to employ; it would be laborious and unnecessary to teach a straightforward and precise subject such as an electrical system using facilitation. Furthermore, instruction can be used to train larger numbers of people, and is particularly useful if only certain answers are acceptable.

On the other hand, trying to change people's attitudes using instruction as the technique, normally has limited success. People, particularly adults, do not like being told how to behave and what to think. There are rare occasions when a sharp 'kick up the backside' delivered by the right person at the right time has the desired effect, but in general, telling people to change their attitude is not usually effective. This is particularly so if the person doing the telling does not have the respect of the recipient, or represents an authority that lacks credibility. Ironically, this is also consistent with the instruction of positive behaviour, such as 'keep up the good work' which has been known to produce an adverse reaction.

The reason for this is that a person's behaviour is based on their past experiences, values and beliefs which will be different from those of others. Therefore, telling people to behave differently carries the implication that their values and beliefs are wrong, and this is not convincing. People generally behave in a way that they think is rational, and often find it easy to justify their behaviour to themselves and others. However, what they may not be aware of is the effects of their behaviour on other people or the operation; and that an alternative behaviour, which does not question their values but has a more positive effect, may be something they might wish to consider.

The technique of facilitation allows this process to occur, although it is not just for the poor performer nor for the development of attitudes. Facilitation can be equally used to reinforce effective behaviour because it gives people an understanding of why they are good which encourages their continued development. Furthermore it can be used in the development of skills and even knowledge, because it is an effective tool for allowing self analysis and in depth thought, which is an easier way for people to learn, as there is less recourse to memory techniques. The skills of self analysis are not just to get the most from the training session, but can also be continually used for self development on the line.

Table 1. Differences between Instruction and Facilitation

	INSTRUCTING	FACILITATING
1. What do the words imply?	Telling, showing	Making easy, enabling
2. What is the aim?	Transfer knowledge and develop skills	Gain insight / self analysis to enable an attitude change
3. Who knows the subject?	Instructor	Both
4. Who has the experience	Instructor	Both
5. What is the relationship?	Top down	Equal
6. Who sets the agenda	Instructor	Both
7. Who talks the most?	Instructor	Student
8. What is the timescale?	Finite	Infinite
9. Where is the focus?	Instructor / task	Student / attitudes / behaviour
10. What is the workload?	Medium / high	Intense
11. What are trainers thoughts?	Judgemental	Non-judgemental
12. How is progress evaluated?	Test	Observation / self assessment

Dr Guy Smith NWA

Notes on Table

1. Although instructors have used facilitation techniques naturally for many years; in its purest sense instructing has a lot to do with telling, demonstrating and checking that the task is being done in accordance with a standard. Whereas facilitation means that students are given the opportunity to discover what they are doing and the effect it has on others and the task, so that they can make the decision themselves to alter their behaviour or even reinforce any positive behaviour. This process should be made as easy as possible.
2. The principle purpose of instructing is to transfer knowledge and skills efficiently, whereas with facilitation the principle purpose is to encourage a change in attitude or behaviour by the student gaining insight or becoming aware of what they are doing, and being motivated to change. People tend to only do things that they want to do; so telling people that they are wrong and need to change is rarely effective. People generally do not behave in a way that *they* think is wrong. They are aware that others might disapprove, but they will rationalise their behaviour as being appropriate under the circumstances. Telling them that you think they are wrong gives them no new information and often motivates them to continue their current behaviour. The key is for them to understand why others disapprove and the consequences of continuing as they are.
- 3/4. When instructing, the trainer knows the subject and has the experience, otherwise it would be a pointless exercise. When facilitating both parties know the subject and have the experience, particularly when discussing behaviour. In fact, very competent facilitators are quite capable of being effective without knowing the subject or having any experience of it. In many respects this can be a useful pointer to know when to change hats from being an instructor to a facilitator. If you are certain that only you have the relevant knowledge, and the student would find it difficult to work it out for themselves in the time available, then instructing is probably the most appropriate technique to employ.
5. The relationship when instructing can be perceived as being top down in that the instructor knows more than the student, whereas when facilitating it must be apparently equal. A common mistake by inexperienced trainers when facilitating is to create the impression that they are in some way superior, by implying they know more or have a better attitude.
6. The agenda when facilitating must be set by both parties if the process of buy-in is to get the right start. Agreeing what you are going to talk about and how you will go about it is an important first step. The trainer can greatly assist the learning of the session by summarising and giving meaning to the students' discussions. It is still the trainer's responsibility to ensure that all the training requirements are included in the facilitative session.
7. One of the best measures of identifying which technique you are using, whether it is instructing or facilitating, is to note who is doing most of the talking. When facilitating, students need to be clear in their own minds and be able to self assess what they are doing and the benefits of changing. It is difficult to do this whilst trying to listen to a trainer passing multiple messages.
8. The time taken to cover a subject when instructing tends to be finite and consistent; whereas with facilitation the timescale is indefinite. This does not mean that it takes forever, but that the process of facilitation must be given sufficient time to achieve its aim. The human factors instructor should not be worried about longer debrief or exercise times, because the student's concentration period is much

longer when they are actively involved in the thinking and discussion rather than passively listening. In a limited time period such as a debrief, the process may need to continue afterwards, while students try out new options back at work. Conversely, if the aim is achieved in a few minutes, the job is done and there is no point dragging out the discussion.

9. The focus when instructing is often on the task and the instructor – how well they are doing, did they get things in order, are they being clear, is the equipment working, are they on time. With facilitation the focus must be solely on the student, their attitudes and behaviour, and whether they are learning and are comfortable with the process that is being used. The focus should also be on the student demonstrating an understanding and willingness to change.

10. Because each student is different and it is difficult to read people’s minds, the workload whilst facilitating is intense, and more so in a group. The facilitator in this respect is having several conversations simultaneously, both verbally and non verbally, and having to think on their feet in reaction to what is being said. With instructing the workload is high in preparation and initial delivery, but then reduces over time as the instructor becomes more familiar with the material.

11. Although the trainer’s observations and training objectives are inevitably judgemental; in order to prompt a student’s self analysis, the attitude of the trainer when facilitating a debrief should be non-judgemental. In other words, he or she must be prepared to accept that the opinion of the student is valid and not necessarily wrong, even though the trainer’s own experience dictates otherwise. This attitude is the most difficult to genuinely achieve, particularly for trainers who have spent many years instructing and ensuring things are right.

12. The evaluation of an instructing session is relatively simple and measured by test, where a judgement is made whether the standard has been achieved. When facilitating evaluation is made by observation only and the student’s self assessment.

2. Facilitation Skills

The skills required to use facilitation as a technique are as follows:-

Questioning

Asking the right questions at the right time is a fundamental skill of facilitation and these are the type of questions that can be used.

Type	Purpose	Response	Example
Open	To get a more accurate and fuller response.	Unknown but they will say more than a few words.	‘What, when, why, where, who, how....’
Closed	To check understanding and to control the discussion.	Can be ‘Yes’, ‘No’ or specific data.	‘Did you, were you, had you’....
Probing / building	To obtain further information	More in depth response.	‘Tell me more, why was that, explain....’
Summarising	To confirm agreement	Yes	‘Is what you mean, have you agreed ...’

Avoid:

- a. Leading:- ‘You did do that didn’t you, wouldn’t you agree that.....?’
- b. Multiple.
- c. Rhetorical:- ‘Who cares?’
- d. Ambiguous

Listening

It has often been said that hearing is done with your ears whereas listening is done with your mind. In this respect the term active listening means that a person is concentrating carefully on what is being said, so that they can really understand the other person. This mnemonic helps to capture some key points:

- Look interested
- Inquire with questions
- Stay on target
- Test understanding
- Evaluate the message
- Neutralise your thoughts, feelings and opinions

Body language

Reading body language and managing your own are essential when facilitating. A trainer should be able to know when a student is uncomfortable, confused, interested, distracted or bored.

Furthermore it is important that a trainer is able to manage their own body language so that the messages they are giving are accurate and consistent.

Observation of behaviour

The ability to observe and discuss behaviour and attitudes rather than technical issues is an important skill that trainers need to develop to become effective at facilitation. Also trainers should have the ability to observe behaviour objectively against established standards.

Role modelling

As attitude is an imprecise part of competency, there is no better way of demonstrating appropriate behaviour than role modelling. This is because the student can observe at first hand what this behaviour is and experience the positive effects on themselves. Furthermore, in order to maintain credibility as a trainer in human factors, it is important that you behave to the highest level of CRM standards.

Giving and receiving criticism

A trainer should be able to receive criticism well in order to develop and be approachable.

Furthermore, there may be occasions when it is appropriate and constructive to give students direct criticism and this must be carefully handled.

Continuous development

In order to ensure that you are able to continuously improve your facilitation skills, the recommended method is to seek feedback from those you are training. This must be done regularly and genuinely, otherwise you may not be given anything useful - and a measure of whether you are doing this well is whether you do in fact get any criticism. If you find that people are not giving you any criticism then the following may be occurring:-

- a. You are perfect.
- b. You have developed a reputation as someone who has difficulty receiving criticism.
- c. You are not respected enough to deserve being told.

Facilitation skills; Trainer Checklist

DO:
<p>Give an introduction</p> <ul style="list-style-type: none"> • Purpose - to encourage self analysis (research says that it is the best for of learning) • Participation from them is needed • Allow pilots to set the agenda order by asking <ul style="list-style-type: none"> ○ Which bits of the session they want to discuss ○ What went well <p>Use open questions (who, where, when, what, why, how)</p> <p>Deepen the discussion with supplementary questions - let them analyse.</p> <ul style="list-style-type: none"> • What happened/ why it happened/ what could we improve on? <p>Listen and encourage</p> <ul style="list-style-type: none"> • use names, nod, smiles, eye contact • sit forward to show interest <p>Use silence/ pauses (sit back and allow them time to think for several seconds)</p> <p>Mix instruction with facilitation for issues on which they don't have the knowledge themselves</p> <p>Summarise discussion to meet training aims</p>

DON'T:
<p>Miss the introduction - it is the most common way to spoil facilitative training</p> <p>Lecture</p> <p>Use your chronological agenda</p> <p>Short change high performing crews with quick debrief</p> <p>Interrupt</p> <p>Don't train them not to discuss by:</p> <ul style="list-style-type: none"> • Answering your own questions (better to reword the question) • Just use question and answer <p>Do the thinking for them</p>

Self Check:
<ul style="list-style-type: none"> • Who is talking most - you or them? • Have you used at least 2 questions per issue (to deepen discussion)

- Are the students doing the analysis themselves
- Are the training points being covered
- Have the students spoken to each other
- Has positive behaviour been reinforced

