Proving the Competence of the Aircraft Maintenance Engineer

Paper presented by

Tony Hines MBE MSc FRAeS MCIPD LCGI

UK Aviation Training Association

at the

International Air Safety Seminar
Washington DC USA

November 2003

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Tony Hines
U.K. Aviation Training Association

Abstract

“Competence” is a commonly used term but what does it mean and how can you measure it? The competence of aircraft maintenance technicians and mechanics is usually inferred from the training that they have received and their length of post-training experience. All too often “training standards” relate to a specification of what has to be taught rather than a specification of what the trainee can do or know, as a result of the training and experience.

After many years experimenting with competence assurance systems for the engineering profession, the UK now has a set of generic Engineering Competence Standards, which can be contextualised to meet the needs of different industry sectors. The Aviation Training Association has used these to produce performance standards for aircraft maintenance technicians and mechanics.

European Joint Aviation Requirement (JAR) 145 makes a number of references to the need to assess the competence of all personnel involved in the management, execution and quality audit of the aircraft maintenance function. It has recently extended competence requirements from the practical aspects of the task to include “human factors”.

The current drive to establish a common set of skill standards across the USA has been published by the National Skill Standards Board These standards are developed in the US by Voluntary Partnerships. The NSSB website (www.nssb.org) describes this initiative. It provides a link to certification programmes for avionic technicians, but national standards have not yet been developed for the aircraft maintenance sector.

This paper looks at what is meant by “competence” and how it can be applied to aircraft maintenance engineering.
Introduction

JAR 145 specifies the requirements for Approved Maintenance Organisations.

Section 1, Para 30(e) Amendment 5 (01 Jan 2003) states that:

“The competence of personnel involved in maintenance, management and/or quality audits must be established and controlled in accordance with a procedure and to a standard acceptable to the JAA full member Authority. In addition to the necessary expertise related to the job function, competence must include an understanding of the application of human factors and human performance issues appropriate to that person’s function in the organisation.”

Section 2, which sets out “Acceptable Means of Compliance” explains, in AMC 145.30(e) that:

“The referenced procedure requires, amongst others, that planners, mechanics, specialised services staff, supervisors and certifying staff are assessed for competence by ‘on-the-job’ evaluation and/or by examination relevant to their particular job role within the organisation, before unsupervised work is permitted.”

With respect to Human Factors, it does not call for the assessment of behaviour, rather that:

“In respect to the understanding of the application of human factors and human performance issues, maintenance, management and quality audit personnel should be assessed for the need to receive initial Human Factors training.”

With respect to Certifying Staff, AMC 145.35(e) stipulates that:

“....all prospective certifying staff are required to be assessed for competence, qualification and capability related to intended certifying duties....” and

“Competence and capability can be assessed by working the person under the supervision of either another certifying person or a quality auditor for sufficient time to arrive at a conclusion. Sufficient time could be as little as a few weeks if the person is fully exposed to relevant work. It is not practical to assess against the complete spectrum of intended duties and this should not be done.”

The “assessment of qualification” is described as collecting and verifying “all documents that attest to qualification”.

Thus maintenance organisations are left in no doubt that they are required to assess the competence, capability and qualification of aircraft maintenance personnel. They should experience little difficulty in verifying formal qualifications, but they might well ask what constitutes valid and reliable ‘on-the-job’ evaluation and whether the ‘and/or’ relevant examination is an acceptable alternative, when assessing competence.

They may seek guidance on the difference between ‘competence’ and ‘capability’ and wonder whether the judgements made by one certifying person will be consistent with similar judgements by other another certifying person in their own organisation, let alone in all the other approved organisations. If they feel confident about assessing job performance, will this extend to the assessment of the need for training in the application of human factors and human performance?
As in the case of assessing the performance of aircraft hardware, the assessment of technical and interpersonal human performance needs performance criteria. These can be provided by Standards of Competence and Competency frameworks.

**What is Competence?**

The current drive to develop competencies and competency based assessment in the UK, USA and other countries follows initiatives in the US over 15 years ago. Much of the US interest in competency occurred as a result of concern about the quality of teacher training and the resultant quality of education in schools.

**UK Initiatives**

In 1986, the competence movement in the UK was triggered by a Government Review of Vocational Qualifications, chaired by H G (Oscar) Deville\(^1\). The report defined **competence** as:

> “The ability to perform a particular activity to a prescribed standard”

The Oxford dictionary defines “standard” as “a specification serving as an example or principle to which others should conform or by which they are judged: a required or specified level of excellence”.

So how do we relate this to measuring competence? In the simplest terms, a standard is a written statement of what is expected from a competent person in a given job role. In practice, they are:

- comprehensive statements outlining the function that has to be fulfilled,
- the criteria by which the performance is judged,
- circumstances in which performance can be assessed and
- the knowledge and understanding needed to perform the role.

The methodology used to establish the “prescribed standards” was “functional analysis” of job roles. This was conducted by consultants, approved by the UK Manpower Services Commission (now the Department for Education and Skills). It involved group discussions with industry experts, usually line managers and trainers. The outcome was a large range of competence standards - from very industry specific (eg airline pilots) to very generic (eg administration). The form, structure and language were common, thereby facilitating ease of communication about competence.

This was subsequently augmented by the specification of “Key Skills”, which constitute a broad range of generic skills that apply to everyone, throughout their lives, whether or not they are in employment. They are: Communication; Application of Number; Information Technology; Problem Solving; Improving one’s own Learning and Performance; and Working with Others.

The UK Aviation Training Association was responsible for developing competence standards and vocational qualifications for the aviation industry. They included pilots, cabin crew, aircraft maintenance engineers and a wide range of airline and airport occupations.

Engineering Competence Standards (ECS) have been developed for the full range of engineering occupations by the UK Occupational Standards Council for Engineering (www.osceng.co.uk). These have been contextualised to provide job performance standards for maintenance technicians and mechanics working on aircraft and in component overhaul workshops.
US Initiatives

The current drive to establish a common set of skill standards across the USA is comprehensively described in documents published by the National Skill Standards Board. Skill standards, as defined by the NSSB, are made up of two parts:

- The **work**-oriented component, which describes what needs to be done and how well, and
- The **worker**-oriented component, which describes the skill and knowledge needed by an individual to perform competently.

The NSSB Common Framework divides knowledge and skills into three categories:

- **Academic**
  - Reading
  - Writing
  - Mathematics
  - Science

- **Employability**
  - Listening
  - Speaking
  - Using information and communications technology
  - Gathering and analysing information
  - Analysing and solving problems
  - Making decisions and judgements
  - Organising and planning
  - Using social skills
  - Adaptability
  - Working in teams
  - Leading others
  - Building consensus
  - Self and career development

- **Occupational and Technical**

Unlike academic and employability knowledge and skills, that apply across different industry sectors, the occupational and technical knowledge and skills will typically apply to only one industry. These are developed by Voluntary Partnerships. The NSSB website ([www.nssb.org](http://www.nssb.org)) provides a link to certification programmes for avionic technicians.

Although it is structured differently, the UK system embraces all of the above.
Standards and Frameworks

In an article “Why Competencies may not be enough”, Karen Moloney (1997) argues that behaviours, job skills and personal targets are all required for a rounded view of performance at work. She suggests that:

**Standards of Competence**, derived from a functional analysis of jobs, are useful for performance management, while

**Competency Statements**, which address personal qualities, are relevant to personal development.

The Aviation Training Association has conformed to this concept when developing Performance Standards for aircraft maintenance technicians and mechanics and a competency framework for Licensed Aircraft Maintenance Engineers.

### Standards of Competence for Aircraft Maintenance Technicians and Mechanics

The Engineering Competence Standards (developed by OSCEng) are presented as Units of Competence, within eight groups, covering the whole spectrum of engineering functions within the UK economy:

<table>
<thead>
<tr>
<th>Group</th>
<th>Function</th>
<th>No of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Design, Develop and Specify</td>
<td>28</td>
</tr>
<tr>
<td>2.</td>
<td>Preparation Techniques and Procedures</td>
<td>18</td>
</tr>
<tr>
<td>3.</td>
<td>Manufacturing and Processing</td>
<td>16</td>
</tr>
<tr>
<td>4.</td>
<td>Installation and Dismantling</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Maintenance and Repair</td>
<td>7</td>
</tr>
<tr>
<td>6.</td>
<td>Compliance and Testing</td>
<td>8</td>
</tr>
<tr>
<td>7.</td>
<td>Engineering Support and Risk Management</td>
<td>9</td>
</tr>
<tr>
<td>8.</td>
<td>Personal Development</td>
<td>2</td>
</tr>
</tbody>
</table>

Each unit comprises three main components:

- **Performance Statements**, in the form of “You must...” e.g. “....carry out maintenance activities within the limit of your personal activity.”

- **Knowledge Statements**, directly related to the Performance Statements, in the form of “You must have a knowledge and understanding of...” e.g. “....maintenance records and documentation procedures.”

- **Scope**, which provides guidance on the breadth of application in the work environment. e.g. Types of maintenance procedures and activities.

A project team comprising representatives from military and civil aircraft maintenance organisations carefully examined all 96 units and identified 28 which were contextualised to suit the aircraft maintenance sector. These can be combined into “Trade Group” clusters, related to the employment arrangements in the industry:
Aircraft Maintenance - Mechanical
- Aircraft Maintenance - Avionic
- Component Maintenance - Mechanical
- Component Maintenance - Avionic.

This structure, within a modular assessment regime, allows engineers or their employers to make an appropriate selection of units related to their trade and employment environment.

The assessment process consists of gathering evidence and making judgements based on that evidence. The only decision that should be made is:

- the candidate is competent, OR
- the candidate is not yet competent, OR
- there is insufficient evidence to make a judgement.

Note that the terms “Pass” and “Fail” are not used in competence assessment. “Not yet competent” does not imply “incompetence”. Rather, it signifies that the candidate has to undertake more training or more practice to achieve the standard. The degree to which the performance criteria have not been met provides a basis for constructive “formative feedback” by the assessor to the candidate, who should then take responsibility for achieving the necessary improvement before further assessment.

The evidence is in the form of:

Observed Performance: can the candidate show that he/she can consistently perform real work activities to the required standard?

Knowledge: does he/she have the knowledge and understanding necessary for effective and safe job performance?

Understanding: can he/she relate the knowledge to the job in hand?

**Performance Assessment**

To ensure the validity of performance assessment, it should be carried out in an aircraft maintenance environment during normal working activity. Simulation is allowable, as long as it genuinely reflects work-based activities and the working environment. There is little value in demonstrating competence in an off-job training environment if the real job involves working in cramped or difficult work spaces, with other people working close by or in varying climatic conditions and commercially dictated time constraints. Of overriding importance is the airworthiness of operational aircraft and their components and this has to be reflected in the assessment conditions. Only where assessment is not possible within the normal production work programme, may simulated work-based tasks and activities be used.
Testing Knowledge and Understanding

To be regarded as competent, engineers must be able to show that they know what they are doing and understand the implications of not performing to the standard. Knowledge and Understanding can be tested orally by assessors or independently by written examinations. Properly constructed, validated and moderated written tests provide a better chance of valid and reliable results. However, evidence of a full “understanding”, is best achieved through supplementary questioning by the assessor in relation to the performance being observed. The assessor should ensure that the candidate demonstrates an appropriate level of knowledge and understanding in relation to all technical, legal, procedural and health and safety aspects of the work. The Standards of Competence specify the level to be demonstrated by reference to the appropriate definition used in JAR 66. It is recognised that the competence of aircraft technicians and mechanics does not demand the full knowledge syllabus of JAR66, which relates to licensed engineers.

Competence assessors must be able to demonstrate that they are able to consistently evaluate and judge that the evidence of performance and related knowledge and understanding meets the standards. Typically they will be in one of the following occupations:

- Licensed aircraft maintenance engineer
- Aircraft maintenance engineer with JAR 145 Approved Maintenance Organisation delegated approval
- Aircraft maintenance engineering training officer/instructor
- Aircraft/component maintenance inspector/quality assurance engineer
- Aircraft hangar or component workshop supervisor/manager
- Non-commissioned officer/technician in equivalent roles in the Armed Services.

The assessment process should be subject to independent verification, ideally by the Maintenance Organisation’s Quality Assurance department.

The standards are now being further developed by the Science, Engineering and Manufacturing Technology Alliance, in its capacity of a licensed UK Sector Skills Council (www.semta.org.uk). (The engineering functions of the Aviation Training Association were absorbed into SEMTA in April 2003, as part of a UK Government restructuring of the national training arrangements)
A Competency Framework for Licensed Aircraft Maintenance Engineers

A **Competency Framework** is a description of personal qualities. It describes behaviours (or capabilities) exhibited by a person who is regarded as highly effective in their job. Unlike Standards of Performance, which describe what people *do*, competencies describe what they need to *be*, in order to perform competently.

In 2000, the author of this paper conducted a research project to establish a Competency Framework for Licensed Aircraft Maintenance Engineers. A consultation workshop of “industry experts”, comprising maintenance managers, quality assurance engineers, trainers, regulators and trade union representatives, produced the Competency Framework, a summary of which is shown below.

Each “competency” is supported by a descriptor (*italicised*) and a list of between five and seven behaviours that would indicate possession, by a LAME, of that competency.

<table>
<thead>
<tr>
<th></th>
<th>Competency</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Decision taking and judgement making</td>
<td><em>(Acting decisively to resolve issues satisfactorily)</em></td>
</tr>
<tr>
<td>2</td>
<td>Professionalism</td>
<td><em>(Inspiring confidence in others of one’s capabilities and soundness of judgement)</em></td>
</tr>
<tr>
<td>3</td>
<td>Integrity</td>
<td><em>(Not sacrificing high standards for immediate gains)</em></td>
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<tr>
<td>4</td>
<td>Adaptability</td>
<td><em>(Being flexible with change)</em></td>
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<tr>
<td>5</td>
<td>Leadership</td>
<td><em>(Inspiring teams and individuals to better performance)</em></td>
</tr>
<tr>
<td>6</td>
<td>Teamworking</td>
<td><em>(Collaborating positively with others for mutual benefit)</em></td>
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<tr>
<td>7</td>
<td>Self Development</td>
<td><em>(Growing with the job by keeping up to date with individual skills, knowledge and business practices)</em></td>
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<tr>
<td>8</td>
<td>Communication</td>
<td><em>(Ensuring clear and common understanding on both sides)</em></td>
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<tr>
<td>9</td>
<td>Methodical</td>
<td><em>(Planning and organising to maximise the resources available)</em></td>
</tr>
<tr>
<td>10</td>
<td>Accuracy and thoroughness</td>
<td><em>(Ensuring consistency, completeness and quality of work)</em></td>
</tr>
<tr>
<td>11</td>
<td>Analytical</td>
<td><em>(Getting to grips with the essence of the problems)</em></td>
</tr>
</tbody>
</table>

The full Competency Framework is reproduced as an Appendix to this paper.
The Framework was validated by the completion of questionnaires by a wide range of practising LAMEs and by “managers”, other than those who created the framework (i.e. maintenance managers, quality assurance staff and CAA officials etc). Questionnaire respondents were given the opportunity to comment on the content, structure and wording of the Framework. This is a summary of their contributions.

- The concept of a Competency Framework was generally endorsed.
- All the “qualities” were accepted, but a few were challenged and some additions suggested.
- Although many of the suggested additional qualities appeared to be variations of those in the draft framework, they should be carefully considered, if the framework is to be implemented.
- The framework was seen as representative of an “ideal” LAME, which cannot be achieved easily but should be aimed for.
- Reference to “improvisation” and the implication that reference to manuals could be “optional” were challenged on the grounds that these are fundamental taboos for aircraft maintenance engineers.
- The non-parametric ranking of qualities in order of importance caused some difficulty. There was, however, a close correlation between LAMEs and “managers” rankings, based on ordinal data, as shown below, with “integrity” being ranked as most important by both LAMEs and “managers”, significantly ahead of any other quality.

<table>
<thead>
<tr>
<th>Competencies ranked in order of importance, by LAMEs and Managers</th>
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<tbody>
<tr>
<td>LAMEs</td>
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<tr>
<td>-------</td>
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<td>11</td>
</tr>
</tbody>
</table>
Analysis suggested that over half the LAME respondents had had little or no “training” in relation to those qualities that they had ranked as most important to their role as LAMEs. In fact, the figures suggested that there was little emphasis on any of the qualities within training and development programmes.

It is likely that respondents interpreted the term “training” to mean formal training courses, as that is the principal way they have learned their skills and technical knowledge. It could also be that these qualities (Integrity, professionalism etc) are acquired as part of the culture. This does not, of course, preclude the need for personal development programmes which assist the LAME to gain (as one manager suggested) an understanding of his/her personality type and the ability to address his/her strengths and weaknesses.

“Self development” ranked the highest in terms of difficulty and, ironically, lowest in terms of importance. A simple explanation could be that maintenance engineers rely on training and development to be organised for them, particularly during initial training or apprenticeship, and see no personal responsibility for their own development. If engineers are not encouraged to “learn to learn”, and see themselves in a low esteem role, they are unlikely to attach much importance to self development, to seek assistance or to respond enthusiastically to “additional” training or coaching.

US - UK Comparisons

These cultural problems are highlighted by J C Taylor and T D Christensen (1998), in their book *Airline Maintenance Resource Management ~ Improving Communication*. Although this describes the American aircraft maintenance industry it is, broadly speaking, indicative of UK attitudes.

They say (Pg 164) that

“the [aircraft maintenance] culture resists fundamental change. It’s cautious, conservative. By its very nature it’s slow to apply lessons learned in other industries, even in other airlines. The maintenance culture rests on a proud tradition that has now become its worst enemy. But culture is a product of human mind. To change the culture, all you have to do is change your mind.”

This is developed (Pg 169).

“The maintenance culture was once built around the ideal of the all-purpose, generalist mechanic. It worked. It made maintenance the proud profession that it has been for a long time. But the old culture is already slipping the wrong way - towards a kind of factory system, reducing workers to mere specialized parts that have to be controlled from outside and above. This is not progress, but its opposite. It spells trouble in more ways than you can count. Don’t go down that road. It’s a dead end.”

They go on to advocate that the Aircraft Maintenance Technician (AMT) must be part of a team and be developed to function effectively as part of that team.
They list (Pg 13) the characteristics of an AMT, as identified by Richardson and Associates', which appear to reflect those of UK LAMEs.

- Commitment to excellence
- Willingness to put in effort and hours
- Integrity
- Dependability
- Distrust of words
- Tendency to be a loner
- Modesty (doesn’t like to be in the spotlight)
- Doesn’t ask for help
- Tends to be self-sufficient
- Doesn’t share thoughts too frequently

Those characteristics with a spot (◦) are part of the proposed LAME competency framework. Those with a square (□) are formidable barriers to the introduction of any form of training or personal development programme to ‘develop’ or ‘exploit’ the competencies. This will be exacerbated if the LAMEs’ managers, or others who might be called on to endorse a programme, have the same personal characteristics.

To overcome these barriers and cultural inertia, it will be necessary to find a way for LAMEs to take responsibility for, and manage, their own personal development programme.

**Implementing a Competency Framework for LAMEs**

The inferences drawn from the research data, the support of those people who facilitated questionnaire distribution and the positive reaction of members of the Royal Aeronautical Society Aircraft Maintenance Engineering Steering Group indicated that there is interest in a Competency Framework for LAMEs and for a means of assisting LAMEs to achieve the standards that it enshrines.

The difficulty of implementing such an initiative must not be underestimated. The author’s personal involvement in the training and development of aircraft maintenance supervisors suggests that cultural inertia will make implementation a difficult and time-consuming exercise.

The formation of most aircraft maintenance engineers traditionally comprises an apprenticeship or other basic training followed by courses of technical instruction on aircraft systems. Recently this has been extended to include an “appreciation” of Human Factors. What is needed is a means of assessment and feedback against the competency framework and access to coaching, self-help groups and learning resources. Such an infrastructure would enable and encourage LAMEs to progress to “self-managed” learning.

This would require a commitment from employers to engender and sustain a climate conducive to a self development infrastructure. An increasing level of self-confidence will come about only if the LAMEs’ efforts are rewarded by:

- improvement in job performance, through formative feedback and learning and
- encouragement and recognition by their superiors.
It can be inferred from some of the more general comments by respondents to the research questionnaire that this is unlikely to be forthcoming. This suggests that the process should be largely self-managed by the LAMEs. This, in turn, will require valid and reliable feedback on current performance.

Performance Feedback

DeNisi and Kluger (2000) report that an analysis of literature on the effectiveness of feedback interventions showed that in more than one third of the cases feedback actually lowered subsequent performance. Their search for theories or models that describe how feedback might affect behaviour and performance established that there is no unified theory.

They assert that it is generally assumed that job performance will improve as a result of feedback but that a poorly implemented feedback intervention could actually hurt, rather than help performance.

The following extract from their Executive Overview of their paper “Feedback Effectiveness: Can 360-degree appraisals be improved?” is worthy of consideration in relation to the LAME Competency Framework.

There is a conflict between “Ideal self”, which is what we aspire to be, and “Ought self”, which is what others expect us to be.

Working on tasks that we want to work on is more likely to produce a focus on the “ideal self”, which means that we will concentrate on trying to achieve those goals we set for ourselves.

Working on tasks that we are supposed, or forced, to work on is more likely to focus on the “ought self”, which means we will try to avoid punishment and pain.

A significant factor is whether the feedback is “positive” or “negative”.

Receiving “negative” feedback under an “ought self” focus, we feel threatened and seek to avoid punishment by improving our performance. Therefore, “negative” feedback that focuses on the “ought self” is likely to result in improved performance. Conversely “positive” feedback on such tasks provides no incentive to improve.

On the other hand, when we receive “positive” feedback under an “ideal self” focus we see an opportunity to maximise reward by continuing to improve performance and our self-image. If we receive “negative” feedback on our performance of the things we want to do, we may see the improvement gap as too big and so we give up.

In summary, “positive” feedback is more appropriate at the (highest) self-image level and “negative” feedback is more effective at the task level.

These academic arguments, though difficult to appreciate on first reading, are important if an appropriate feedback intervention is to be developed against the LAME competency framework. The following diagrammatic interpretation of this theory is offered.
We respond to feedback in relation to:

<table>
<thead>
<tr>
<th></th>
<th>When the performance feedback we receive is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>our “Ideal Self”</td>
<td>If the improvement gap is too big, we become discouraged and may give up</td>
</tr>
<tr>
<td>i.e what we aspire to be, and</td>
<td></td>
</tr>
<tr>
<td>our “Ought Self”</td>
<td>We feel threatened and try to improve performance to avoid punishment</td>
</tr>
<tr>
<td>i.e what others expect us to be</td>
<td></td>
</tr>
</tbody>
</table>

deNisi and Kluger’s Feedback Intervention Theory, interpreted by Tony Hines.

Given the “vocational” nature of the LAMEs’ role, there will be a mixture of “Ideal self” and “Ought self” and thus, to be effective, the feedback intervention will have to discriminate between them.

**Performance Management**

To be effective, the feedback intervention should be incorporated into a performance management system. Creating a performance management system that line managers see as a benefit rather than a burden is not easy. Michael Armstrong points out that there are a number of significant differences between performance management and traditional appraisal schemes. He lists thirteen, of which the following are particularly relevant to the Competency Framework for LAMEs.

Performance management, he says:

- focusses on improving performance, developing competence, realising potential and providing non-financial rewards in the form of feedback, recognition and opportunities to develop skills, competencies and careers,
- concentrates on “self-managed” learning, giving people the encouragement they need to develop themselves with whatever support and guidance they need from their managers and the organisation,
- involves all members of the [aircraft maintenance] organisation as partners in the process - it is not something handed down by bosses to subordinates,
- is concerned with performance in the broadest sense, embracing not only outputs (results) but also inputs (levels of competence and how competencies are used),
- treats performance review as a joint affair which is primarily concerned with looking constructively towards the future,
- is based on agreements on people’s roles, covering accountabilities, expectations (objectives and competence requirements [LAME Competency Framework] ) and development plans,.
- is a continuous process, not relying on a once-a-year formal review
Performance Assessment

Assessment is the process of estimating the worth of something or somebody. It involves making a judgement based on standards or criteria.

In *The IRS Handbook on Competencies - Law and Practice*, the editor Neil Rankin (2001)' says that many employers using competency frameworks find that assessment presents an area of difficulty.

He reports on a benchmarking survey in the *Competency & Emotional Intelligence* journal which established that 59% of the 113 organisations surveyed reported assessment problems. He suggests (Pg 272) that the following key issues can make or break an effective competency-based assessment process.

- gaining the commitment of line managers to conduct assessments in a thorough way.
- consistency: ensuring that the requirements of a competency are interpreted in the same way by different assessors.
- objectivity: ensuring that assessors do not display favouritism or discriminate unfairly.
- guidance: providing good, clear guidance to employees and managers about each competency’s requirement.

Performance assessment can be relatively straightforward in production or administrative jobs, where output is measured against targets. Professional job performance is more difficult to assess and the judgements are, inevitably, more subjective. The introduction of UK National Occupational Standards has provided batteries of “performance criteria”, each relevant to a particular occupation. Objectivity is sought through simple expression of “competent” or “not yet competent” against each performance criteria. The latter decision will indicate that the jobholder needs further training, development or experience in order to meet the standard.

The assessment results can be used to provide “formative” feedback whilst the person is within a training and development process (whether on- or off -job) and “summative” decisions within a test or examination system.

Using a “now/not yet” judgement when assessing a LAME against the Competency Framework statements is neither practical nor helpful within a personal development process. Some form of analogue measure is needed, but this would require carefully worded descriptors if assessments are to be valid and reliable.

Michael Armstrong offers advice on this. He says that, traditionally, definitions have regressed downwards from a highly positive, e.g. ‘Exceptional’ to a negative e.g. ‘Unsatisfactory’ definition, as shown in the following example:

A Outstanding performance in all respects
B Superior performance, significantly above normal job requirements
C Good all-round performance which meets the normal requirements of the job
D Performance not fully up to requirements: clear weaknesses requiring improvement have been identified
E Unacceptable; constant guidance is required and performance of many aspects of the job is well below a reasonable standard.
An increasingly popular alternative, he suggests, is a rating scale which, as far as possible, provides positive reinforcement. It avoids entirely negative feedback, although it will indicate where improvements are required, as in the following example.

**Very Effective**
Consistently exceeds targets and required standards, and continually performs in a thoroughly proficient manner beyond normal expectations.

**Effective**
Fully achieves required objectives and standards of performance and meets the normal expectations of the job.

**Developing**
A contribution which is stronger in some aspects of the job than others. Most objectives are met but performance improvements should still take place.

**Improvable**
A contribution which leaves much room for improvement in several definable areas.

Such a scale would be more appropriate for the LAME’s Competency Framework, with amended descriptors.

**Feedback Sources**

Traditional job performance assessment is based on an annual dialogue between boss and subordinate and usually results in a rating and an agreed statement of strengths, weaknesses and objectives for improvement over the coming year. Unless these assessments are linked to a performance related pay system, they are often not done or executed very casually.

Whilst LAMEs’ technical job performance may be subjected to such an appraisal, assessment of their approach to the job, as described in the Competency Framework must be for personal development purposes only. Given the variety of people in the organisation who have an interest in LAMEs’ role, it is possible to widen the sources of feedback. e.g. Line Manager, Quality Assurance dept, Production Control, fellow LAMEs and other unlicensed engineers whose work the LAME supervises or inspects. This multi-source feedback system is commonly used in professional and management appraisal systems and is known as 360° feedback.

Although it is over 30 years old, the 360° feedback system is only now gaining popularity. Surveys have indicated that this is due to increased recognition of the value of performance feedback and the availability of cost effective computing systems.
Collection Method

For maximum effectiveness, the collection method for feedback data must:

- be initiated and controlled by the LAME,
- collect data from as many people as possible who are associated with the LAME’s performance, preferably from a variety of occupations and levels of seniority,
- place minimal demands on the LAME and the feedback ‘raters’, in terms of time to make judgements and provide responses,
- provide valid, reliable and constructive feedback to the LAME, on which personal development plans can be formulated,
- if possible, contain advice and recommendations on what personal development plans might contain (reading, practice, training courses etc),
- be capable of repetition at appropriate intervals of time to give an indication of change (improvement) in performance,
- provide non-attributable data to the industry “focal point” to facilitate maintenance and development of the system and identify common training and development needs.

Whilst paper and disk based systems could satisfy some of these criteria, processing the data would be very time consuming. The only satisfactory method is to deliver the system through the internet. Given the rapidly growing use of this medium, it should pose no threat nor inconvenience to the users and may be particularly popular with younger engineers.

An Internet based system

A well established system worthy of consideration is represented below. The competency database would comprise the LAME competency framework described above. The development database would comprise a collection of known sources of development activities including courses, self study material, action learning groups etc. Assessment would be the 360° system described above. The personal development plan results from automated mapping of the data, within a secure internet based system.
To make it acceptable to LAMEs, their employers and their development advisers, the system will need to be customised to reflect the aircraft maintenance culture and vocabulary.

Meeting the Regulator’s Requirements

The JAA’s requirements with respect to “competence” and “capability” and some possible questions from aircraft maintenance, repair and overhaul organisations were set out in the Introduction to this paper. Hopefully the remainder of the paper has provided some answers or at least some food for thought, particularly in relation to Standards of Competence and competence assessment.

In the UK, the CAA expects Approved Maintenance Organisations to demonstrate, to its satisfaction, that they have systems in place to meet the requirements. It will not endorse nor approve an industry-developed independent system of competence assessment but its surveyors will accept the use of such a system as evidence of conformance.

The Competency Framework has more relevance to “assessment of the need for training in the application of human factors and human performance”.


Paragraph 2 sets out the Aims and Objectives of Maintenance Human Factors Training thus: (Certain words have been shown in bold type to indicate relevance to this paper)
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 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.

The Competency Framework described in this paper was developed for Licensed Aircraft Maintenance Engineers. It would not be difficult to develop similar frameworks for all the staff listed in the report. viz:

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) Stores department staff, Purchasing dept. staff
h) Ground equipment operators
i) Contract staff in the above categories

Thus there would be a set of standards to assist managers and engineering personnel in the “assessment of the need for training in the application of human factors and human performance”.

A set of Competency Frameworks and a feedback system, as described in this paper, would also help managers, trainers and regulators to assess the application of learning in on-job, post training, performance.................which brings us back to the opening paragraph of this paper.

A final thought:

If all the personnel listed above had complementary Competency Frameworks and participated in mutually supportive feedback processes, it would “encourage a positive attitude towards safety, discourage unsafe behaviour and practices and so make a positive impact on the safety and efficiency of maintenance operations”.

- end -
### Bibliography

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Tony Hines MBE MSc FRAeS MCIPD LCGI has worked in civil aviation for 48 years. His career with BOAC/British Airways included working as an aircraft maintenance engineer, technical author, maintenance facilities planner, training manager and human resource manager (in engineering, operations and commercial departments).

As Chief Executive of the UK Aviation Training Association (1985–2003), he was responsible for the development and maintenance of standards of competence and vocational qualifications for airline and airport operational, engineering and customer services staff.
A Competency Framework for Licensed Aircraft Maintenance Engineers

A Competency Framework is a description of personal qualities. It describes behaviours (or capabilities) exhibited by a person who is regarded as highly effective in their job. Unlike Standards of Performance, which describe what people do, competencies describe what they need to be, in order to perform competently.

In 2000, the author of this paper conducted a research project to establish a Competency Framework for Licensed Aircraft Maintenance Engineers. A consultation workshop of “industry experts”, comprising maintenance managers, quality assurance engineers, trainers, regulators and trade union representatives, produced the Competency Framework, shown below.

The Framework was validated by the completion of questionnaires by a wide range of practising LAMEs and by “managers”, other than those who created the framework (i.e. maintenance managers, quality assurance staff and CAA officials etc). Questionnaire respondents were given the opportunity to comment on the content, structure and wording of the Framework. A summary of their contributions is shown in the paper.

Each “competency” is supported by a descriptor (in italics) and a list of between five and seven behaviours that would indicate possession, by a LAME, of that competency.

1 Decision taking and judgement making (Acting decisively to resolve issues satisfactorily)

a) Does not jump to conclusions, but bases decisions soundly on factual evidence, using all available information,

b) Anticipates problems in advance and takes action to deal with them,

c) Weighs up alternative options and chooses the most practicable for the circumstances,

d) Ensures that their decisions are realistic, workable and permissible,

e) Does not allow personal preconceptions and opinions to cloud their views and arrives at objective judgements,

f) Follows through decisions but remains open to persuasion and reappraisal.

2 Professionalism (Inspiring confidence in others of one’s capabilities and soundness of judgement)

a) Assesses accurately and objectively their own strengths and limitations, seeking advice when out of their depth or unsure,

b) Accepts responsibility for health and safety and accountability for their own actions and decisions,

c) Resists the temptation to give “popular” responses and to lower standards when under pressure,

d) Explains, with conviction, the consequences of decisions and the implications of actions to customers so that they understand the risks involved

e) Remains calm, efficient and objective when under pressure.
3 **Integrity** (*Not sacrificing high standards for immediate gains*)

- a) Understands the implications of commercial imperatives,
- b) Maintains consistently high standards of work, loyalty, honesty and commitment,
- c) Never cuts corners nor jeopardises the safety of others by taking “the soft option”,
- d) Stands by their decisions and principles even in the face of strong opposition or threats,
- e) Has the courage and strength to admit mistakes and weaknesses and to act on them,
- f) Diligently pursues work to the end to ensure the optimum service to internal and external customers.

4 **Adaptability** (*Being flexible with change*)

- a) Accepts the need to adapt and face change positively,
- b) Learns from their mistakes and those of others,
- c) Considers a problem from all aspects and improvises resourcefully yet systematically when dealing with unfamiliar situations,
- d) Alters their approach, attitude and methods of working to deal with new and changing situations,
- e) Regularly makes constructive suggestions for continuous improvement to processes,
- f) Consistently exhibits a positive and constructive attitude.

5 **Leadership** (*Inspiring teams and individuals to better performance*)

- a) Does not wait to be told what to do but energetically gets on with the job in hand, needing little or no supervision,
- b) Actively encourages others to achieve or exceed their objectives, guiding them through challenging situations and difficult problems and publically applauding their efforts and successes,
- c) Motivates others by setting a role model to others through exemplary behaviour and quality of work,
- d) Is not afraid to ask for help when needed and accepts advice constructively,
- e) Takes personal responsibility for ensuring that tasks are fully completed.

6 **Teamworking** (*Collaborating positively with others for mutual benefit*)

- a) Puts team considerations before their own individual needs,
- b) Shows respect to all team members at all levels by treating them with equal courtesy and consideration and exemplifies corporate culture and values,
- c) Understands the effects of their actions and words on other people and modifies their behaviour to achieve results,
- d) Minimises conflict and takes active steps to relieve tension and stress within the team, exhibiting rapport and compassion to build effective working relationships,
- e) Offers support and help to others beyond what is required,
- f) Coaches and trains less experienced colleagues and shares ideas, information and solutions for the team’s benefit,
- g) Considers the needs of other people beyond their own team.
7 **Self Development** *(Growing with the job by keeping up to date with individual skills, knowledge and business practices)*

a) Recognises the need to keep their skills and knowledge up to date,
b) Takes personal responsibility for developing themselves and their career,
c) Accepts criticism constructively and takes action to correct areas of personal weakness,
d) Keeps abreast of wider technical, business and commercial developments which might the team’s and the company’s work,
e) Seeks to understand the business environment and the financial implications of their decisions and actions,
f) Is mindful of costs and seeks to work efficiently and economically,
g) Asks for opportunities to take on new challenges in order to develop their personal and social skills.

8 **Communication** *(Ensuring clear and common understanding on both sides)*

a) Listens actively and carefully to what others are saying and appreciates their point of view, even when it contradicts their own,
b) Checks to ensure that they have correctly understood what is being communicated,
c) Structures what they want to communicate and expresses themselves clearly, consisely and assertively to non-technical people so that they can understand the implications of an issue,
d) Adapts their style, expression and choice of words according to the audience to ensure clarity of understanding,
e) Negotiates diplomatically and seeks to find compromises and mutually acceptable solutions in disagreements,
f) Shares information openly with others to ensure lessons are learned for future benefit.

9 **Methodical** *(Planning and organising to maximise the resources available)*

a) Systematically draws up plans and distinguishes urgent from other priorities, juggling tasks and priorities to meet deadlines,
b) Allocates clearly roles and responsibilities within the team as a whole,
c) Sets personal goals and targets to keep on top of their own work,
d) Organises work logically so as to make the best use of time, people and equipment available to complete the task on time,
e) Completes the necessary documentation accurately,
f) Refers to manuals and instructions when necessary and does not rely on memory,
g) Makes back-up plans to allow for scheduled and unscheduled maintenance, contingencies and any unforeseen situations.
10 **Accuracy and thoroughness** (*Ensuring consistency, completeness and quality of work*)

a) Is conscientious in taking responsibility for ensuring that their work is consistently of the highest quality possible,
b) Patiently takes time to think things through to ensure every angle of a problem is addressed, even when under pressure,
c) Meticulously attends to detail in every aspect and exercises self-discipline in double-checking their work,
d) Uses every piece of information available from others to solve a problem and ensures they are thorough in giving information to others to enable them to do the same,
e) Maintains accuracy and attention to detail, even when under pressure,
f) Sees tasks through to the logical conclusion and to the required standards.

11 **Analytical** (*Getting to grips with the essence of the problems*)

a) Does not take what is presented at face value and challenges information when in doubt,
b) Takes a systematic approach to fault finding and identifies accurately the requirements of a task,
c) Spots the links between different pieces of information and emerging patterns,
d) Draws conclusions only when they can be supported by evidence,
e) Recognises negative or gradually deteriorating situations easily and alerts others promptly to the need to take urgent preventive action,
f) Considers all the information available and sifts out the surplus to consider only what is relevant to an issue,
g) Reasons through a problem, thinking creatively and looking at the whole problem rather than focussing on one part of it.

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