Managing competence for safety-related systems
Part 2: Supplementary material

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Introduction

1 This document is intended to be read in conjunction with Managing competence for safety-related systems [Ref 1]. It is not intended to be read on its own without reference to that primary document.

2 Managing competence for safety-related systems establishes 15 principles to be followed when establishing a competence management system (CMS).

3 This supplementary material suggests ways to realise each of those principles. Some suggestions may not be applicable to your own organisation. For example the resources necessary for some suggestions may not be proportionate to the risk, or appropriate for the size of your undertaking. The intention is not to prescribe a way to establish the CMS so that it satisfies each principle; rather it is to stimulate you to establish your own policies and processes, drawing on the suggestions that are offered here only if you find them appropriate.

4 To facilitate cross-checking with Managing competence for safety-related systems, the topic numbering of each principle is shown in the left-hand margin of this material wherever there is a direct relationship with a particular requirement. However, each paragraph does not necessarily relate to a specific requirement of the relevant principle; some of the material is about how to approach that principle more generally.

Risk and proportionality

5 No specific guidance is given on how the risk associated with inadequate competence governs the effort expended in meeting the principles. But it is still valuable to bear in mind that, generally speaking, more rigour is expected in the CMS for developing a safety-related system with safety integrity level 4 than for a system with safety integrity level 1.

6 Although increased risk associated with inadequate competence will require greater rigour in defining competence criteria (e.g. in ensuring that the criteria directly match the work activity), it is not suggested that the criteria for an activity need differ according to the risk associated with each application, for example according to safety integrity level. (Note that safety integrity level can be relevant when defining the context of an assessment – see Principle 5.)

¹ The effort expended in meeting the principles of this guidance should be in proportion to the risk associated with inadequate competence (see Risk and proportionality).
Getting started

Planning the introduction of the CMS

7 Although there is a logical progression in the principles (see Figure 1, below), they need not be introduced or executed sequentially. You will probably iterate between the activities associated with implementing the CMS and the activities associated with its ongoing design, operation and maintenance.

8 A ‘big bang’ introduction of your CMS, in which you introduce a suite of new, predefined standards and processes to your staff, is inadvisable and unlikely to work in practice. It is unlikely that any organisation will design the whole of its CMS in advance of implementing some parts of it. With a more gradual approach you will reduce disruption to existing tasks and carry more support from your staff.

Figure 1: Phases and principles of a continuously improving competence management system
When planning the introduction of the CMS, you may wish to consider:

- the areas of your organisation that are currently weakest with respect to the requirements of the CMS
- the number of staff and the order in which they are to be included
- the benefits and practicality of an incremental approach
- the political and organisational hurdles to be overcome
- the presentation of the CMS and its advantages to affected staff.

You may already have some elements in place that can be adapted to implement parts of the CMS, such as existing organisational structures, people, processes and infrastructure (see Principle 3).

You could extend and refine existing management processes to address the needs of the CMS. For example, you might introduce review procedures (Principle 15) by creating a new kind of management review by setting up a task team that reports to the person responsible for the CMS (see Principle 3). This team could define and revise the strategy for introduction of the CMS, and monitor its progress.

If your staff are unfamiliar with the concept of maintaining evidence of the demonstration of competence, as required for assessment, your organisation will require new processes and infrastructure to enable them to do this efficiently and effectively.

One way to facilitate gradual introduction of a CMS is to adopt a process improvement approach. This leads an organisation from a situation in which processes are not documented at all, to one where they are well-documented and continuously improving.

Even if you have not already mapped your existing management system processes to your requirements for a CMS, you may nevertheless already have management processes for staff appraisal, for assigning staff to particular tasks, and for training and development – however informal those processes may be.

You could therefore start, in the spirit of continuous improvement, by documenting what you do, and then comparing that with the appropriate principles in this guidance. For instance, processes that you might already have for selecting appropriate courses for individuals can be formalised, and a record-keeping system established, in advance of the competence criteria being decided.

You might also consider bringing into your organisation one or more people with experience of running a CMS, to advise on the design of the CMS and on its introduction, and perhaps to design some of it themselves. They need not necessarily be consultants, as commonly understood: they could be seconded from customers, suppliers, or from companies working in related fields with which you would not have a problem of confidentiality or competition.

**Deciding whose competence you wish to manage**

Principle 1 addresses the scoping of your CMS and in particular, identification of the activities of your organisation that should be covered by the CMS. The first people to include in your CMS are those who currently perform these activities.

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1 The Carnegie Mellon Software Engineering Institute has been a major source of innovation in process improvement in software engineering. In recent years the concept has been extended well beyond software engineering, and an international standard on generic process assessment - ISO/IEC 15504 – is under development. The Institute provides extensive guidance on process improvement, based on the concept of a maturity model of an organisation being gradually transformed from 'initial' through to 'optimising' [Ref 2].
If other staff are likely to perform these activities in future, then you can increase flexibility and reduce delay by including those staff in your CMS before they are moved to these activities. This is particularly relevant for project-oriented organisations, in which new teams are frequently formed, changed, and dissolved as projects come and go, and activity assignments are quite dynamic.

**Finding assessors**

The availability of assessors may become a bottleneck, once competence criteria have been decided and the assessment process defined. It may help to think early about selecting, recruiting or hiring assessors that are competent themselves both to perform competence assessment and to advise on training and other professional development needs.

**Providing administrative support**

Administrative support, particularly computer-based systems, can both facilitate management of the CMS and help your staff. For example, a database of competent assessors, indicating their specific competence, will ease the management of the assessment process, and a library and record-keeping system will help staff to maintain evidence to support their claims for competence during assessment. (See also Principle 12.)

**Communication**

However much you may try to avoid the CMS being a burden on the organisation as a whole or on individual staff, it is likely to be perceived as such – or even as a threat – by at least some staff.

You should increase acceptance of the introduction of the CMS if you clearly explain to your staff – and to external assessors if they are likely to be involved – the areas of your business that will be within the scope of the CMS, why they are, how your staff will be affected by it, and your approach to its introduction.

Such communication can include, for instance:

- your intentions, the reasons and the benefits to staff and to the organisation;
- your strategy;
- timescales;
- who is affected and when; and also
- any downside for staff.

Integrity in introducing the CMS will help it to be regarded with respect and operated in line with its objectives.

**CMS resourcing**

Effective implementation of the CMS will need effective resource planning and sufficient resources (people, time, materials, computational capability, etc.) and budget.
PHASE ONE: Plan

Principle 1: Define purpose and scope according to risk

OBJECTIVE

To specify all work activities to be included in the CMS, based on the risk associated with those activities.

SUPPLEMENTARY MATERIAL

Identifying competence needs

26 The types of competence that your organisation requires to do its job professionally is likely to be wide-ranging – for example from filing of reports, through equipment maintenance, to design of a safety management plan.

27 There are several ways to analyse your organisation so as to identify the work activities requiring competence that you want to include in the scope of your CMS. You could, for instance, analyse it by:
   - your different operating units,
   - your different departments,
   - your different customers,
   - the different types of contract you typically undertake,
   - the different types of work that your staff undertake, or
   - any combination of these.

28 Relevant work activities may be necessary to ensure the safety of your own staff, to ensure the safety of the general public and/or to ensure any products you contribute towards are sufficiently safe for use by others.

29 If you are not directly associated with the end use of your safety-related system, you may not know or be able to determine the exact hazards and risks associated with failure. In this case the safety integrity level is a good indicator of the amount of risk associated with failure, since the user should have taken the hazards and risks into account when specifying which safety integrity level is required.

30 You might also consider ‘future-proofing’ your CMS, saving time and energy in future, by including work activities that you intend to do in future as part of your business strategy.

31 In analysing your needs for competence, rather than simply accepting and managing the needs that emerge, you will gain from reducing your dependence on competence in the first place. Sometimes it may be possible to redesign a task to reduce its complexity, for example using better tools, user interfaces or procedures.

32 However, reducing competence-related risk usually entails a trade-off against cost and resources and may also involve shifting the risk onto different activities, systems or people. Greater use of automated tools, for instance, such as the introduction of automatic code generation, may reduce the dependence on some skills, but may require new skills. It will almost certainly change the engineering process, introducing new risks to be considered.
33 The guidance applies to activities affecting functional safety of safety-related systems. Any other activities are outside the scope of the guidance. However, you may choose to widen the scope to other activities for efficiency purposes.

34 Your customers may, as part of their CMS, need to manage the competence of their suppliers, including your own organisation. And different customers might have different requirements. This might affect the purpose and scope of your own CMS. How will you, for instance, be able with your CMS to satisfy your various customers’ requirements for their CMS? **Principle 11** offers guidance on managing supplier competence: you might use this to inform your own approach as a supplier.

**Managing diverse competence requirements**

35 If you have a diversity of national and sectoral requirements for competence management, you might find it more efficient to have a common scheme based on a ‘best of breed’ set of requirements that will satisfy all of them, rather than maintaining several different ‘subschemes’ to meet each set of requirements.

**Extending the scope of your CMS for business efficiency**

36 Having identified the activities associated with functional safety of safety-related systems that need to be included in the scope of the CMS because of the risk, you may, in the interest of business efficiency, wish to extend the scope of the CMS to other activities carried out by your organisation.

37 You may wish to have a scheme that recognises and captures the competence of all members of your staff. This could motivate your staff to develop their competence. It could reduce the learning curve for staff moving into a regime where there are formal competence requirements. It could give you more flexibility in allocating staff. But it is not necessary to have an all-encompassing formal CMS; you can, if you wish, manage the competence of your staff with varying degrees of rigour.

38 Even if some parts of your business are not subject to external competence requirements, you might consider future-proofing your CMS by taking account of emerging or likely future standardisation that will affect your areas of operation.
PHASE TWO: Design

Principle 2: Establish competence criteria

OBJECTIVE

To select or develop a suite of competence criteria that covers all activities within the scope of the CMS and gives sufficient confidence that all staff that meet particular criteria are competent to perform the related work activity.

SUPPLEMENTARY MATERIAL

Identifying roles

39 The activities of your staff can affect functional safety either directly or indirectly. Activities with an indirect impact include management, operation of the CMS, and training.

40 It is important that those who have a role in managing the system keep up to date with technology and working methods. Otherwise, there is a real danger that they will rely on their own experience from when they did similar work, which may no longer be applicable.

Selecting and developing competence criteria

41 The quality of the competence criteria will have a significant influence on the efficiency and effectiveness of the CMS. You should be aware that selection and development of a suitable suite of competence criteria is an intellectually demanding task that should not be underestimated.

Different types of competence

42 Competence criteria can address a range of types of competence that you require of your staff, including:

- technical skills; for example, hazard analysis, report writing;
- behavioural skills; for example, personal integrity, interpersonal skills, problem solving, attention to detail;
- underpinning knowledge; for example, a person performing a hazard identification needs knowledge of the particular application to be able to identify the likely hazards that exist;
- underpinning understanding; for example, it is unlikely that somebody could establish risk tolerability levels for a particular problem without an understanding of the principles of safety and risk.

43 For example, a competence criterion for ‘Hazard Identification’ might require that a person has a mixture of technical skills and underpinning knowledge, such as:

“Identifies hazards and hazardous events, including contributory and aggravating factors, for normal and degraded modes of operation through:

- formation of a suitable hazard identification team (where appropriate)
- consideration of factors which could affect the operational environment and system performance
- use of appropriate historical information sources and hazard identification techniques.”
Whereas a competence criterion for ‘Decision making’ might require that a person has a particular behavioural skill:

“Uncovers the key facts associated with a situation and communicates a firm, rational decision based on an analysis of those key facts.”

**Clear-cut assessment**

It is important that staff are not subjected to inconsistent assessment, either when different assessors are used or even the same assessors on different occasions. This requires criteria that can be interpreted consistently.

Both to assist assessors and to help achieve consistency, you could provide some guidance on how an individual should be assessed against each competence criterion. Such guidance could, for instance, indicate for particular competence criteria what an individual is expected to have done to be able to claim to meet them.

For example, the competence criterion for ‘Hazard Identification’ suggested in Ref. 3 reads

“Can explain the difference between hazards, accidents and failures.

“Has participated in hazard identification exercises (e.g. brainstorm) that demonstrate the use of lateral thinking in identifying hazards and, in particular, hazards relating to the operation and maintenance of the system and degraded modes of operation.

“Can show how information from previous designs, incidents and other sources has been used in hazard identification exercises.”

If your competence model (see Appendix 1) includes the concept of competence levels (such as supervised practitioner, practitioner, expert, as in Ref. 3) then you might have different guidance for each level, to indicate the different type of evidence needed to demonstrate competence at that level.

Ideally, all competence will be demonstrable by the provision of documentary evidence. However, it is often more difficult to find documentary evidence of performance for competence criteria that are concerned with behavioural skills and understanding rather than technical skills and knowledge. Your guidance can indicate the kind of evidence that would be acceptable in each case. (Principle 5 indicates a range of types of evidence that might be used. See also other examples in Ref. 3.)

**Reusing competence criteria**

Reusing existing criteria facilitates ‘portability’ – the acceptance of previously assessed competence in different circumstances (see portability of criteria section below). And sharing a competence model and perhaps competence criteria with customers and suppliers will make it easier for you to meet your customers’ requirements and for your suppliers to meet yours.

Rather than devising new criteria specifically for your own needs and the scope of your CMS, you might:
- select criteria from existing available sources
- edit existing criteria to tailor them to your own needs.

The selection of nationally recognised competence criteria will help you to achieve the goals of portability and a common interpretation of competence criteria.

In many situations, however, even if you reuse criteria, you will have to tailor them for the particular context of your organisation. Nevertheless, it will help to facilitate common understanding of competence requirements, and to enable portability of competence assessment, if such tailored criteria are developed to a structure and quality similar to those of nationally recognised competence criteria.
Matching criteria to your business roles

54 You may find it easier to structure your competence criteria and to achieve modularity (see below) if you establish a competence model that relates organisational activities, staff roles, and competence criteria. Appendix 1 explains this concept further and provides an example of a competence model.

55 While roles of staff are not generally standardised, you can nevertheless simplify competence management by identifying a suite of roles typically performed by your staff. You could start by identifying the various roles necessary to undertake the activities that you decided (in Principle 1) to be within the scope of the CMS.

56 There may be a one-to-one match of such roles to the work undertaken by individuals. An individual could perform several roles, either individually or as a part of one or more teams.

57 For each role, a set of appropriate competence criteria is identified. See Appendix 1 for a more detailed example of how roles can combine in teams and how individual competence criteria can be specified using competence profiles.

58 Mapping the way you run your business to a set of roles with defined competence criteria also provides an opportunity for business improvement. It provides a complementary viewpoint to the mapping of business processes for the delivery of goods and services. As with business process mapping, such competence mapping gives a basis for refinement, evolution and continuing improvement.

Portability of criteria

59 It is in the interests of both staff and employers for criteria to be portable. That is to say that when you are considering recruiting someone from elsewhere – either in the same organisation or from outside – and the competence of that person has already been assessed in their existing position, you will be able to understand the relevance and appropriateness of that competence to your own needs, without having to assess the person against entirely different standards of your own. (Though once employed, they will still need to be assessed in accordance with Principle 5.)

60 By separating the core principles of competence criteria from their context, a limited set of common competence criteria can be applied universally in many industry sectors, applications, technologies, and regulatory environments. (See Appendix 1.) You can capture the actual context (of sector, application area, technology, etc.), in which the general competence criteria have been demonstrated, during an assessment. Principle 5 expands on context as it applies to an assessment.

61 This is not to say that a new staff member can be deployed without additional supervision while adjusting to their new context – however senior they may be. There may be many subtle differences between nominally the same competence applied in different contexts.

Modularity

62 The roles that staff perform and the activities of organisations are not, in general, standardised across industry. Given the wide range of capabilities of different individuals, and the wide range of ways that organisations structure their work, competence criteria tailored to the specific activities that particular individuals undertake in any one organisation are unlikely to be appropriate for different individuals, or to survive changes in technology or work processes. Nor would they meet the requirement for portability. However, you might consider a modular scheme of competence criteria in which each individual will have a suite of competence components. (See Appendix 1.)

63 There is no ideal level of granularity for competence criteria, but it will save effort in future, as roles change, if the criteria are defined at a level that minimises the burden on both staff and the organisation as staff change roles and as the roles themselves change.
Validation

64 One approach to validation of a competence criterion is a self assessment against a criterion by a person generally acknowledged to be highly competent within the scope of the criterion, followed by a critical review with others; another approach is to perform a ‘mock assessment’ of staff with well-understood competence by staff both with and without assessment experience, to identify any scope for inconsistent interpretation of the criterion.

FURTHER INFORMATION

65 The examples of competence criteria given in this principle are drawn from the IET’s safety-related systems competence criteria [Ref 3], which contains many such examples produced by the IET and the BCS, in collaboration with HSE.

66 Other criteria available include: standards for assessors and verifiers (e.g. from Employment National Training Organisation); for personnel work including selection and recruitment (e.g. from the Institute of Personnel and Development, and from Employment NTO); for health and safety (e.g. from Employment NTO); and for auditing (e.g. from the Institute of Quality Assurance).
Principle 3: Decide processes and methods

**OBJECTIVE**

To establish efficient and consistently repeatable processes, procedures and methods that implement the requirements of the principles in this guidance.

**SUPPLEMENTARY MATERIAL**

**Person with overall responsibility**

67 Necessary competence and authority for the nominated person include:
- knowledge of your organisation’s functional safety management strategy
- knowledge of your organisation’s processes and management and job structure (e.g., recruitment and assignment, contract management, typical job responsibilities)
- sufficient authority to ensure that the principles of the CMS are fully observed in practice.

**Transparent and repeatable processes and methods**

68 You will need to translate the principles into more specific processes and procedures suitable for your own organisation. Well-defined processes will enable:
- consistent interpretation and application;
- traceability, so that progress through the processes can be monitored for specific instances, such as the application of the assessment process in the case of a particular individual on a particular occasion;
- a basis for planning an audit of the CMS.

**Supplier relationships**

69 Principle 11 indicates some of the issues to be addressed in the management of competence of your suppliers’ staff, and some of the options to consider.

70 ‘Supplier’ (of products or services) is defined very broadly, and you might require different procedures for each type of supplier. Even then, you might want to further tailor your processes and procedures to inter-operate effectively and with minimum burden with those of particular suppliers, and possibly even for particular contracts.

71 Supplier relationships can change, and new supplier relationships can emerge. For example, a supplier might decide to subcontract out some of their work, or a supplier might be taken over by another organisation. Such changes might require amendments to your choice of working processes and their tailoring to specific circumstances. Your contract management procedures could try to capture changes like these and feed them into your CMS so you are able to modify your competence management arrangements appropriately.

72 Principle 12 offers guidance on record-keeping and information management.

**Maintaining efficiency**

73 To avoid the CMS being perceived as a burden, you can approach it as a way to increase operational success.
74 You can, for instance, make your organisation more efficient by making the processes and procedures of the CMS consistent and compatible with any existing management systems that you operate, such as a Quality Management System. For even greater efficiency, your various management systems could share some processes.

75 You might start by comparing those other management systems for conformance with the CMS principles. It may be best to start with the principles associated with Phase Three (Operate), where the CMS has the most direct impact on the way that staff do their work.

76 For example, your existing recruitment process may already have most of the elements necessary to meet the requirements of Principle 4 (Select and recruit staff), and most of the infrastructure to support it, and may require little more than the introduction of competence criteria (Principle 2) and an assessment process (Principle 5). This gives you an opportunity to simplify your annual appraisal system and make it more effective, while giving your staff a more consistent and coherent set of expectations and a framework for their personal development.

77 In addition, you may well have existing policy and processes for health and safety management. Again you can be more efficient if you integrate your CMS processes with these existing processes.

78 Moreover, developing competence (Principle 6) addresses at least some requirements of the engineering institutions’ professional development schemes. By harmonising the processes of the CMS with such schemes and by combining procedures wherever possible, your competence development processes may satisfy the requirements of a professional development scheme without any additional overhead.

79 In general, there are two opportunities for gaining efficiency through compatibility with other management systems:

- modify an existing procedure that can satisfy a CMS requirement, to avoid creating a new procedure (for example, an existing procedure for audit might be used for all your management systems); and/or
- adopt an existing format for a management procedure – specifically, companies accredited to ISO 9001 are likely to have a standard template and structure for management system procedures.

FURTHER INFORMATION

80 Guidance on quality management systems is provided by ISO9001:2000 Quality management systems [Ref 4].

81 The Qualifications and Curriculum Authority publish booklets of guidance and checklists for good practice.

82 Benchmarking is a method for identifying and developing good practice, and further guidance on this can be found in ‘Health and safety benchmarking: Improving together’ [Ref 5].
PHASE THREE: Operate

Principle 4: Select and recruit staff

OBJECTIVE

To select internally, and recruit externally, staff that have an appropriate and demonstrable competence profile.

SUPPLEMENTARY MATERIAL

Selection and recruitment covers a range of possibilities, including:

- transferring a person from elsewhere within your organisation;
- recruiting a new member of staff; and
- employing freelance or agency personnel.

The importance of competence management in your organisation can be reinforced by explicit reference to it during the recruitment process, for example in advertisements, in job descriptions and during your induction processes.

Recruiting specific competence

If you recruit to meet clearly defined competence requirements, then you might integrate elements of your competence management system into your recruitment process – in particular elements for assessing competence (Principle 5) and assigning responsibilities (Principle 7). But this may add considerable overhead through a more in-depth interview that includes the candidate bringing evidence of competence of previous work done. This may be difficult due to confidentiality of employer and client information.

On the other hand, if the present or previous employers of a candidate have operated their own CMS, then the potential recruit may be able to offer evidence of satisfying their competence criteria. However, even if their CMS arrangements are similar to your own, you will still need to establish the context of that competence (see Principle 5 and an explanation of context in Appendix 1).

Recruiting in the absence of specific competence requirements

Often though, organisations recruit personnel with a view to long-term employment on a range of activities, rather than for a specific task with specific competence requirements. So it is not generally possible to know precisely the activities that a new recruit will be expected to undertake. Indeed, part of the process of recruitment is to gain information that will enable you to decide not only whether a potential recruit should be employed by your organisation, but to which activities they might contribute.

You can at least make your staff responsible for recruitment aware of the content of the potentially applicable competence criteria. They can then informally assess the potential recruit’s competence profile, even if supporting documentary evidence is not available.

If an individual was not assessed according to Principle 5 during recruitment, you will need to perform a full assessment once the individual commences employment, before they are assigned to activities covered by your CMS.

You may have to vary your assessment process and methods to compensate for a lack of primary evidence for newly recruited staff. You might, for instance, use additional written or practical tests. You may also wish to cater for initial uncertainties in an individual’s competence through probation arrangements and increased supervision.
Principle 5: Assess competence

OBJECTIVE

To determine the extent to which staff currently meet the established competence criteria.

SUPPLEMENTARY MATERIAL

Assessment planning

91 Typically, in agreeing the competence criteria against which the individual will be assessed, instead of just one or even a few pass/fail criteria, the individual will be expected to satisfy a range of competence criteria at different levels. The purpose of the assessment will then be to establish a competence profile for the individual. (See Appendix 1.)

92 To assess competence for abnormal situations, emergencies and other infrequent events, you may need to use different methods from those required for normal situations. Competence in these situations is very important, yet these situations are, by definition, rarely encountered. It will be difficult or impossible to test this competence in normal situations, and even if a relevant situation does occur, it may be impractical to monitor the performance of staff in these circumstances. Alternative techniques include group exercises, training videos, exercises in the industrial environment, use of simulators, computer based training and variants, practical demonstrations and table top exercises. Note that it is not just operators and maintenance staff who require their competence to be assessed for such situations: commissioning engineers and on-site designers are also affected.

93 While it is desirable to maximise the impartiality of the assessor or assessors, in some situations it may be difficult to avoid involving the line manager, either because of the small size of the organisation or because the line manager may be the only expert, or one of only a few experts, able to judge competence in the particular activity. In such situations you could consider using additional assessors, perhaps less technically expert, just to ensure impartiality.

94 Where the risks justify the use of the resources, you could consider using two assessors more generally. Two assessors can form a more balanced and more self-verified assessment than an assessor working alone.

Changes in expectation – explicit and implicit

95 Apart from explicit changes to the text of competence criteria, there can be implicit changes. For instance, a criterion might require “awareness of standards” in some domain and there may have been a new standard published, or the introduction of automated design tools might have changed the nature of some of the design processes – particularly the interfaces between processes.

Implications

96 When discussing the objectives and implications with the individual, they are likely to want to know how the assessment relates to any more general staff appraisal process and may be particularly concerned about the implications for their salary. It is generally inadvisable to link competence assessment directly to salary or promotion because staff will be less open about any weaknesses in their competence if they are concerned about financial implications.
97 Competence assessment is also likely to have other implications, such as indicating potential career development paths, or indicating unsuitability of the individual for expected assignments or even their present activities, which may in turn imply either a need for competence development or reassignment to more suitable duties.

**Self-assessment**

98 To maximise efficiency, members of staff could self-assess in advance. This is not a substitute for formal assessment as part of the CMS, but it can help an individual identify early on their needs for competence development, and it can also improve the efficiency of formal assessment. (See also Appendix 2.)

**Gathering evidence**

99 The better prepared the individual, the more efficient and effective the assessment meeting will be. As indicated in Principle 12, corporate support can help the individual to identify the appropriate evidence.

**Applicability and context of certificates**

100 ISO/IEC 17024, *Conformity assessment – General requirements for bodies operating certification of persons* [Ref 6] and supporting IAF guidance [Ref 7] give requirements by which third party certification can be effectively judged. For example, 4.2.5 of the standard requires:

> The certification body shall not offer or provide training, or aid others in the preparation of such services, unless it demonstrates how training is independent of the evaluation and certification of persons to ensure that confidentiality and impartiality are not compromised.

**Evidence of competence**

101 When examining relevant experience, part of the assessor’s task is to distinguish what has actually been carried out by the individual from what has been performed with, or by, other members of the project team.

102 Where documentary workplace records are not available or do not show sufficient involvement of the individual, the assessor might, at their discretion, allow other forms of evidence, such as:

- assignment and/or project records
- records of workplace observation
- records of competence tests
- witness testimony
- performance in an interview, eg structured talk-through of particular processes or situations.

103 In the absence of records that indicate previous demonstration of competence in a work situation, the assessor can seek alternative evidence, such as:

- a demonstration that the individual would be able to perform competently in a hypothetical situation
- a demonstration of understanding by the individual being able to answer questions concerning the required competence, based on past experience
- a demonstration that the individual could follow suitable thought processes – such as those necessary for competence in decision making. (See, for example, paragraph 44 above.)
- evidence of having received appropriate training for a particular competence.

104 Another source of evidence for the assessor is evidence of failure of the individual to perform as expected against earlier competence assessments (see Principle 9).
105 For further discussion on assessment methods, see section 3.6 of Reference 8.

The context

106 Any given competence criterion will usually be applicable to a range of industrial scenarios. For instance, a criterion for ‘hazard identification’, such as the example in paragraph 43 above, could apply in the development of SIL 2 PLC shutdown systems or of SIL 4 engine management systems, despite there being significant differences between these two activities. But the context of interpretation of that criterion will be different: someone who has been assessed as an expert in safe software design for one of these applications will not necessarily be as competent in the same kind of activity for the other.

107 Capture of both the competence criterion met by an individual and the context in which that competence was acquired and demonstrated will enable any differences between old and new contexts to be taken into account for future assignments.

108 Context information includes industry sector, application, organisational standard practices, technology (eg software platform), safety integrity level, applicable standards in use in the particular working environment, and the maturity of the organisation’s safety culture. For example, automatic pilots and landing-gear control are both produced in the avionics sector, with similar technical standards, but can give rise to different hazards and have different technical approaches to avoid and mitigate the risks, requiring different competence (as well as much similar competence). Context includes both formal attributes, such as operation of quality management schemes and personnel development schemes, and less tangible attributes such as ethical attitudes and management style. Safety culture can vary between organisations and between sectors. It can be particularly difficult to describe, but it is worth trying to capture as it will affect how easily competence of individual members of staff can be reapplied when they move to other parts of the organisation or to other organisations. (See also Appendix 1 for a further discussion of context.)

Supervision

109 Supervision can be used for activities that an individual on their own is not yet fully competent to perform. This may be because the activities are relatively new to the individual or because the context of present or future assignments differs from that in which competence was previously attained.

Action plan

110 The action plan might include the individual’s development needs for their present jobs, their needs for any anticipated changes in the work environment, and their more general needs for career development. Appropriate actions might include gaining experience of a new application domain or technique, or training for potential future duties.

Validity period

111 There needs to be a balance between the frequency of assessment, the rigour of assessment (in terms of nature and frequency), the cost (in terms of time and trouble), and the risks that are being managed through the activities of your staff.

112 A typical validity period might be 3-5 years, although events such as project assignment or an incident may trigger an assessment sooner than this. Less-experienced members of staff may also require more frequent assessment to recognise and give credit for the rapid increase in competence that they are likely to experience during their early career development.
Communicate results

113 In addition to giving the individual a record of the results of the assessment, there may be a need to issue or update any certificate, licence or authority to work. This record would typically include at least the activity, the competence criteria achieved, the name of the assessor(s) and the expiry date and be validated in some way so as to prevent fraudulent use.

114 Team leaders and line managers in particular need to be aware of any need to encourage and facilitate competence development for the individual beyond that required for their presently assigned tasks.

115 In addition to communication of the results of the assessment within the organisation, it might also be appropriate to communicate the results to your client organisation.

116 Rapid communication of assessment results is especially important if a person has failed to demonstrate all the competence required for activities to which they are currently assigned.

Re-assessment

117 In addition to scheduled reassessment, reassessment might be triggered by:

- changes in technology, working practices, legislation, standards, business practice, expectations of customers and of the public, and in corporate culture and the consequent expectations of employees (see Principle 13).
- the need to reconsider, after an incident (not necessarily involving your own organisation), your organisation's approach to competence management (see also Principle 9).
- re-engagement of an individual in activities requiring compliance with particular competence criteria after a period involved in other activities.
- concerns about the performance of an individual or a team.
Principle 6: Develop competence

OBJECTIVE
To extend and maintain the competence of staff so that they are able to meet relevant competence criteria.

SUPPLEMENTARY MATERIAL

The personal competence development plan

118 Depending on the breadth of scope of your CMS, an individual’s competence development plan may form part of a more broadly-based personal development plan that also addresses development needs outside the scope of the CMS.

119 By linking training and development to competence assessment, staff can get recognition for their increasing competence, broadening the range of activities they are able to carry out and hence enriching their career prospects.

120 The professional engineering institutions generally operate professional development schemes that require the equivalent of a personal development plan. By linking your staff development to such a scheme, both your staff and your CMS can gain increased recognition.

Training and development programme

121 A structured training and development programme in your organisation could help you to identify appropriate actions for an individual’s personal competence development plan. Such a programme is unlikely to comprise a fixed set of training actions for all members of staff: it is more likely to be a source of training and development activities, from which the appropriate mix of actions can be selected to suit the needs of each individual. However, you may also find it useful to provide some common training for all members of your staff, or for all members of certain teams.

122 Development through practical experience – perhaps supervised – is important if a person is to move from the completion of a training course to attain the level of competence required to carry out the activity reliably. This is the case whether the task is manual or cerebral – an operator or a systems designer. Moreover, actual work done usually provides the most persuasive evidence that the relevant competence has been achieved (see Principle 5). Supervisors will need, of course, to be competent to supervise effectively and to make judgements on the performance of any individual that they supervise.

123 In some fields, for example systems design, the opportunity for appropriate assignments and on-the-job training may not be consistently available, so the individual or his manager will need to discuss his or her development needs frequently with appropriate personnel, such as project managers, to ensure a wide and up to date range of options. An alternative, when opportunities for appropriate development within your own organization are rare, might be to obtain the necessary competence through a secondment, perhaps to a client or a supplier. If there are problems of competition this could be in a different sector (in which case you will need to redress the difference in context on the return to your own organisation). You might consider setting up ‘job swap’ schemes with other organisations that have similar needs.

124 Refresher training is especially useful to help maintain the competence required for the many activities and events that occur infrequently. It also provides an opportunity to repet key messages.

125 Some staff may benefit from a mentor with whom they can discuss problems in confidence. Indeed, this is expected in some professional development schemes.
**P6.4**

**Updating the personal competence development plan**

126 You might find it convenient to schedule updates at completion of any assignment and following any assessment or reassessment of competence.

**Changing circumstances**

127 Additional training and development are likely to be required as part of the introduction of new processes, new hardware, new business rules, etc. (see Principle 13).
**Principle 7: Assign responsibilities**

**OBJECTIVE**

To ensure that staff and suppliers undertake only work for which they have been assessed as competent.

**SUPPLEMENTARY MATERIAL**

**Staff awareness**

128 Part of the purpose of making individuals aware of the importance of competence is to actively discourage them from working on their own initiative on activities (within the scope of the CMS) for which they have not been assessed as competent.

**Assignment of competent staff**

129 In some circumstances, to simplify the matching of the competent individual to the task, you might issue certificates to your staff, along with some means of identification.

**Empowering staff**

130 The individual concerned may be best placed to judge whether or not a particular activity is suited to his competence, in which case you will need to encourage the individual to make that judgement and respect it when made.

131 Staff need to be empowered to refuse to carry out activities for which they have not been assessed as competent because they may still be asked to carry them out. This could be because of a mistake, because no one else is available, because there is no supervisor available, or because of an emergency.

**Teams**

132 Where competence requirements are determined for a team as a whole, there may be more flexibility in individual competence requirements. For example individuals may be able to participate in activities even though they lack particular areas of competence, because this is compensated for by the strengths of other team members. However, it is important to establish where responsibilities and the associated competence actually reside (for example, who is supervising whom).

133 For competence to apply at a team level, the team will need to work together as a genuine whole rather than just a sum of individuals, and each member will require competence specifically related to team-working. For example, behaviourial competence is likely to be relevant, particularly for team leaders, to ensure good relationships within the team, and good communication within and between teams (see Principle 2).
The evolving work environment

134 While Principle 13 is concerned with the major changes that may, for example, lead to changes to competence criteria and to competence reassessment, there are also everyday changes for which it would be unrealistic to expect staff to be reassessed. For instance, a test engineer working in a commissioning team might be expected to work on a series of products that change from week to week, and that are applied in slightly different application contexts. Or a designer may receive an update to a software tool. Such changes would not normally be viewed as a new assignment, but nevertheless they may well expose the staff to contexts that they have not experienced before, requiring slightly different knowledge and ways of working. You may be able to handle these through small-scale adjustments to the individual's responsibilities and supervision arrangements, or on-the-job training, rather than initiating full-scale competence reassessment.
Principle 8: Monitor competence

OBJECTIVE
To monitor whether or not staff assessed as competent are continuing to perform competently and to initiate corrective action where appropriate.

SUPPLEMENTARY MATERIAL

135 Even when staff possess the appropriate competence for the tasks to which they have been assigned, in accordance with Principle 7, most activities, including adherence to management systems, are susceptible to occasional non-compliance. This is usually not malicious, but due to human fallibility or inherent faults in the CMS.

Mechanisms for monitoring competence

136 Reporting of concerns about performance, whether of oneself or of colleagues, is valuable but has associated risks. These include causing hurt to individuals, morale problems in teams and, in the worst cases, accusations of constructive dismissal and the seeding of industrial disputes. The way in which staff and managers respond to such reports can reduce or increase these risks.

137 You can help to reduce risks associated with reporting by:
- encouraging ethical behaviour of individual members of staff (such as taking personal responsibility);
- encouraging colleagues’ mutual respect;
- encouraging a ‘no blame’ culture in which staff are motivated to divulge their concerns – whether about themselves, their colleagues, their management, or the overall safety culture of your organisation;
- establishing procedures for handling reports, agreed with the staff, that ensure confidentiality and ethically sound responses.

Gathering evidence of competence

138 Gathering evidence of their own competence as they perform their assignments will help staff in their scheduled competence assessments, and it will help them to respond to any questions about their competence that may arise in the course of their work.

139 You can help your staff to collect evidence by providing support within your information management system (see Principle 12). Apart from records of competence assessment, you could provide record-keeping support for many forms of evidence, including some of those suggested in Principle 5:
- assignment and/or project records
- records of workplace observation
- competence tests
- witness testimony
Principle 9: Deal with failure to perform competently

OBJECTIVE
To respond to any failures to perform competently so that the impact on safety is minimised, including initiating actions to restore the competence of individuals.

SUPPLEMENTARY MATERIAL

Reasons for failure to perform competently

140 Poor performance of an individual may not be entirely within their own control. There can be many root causes, and possibly several acting in combination:

Organisational culture
There may be significant differences between the stated policy and priorities of your organisation and how these are perceived in practice by workers, who may be subject to pressures (e.g. to perform quickly) that undermine your stated objectives. Also, perversely, a good safety record can lead to complacency.

Team relationships
Poor team working can compromise individual performance. Poor inter-personal relationships at work can also generally lower morale and impair the local safety culture.

Other circumstances that affect the work environment
Even where these factors are outside your control it is helpful to recognise their effects (eg reducing concentration or morale).

Personal situation
It is up to the individual to decide how much personal information they wish to divulge.

Failure of the CMS
A failure of the CMS could lead to staff carrying out activities for which they should not be expected to possess the necessary competence. There may be omissions or deficiencies in previous assessments (Principle 5). The standards themselves (Principle 2) may be unclear. The assignment process (Principle 7) may mismatch the job to the person or it may fail to recognise the need for supervision. Analysis will reveal whether the problem lies with the processes or the people or both.

141 In principle, many cases of inappropriate performance could be blamed on failure of the CMS. Attitudes to ‘cutting corners’ should have been recognised in assessment against required behavioural competence criteria, as should poor leadership and communication skills. Appropriate strategies for coping with stressful factors, should have been built into training and development; lack of confidence or experience, such as a first experience of a ‘real’ infrequent event by a newly qualified member of staff, should have been addressed by supervision.

142 However, many of these may be temporary lapses that the CMS could not reasonably be expected to detect through the regular assessment processes. Only if there is concern that there has been a long-lasting deterioration in competence should reassessment of the individual be necessary.
Corrective action

143 Possible remedies include:

- clarifying your organisation’s attitude to safety, so as not to send ‘mixed messages’ to either staff or suppliers that can lead to them ‘cutting corners’ or taking unnecessary risks,
- directed toolbox talks or workshops,
- team restructuring,
- defining and/or communicating required standards,
- offering support in terms of new or updated equipment,
- alleviating unhelpful pressure,
- counselling,
- addressing an individual’s competence failures through additional training and development.

144 If substandard performance has resulted from personal reasons, which reveal themselves in poor morale or general lack of commitment, an interview with a line manager, personnel manager, counsellor or doctor may be required to identify the underlying causes and help the person to find a way to resolve the problem.

145 Organisational factors causing distraction or stress might be addressed by changes in procedures, but may, like external factors, require additional personal development in order to cope better, and changes to working arrangements to reduce exposure to the problematic factors.

146 Team problems are particularly difficult to address. Both individual and group counselling may be brought to bear, but in the extreme case, it may be necessary to remove members from the team and reassign them elsewhere, or even disband the team altogether and form a new team.

Adjust the monitoring of the individual or team

147 Where a programme to restore competence has been put in place, monitoring of the individual or team may need to be increased for a while. Planned assessments may need to be more frequent, with informal monitoring (e.g. day-to-day observation by a supervisor), remote monitoring (e.g. using recordings of activities), and unannounced checks.

Removing the individual from the type of activity

148 An individual may need to be removed immediately from the type of activity to which they were assigned. In the case of an operator this might be requested by the controller of site safety; in the case of a commissioning engineer, by the trials manager. The decision to remove someone will depend on the context (such as team working or personal problems) and the level of seriousness. Any removal is likely to be short term, pending analysis of underlying causes and identification of remedial action.

149 However, after analysis of causes, it may not be possible to identify appropriate remedial action, or it may prove to be ineffective. In this case, it may be necessary to redeploy the individual or even, as a last resort, terminate employment. This will involve HR processes outside the scope of the CMS.

FURTHER INFORMATION

150 Further guidance on management of non-compliance is provided by ISO 9001:2000 Quality management systems – Requirements [Ref 4].
Principle 10: Manage assessors’ and managers’ competence

OBJECTIVE
To ensure that senior managers, managers of the CMS and assessors are competent to support and fulfil the requirements of the CMS.

SUPPLEMENTARY MATERIAL

151 Often there is no sharp dividing line between managers and non-managers. In a professional engineering organisation, for instance, many senior staff will be performing a combination of managerial and technical roles. But in most organisations there will be managers, from directors down, who, while having no direct involvement in functional safety engineering, do make a substantial difference through the policies they set and the way they discharge their own responsibilities. These managers have a large effect on determining your organisation’s safety culture [Ref 9, 10 and 11]. Seemingly secondary issues such as housekeeping, relocation and investment priorities can have far-reaching effects. The importance of safety management leadership from the company’s own senior managers should not be underestimated.

FURTHER INFORMATION

152 There is a growing body of literature on the importance of safety culture, and on ways to measure and manage it. Reference 9 contains a review of some of this literature.
Principle 11: Manage supplier competence

**OBJECTIVE**

To ensure that all relevant work activities of suppliers are always performed by competent staff.

**SUPPLEMENTARY MATERIAL**

*Responsibilities*

153 Suppliers include subcontractors, out-sourced service providers, component and equipment suppliers, contract and agency staff, and freelance personnel. Irrespective of the human resources you use – whether your own staff or suppliers such as these – your organisation is responsible for safety within the scope of your assigned activities.

154 In addition to the obvious competence required by suppliers’ staff working directly for you, you need to consider as well the importance of competence requirements for support functions that your suppliers in turn rely on, such as the procurement, management and maintenance of their own infrastructure, for example their management systems, computer systems, databases and design tools.

*Assessing supplier competence management*

155 You might be able to gain some confidence through schemes such as industry sector registers of qualified suppliers, third party certification (see paragraph 5.3 of Principle 5), and more informally, from the track record and reputation of the supplier.

*Division of responsibility*

156 The third option suggested in paragraph 11.1 of Principle 11 - that of delegating some competence management activities to the contractor or supplier, might be appropriate when, for example, you employ a specialist service provider. In this case the supplier could manage the competence of their employees with respect to their specialism – particularly recruitment, assessment and development – while you manage change (for example to ensure that the specialism is still appropriate), audit and review. You might have separate competence criteria and assessment processes, but work together on the assignment of responsibilities.

*Formalising the relationship*

157 To pre-empt problems, consider incorporating into your contracts with suppliers a definition of who will be responsible for managing competence and, unless you choose the first option above, a right to verify the operation of the suppliers’ system and the way in which that would be done. These aspects can then be reviewed, as part of your normal contract monitoring process, to take account of experience and changing circumstances.

158 Contracts cannot be used as a means of shifting responsibility without considering whether the organisation concerned genuinely accepts this responsibility, is capable of discharging it and in fact doing so. Even if you place all responsibility on the supplier, Principle 11 still requires you to determine for yourself that their competence management system is effective.
Principle 12: Manage information

OBJECTIVE

To maintain accurate information from the operation of the CMS, in sufficient detail to enable efficient operation and to demonstrate that its requirements are being met.

SUPPLEMENTARY MATERIAL

159 The relevant parties to whom you may wish to demonstrate satisfactory operation of the CMS include customers, regulators, incident investigators, and of course yourselves – not just for audit but for your own peace of mind. In addition, though, such information may be useful for publicity, and for proposals for new work.

Keeping records

160 The information that may be kept and managed includes:

- records defining the CMS itself: the competence criteria, procedures, and so on
- records of the competence criteria satisfied by personnel as a result of competence assessments, and supporting evidence, including evidence gathered since the most recent assessment
- records of the personal development plans
- records that enable tracking of the execution of the CMS processes (in effect work flow information) – both the history and the current status
- records from monitoring the effectiveness of the operation of the CMS – particularly information arising from audit (Principle 14) and review (Principle 15).

161 To be more specific, records may include:

- Records of competence
  - each activity that the person has been assessed as competent to carry out;
  - the standard achieved;
  - names of assessors; and
  - the expiry date of the validity of the assessment (which may be reflected in the expiry date of a certificate or licence of competence).

- Records of assessment
  - the assessment report, made at the time of the assessment;
  - the competence criteria met;
  - the context of the assessment (see Principle 5 and Appendix 1);
  - a record of any certificate or licence issued;
  - name of assessors;
  - assessment locations and events;
  - assessment methods;
  - mismatch between present competence and requirements for work that your organisation is undertaking, and actions taken to develop competence;
  - records of training and development, and any further planned; and
  - date for the next assessment.

162 You can also facilitate assessment by keeping records of work done and training, and making them accessible to yourselves and (under appropriate controls) to the individual. This will help staff to provide evidence that they have the necessary capabilities and experience. (See also Appendix 2.)
A personal log book (used as a record of competencies and activities carried out) can assist in the assessment of some staff. This may be required in some assessment schemes (e.g., the Institution of Railway Signal Engineers uses a licensing log book). Access to such records may also be necessary when following up events.

In addition, you could keep records of other information pertaining to the competence of staff, such as details of any accidents, incidents, and indications of poor performance.

**Identification for the employee**

In some industries, the law (for instance, in the railway sector, the Railways (Safety Critical Work) Regulations 1994) or local operating standards and procedures may require particular classes of employees to carry a means of identification to ensure that only appropriately competent and authorised staff may have access to work areas, information, or equipment. In some cases a document in the form of a certificate or licence may be issued. The generation and safekeeping of such means of identification (by both the organisation and the employee) and the maintenance of its validity will normally be considered to be part of the CMS.

**Using information**

One of the main benefits of operating a CMS is the availability of detailed information. Also, information management is not just record-keeping—it includes analysis of the information and review of the analyses. This can make for more effective management decisions.

CMS information and its analysis can help the organisation to:
- assemble teams so that the tasks involving more than one person can be discharged competently;
- ensure personnel have the appropriate level of supervision to undertake their assigned roles;
- help personnel to plan their competence development;
- identify trends in both the need for different kinds of competence and the extent of your organisation’s corporate capability to satisfy this need;
- identify areas of weakness, and thereby
  - inform the recruitment strategy of the organisation;
  - inform the career development strategy of the organisation;
- identify trends, including deviations from planned performance
- develop measures of the effectiveness of operation of the CMS.

**Version control**

If you already have configuration management procedures for other information in your organisation, you might consider using those same—or similar—procedures for your CMS so that your staff (and perhaps customers, suppliers or third parties) will use the most recent information and so that different versions cannot be muddled.

In doing this, you should include consideration of how to maintain version control over the definition of the design and operation of the CMS itself.

**Keeping information for a sufficient length of time**

The length of time to retain records can be difficult to determine. If you wish to monitor changes and trends—including, for instance, the development path of staff—then you will probably find it useful to maintain information for longer than you would for just the current status. You could consider, for example, keeping records of competence and assessment for twice the normal period between assessments.
171 However, since incidents might raise questions about work done many years before the occurrence of the incident, it may be advisable to make provision for even longer-term storage.

172 In many industries personal log books are maintained by staff. These may need to be collected from departing staff and archived securely, in case they are needed for incident analysis.

**Accessibility**

173 Records associated with particular staff are personal and confidential. Those authorised to have access to staff records will therefore typically be limited to those managing the competence management system, and the line manager and personnel manager for each individual. However, HSE inspectors (by virtue of Section 20 of the Health and Safety at Work Act 1974) will also have the right of access to competence records of relevant staff. In addition, you may need to provide access to any organisation to whom you may have a responsibility, in the same way that you may require access to the information of your suppliers.

174 Appropriate limits for the time between a request for information and the information being provided may depend on the information required, for example whether it is basic competence records or records of assessment, aptitude or significant events.

175 When a member of staff moves from one part of an organisation to another part of the same organisation (i.e. changes jobs) or is recruited by another organisation (i.e. changes employers), the recruiters will need to assure themselves that the recruit is suitable and competent to carry out their activities (see Principle 4). Typically they will undertake some form of assessment. Checking past records of competence, assessments and significant events will facilitate this process. You can also help staff by keeping records when they have left, so as to be able to confirm claims of competence when they are required to provide evidence of past competence for future employers.

**Secure storage**

176 Records may be held on a computer or be paper based. If the CMS information is held on a database, obtaining rapid and accurate management information and analysing it is likely to be easier and much more efficient, though maintaining its integrity and security requires specialist expertise.

177 However the information is held, your storage and access mechanisms should ensure confidentiality and maintain the integrity of the information in the face of potential interference with the information, whether accidental or malicious. You should be able to verify that the information that you hold is genuine. You could maintain multiple copies of information, perhaps on separate sites, for resilience to fire, flood, or other physical damage, and resilience against computer breakdown.

178 Note that the requirements of the Data Protection Act will almost certainly apply to the information you hold on the competence of individuals.

**FURTHER INFORMATION**

179 ‘Survive’ is the leading forum for information exchange on business continuity management.

180 ISO 9001:2000 contains guidance on data storage and on measurement and monitoring [Ref 4].
Principle 13: Manage change

OBJECTIVE
To monitor changes in the external environment and the internal operation of the organisation, to determine implications for the CMS and to initiate changes to the CMS as appropriate.

SUPPLEMENTARY MATERIAL

Internal sources of change

181 Large scale changes in organisational structure arising from internal restructuring or from mergers, takeovers, sell-offs or outsourcing can trigger many internal changes that affect competence requirements and their management, as well as the roles and responsibilities of staff.

182 Changes in structure, in personnel, and in contractual relationships can have an impact on organisational culture. One way to discover this is to monitor morale – however indirectly – since, while an individual may possess appropriate behavioural competence (see Principle 2), morale has a significant affect on the exercise of such competence, i.e. on actual behaviour.

183 Changes in techniques, tools – especially software tools – and equipment may require different structures of individual responsibilities as well as appropriate competence criteria and assessment processes. For example, the integration of automatic circuit layout and automatic manufacture, while removing human error in the translation between stages, can also remove the verification stage based on visual inspection of the layout. Another example is the introduction of smart transmitters in process control, which would require new understanding of their failure modes, as well as of the benefits they offer in functionality.

Novelty

184 When new technologies or techniques are introduced, there will be new risks. Some risks will come from a lack of understanding of how to use the technologies or techniques – not only in your organisation, but perhaps in the community at large. Some risks will come from new failure modes of the technologies, of products based on the technologies, or of the new engineering processes that they entail. For example, when two stages of design automation are integrated into one, you can lose the ability to perform verification after the first stage, with errors being undetectable until later – with possibly hazardous or expensive consequences.

185 Even when an existing technology or technique is applied in new sectors or new application areas, there will be new risks associated with the technology or technique – not only from staff’s lack of familiarity, but also from the possibility of unforeseen differences between application areas. For example, in software engineering techniques used in relatively stable and well-understood domains have failed when applied in development of completely new applications.

186 While you should already have considered how to reduce the risks associated with lack of competence when new technologies or techniques are introduced (see paragraph 1.3 of Principle 1), you may still need to express the competence criteria differently to deal with the unknowns. For example, the criteria could include that staff are aware of the risks posed by novel methods and how to manage such risks. This may require additional care when you come to interpret the criteria during assessment.
**External sources of change**

**187** Apart from explicit changes, such as those listed in this Principle, you can learn lessons from incident analyses (not necessarily of incidents involving your organisation) with implications for competence criteria and for the operation of competence management systems.

**Responding to change**

**188** An exploratory – even informal - impact analysis can help to indicate the appropriate scale of response to changes. For instance, an impact analysis can determine whether the your organisation’s current allocation of staff is still appropriate, from the perspective of both whether staff still have, on paper, appropriate competence for their assigned tasks, and whether, even if that is the case, reassessment is required. This latter circumstance may, for instance, arise from realisation, as part of an incident analysis, of weaknesses in the operation of then CMS, rather than in the competence criteria themselves. Impact analysis can also indicate whether immediate refreshment training and development is required or whether updating can be achieved gradually.

**189** If competence criteria are to be altered as a consequence of change, then you may need to update details of the assessment process (Principle 5) to match. If you operate a continuing professional development scheme, its content may also need updating.

**Communicate**

**190** You can use a variety of methods to keep staff up to date, including safety briefings, toolbox talks, on-the-job instruction and training, feedback from emergencies, and possibly attendance on courses or lectures.

**191** If the changes and their impacts are extensive, then you could plan briefings to inform staff, to convey the importance of the changes, and to gain feedback from staff. The following subjects might be included in such meetings:

- new and revised standards and legislation;
- lessons learned from accidents, incidents, statistical trends and management information systems;
- new and revised contractual arrangements;
- new technology and revised techniques;
- temporary procedures to deal with abnormal situations;
- modified competence criteria; and
- modifications to the processes of the competence management system.

**192** Depending on your industrial and organisational circumstances, you may need to inform not only staff, but customers, external assessors and regulators, of any changes in operation of the CMS.
PHASE FIVE: Audit and review

Principle 14: Audit

OBJECTIVE

To audit the CMS with sufficient frequency to give confidence that it is meeting its objectives and operating as intended, and to initiate improvement action where appropriate.

SUPPLEMENTARY MATERIAL

193 An audit might range from an annual check of the operation of whole of the CMS, to more frequent checks on particular elements of the CMS – on the allocation and monitoring processes, for example – to determine whether staff do indeed have appropriate competence for the tasks they are undertaking, and that they are applying their competence effectively.

194 The scope, nature, level of independence, extent and frequency of audit will vary depending on the risks controlled by the competence management system, the likely failure of such controls, and the results of previous audits. The frequency of audit may be increased temporarily if there are a number of changes being made to the system or where performance indicators show deterioration. The frequency may be reduced later, as the system improves and becomes more stable.

195 Typically, audits will be performed as part of a methodical programme that gradually sample-checks all the processes of the CMS to check the overall effectiveness and efficiency of the system. However, you may choose to focus an audit on specific features of the CMS where you have concerns, and you might also undertake random spot-checks.

196 The objectives of an audit programme can be structured to match the principles of this guidance, for example, to check that:

- all appropriate work activities are included within the scope of the CMS
- competence criteria are appropriate and sufficient for each role
- the CMS procedures are efficient and effective
- assessment methods are judging competence correctly and comprehensively
- personal development plans are realistic, implemented and successful in achieving the required competence
- staff assignment is consistently in line with competence requirements; this could include checks on the up-to-date competence of those managing and operating the system and those managing CMS information.
- monitoring is effective
- lessons from failures are learnt and implemented well
- supplier competence is managed satisfactorily
- recorded information is sufficient and fit for purpose and/or pertinent changes are detected and accommodated sufficiently quickly.

Independence

197 With higher risk activities it may be appropriate to supplement your internal checking with an independent assessment of the design and operation of your CMS. This can often be done by using auditors from another part of your own organisation. However, for really high-risk activities it may be more appropriate to seek external verification. You might consider, for example,
• establishing a mutual verification arrangement with trusted peer organisations operating in the same or a similar sector, so that independence can be achieved without compromising confidentiality, or

• submitting to audit or assessment by one of the awarding bodies for the nationally recognised standards.

Harmonising with other management audits

198 You may have existing arrangements for audit for other management systems that you operate. Most companies, for instance, will have a quality management system, perhaps meeting the requirements of an international standard such as ISO 9001. Some companies might also have a safety management system. All such systems typically have a requirement for audits or their equivalent. As a CMS is conceptually no different from other management systems, it is logical and efficient to have a single integrated audit process where feasible.

199 If your CMS is subject to external audit (e.g. by customers) then you could consider whether it is also possible to combine some aspects of your internal audit with that external audit.

FURTHER INFORMATION

200 Some standards already exist for the performance of audits. The British Standard, Guidelines for auditing quality systems, [Refs. 12 and 13] includes general guidance on various aspects of the performance of audits, including the audit process itself, as well as qualification criteria for auditors and the management of audit programmes.

201 Guidance on internal audits is provided in ISO 9001:2000 Quality management systems – Requirements [Ref 4]. Note that audits as expected in the ISO9000:2000 series focus not on compliance with your ‘planned arrangements’ but rather on your own business requirements, on your customers’ expectations, and on continual improvement.
Principle 15: Review

OBJECTIVE

To review identified changes and the combined evidence on the operation of the CMS generated from dealing with competence failures and from audits, and to initiate improvements to the CMS as appropriate.

SUPPLEMENTARY MATERIAL

Inputs to the review

202 Inputs to the management review might include data on:

- assessments of competence;
- management of subcontractors;
- management of non-compliance;
- management of change;
- safety performance data;
- resourcing requirements (and any resourcing problems);
- analysis of management information;
- CMS audits, especially recommendations for change of the CMS.

203 Analysis of the safety performance data for your organisation can play an important part in the review. One way to do this is to establish a range of key performance indicators that can be traced back to the influence of staff competence.

204 Ideally, there will be little real incident data available, but you could instead monitor and review measures of precursors to incidents such as non-critical mistakes and errors in, for instance, safety systems design, that are picked up by systems tests later in the development process. A root cause analysis of accidents, incidents and precursors may indicate inadequate levels of competence and therefore weaknesses in the CMS.

205 You can also attempt to identify sources of industry-wide data to compare to your own organisation’s performance. Accident, injury and incident (including near miss) reports made available by other organisations provide a valuable benchmark to assess your own organisation against. You might even consider establishing benchmarking arrangements across departments within your own organisation, or with other peer-organisations.

206 Available data will vary across industry, but may include: health and safety incidents; staff turnover; the number of staff identified as working below standard or requiring a development programme; and feedback during assessment.
Outputs from the review

207 Outputs from the management review might include changes to the:

- scope of the CMS;
- optimisation of organisational roles;
- standards of competence;
- CMS process;
- staff requirements;
- allocation of responsibilities;
- development of competence; and
- arrangements with subcontractors.

208 You may also need to make changes to current safety cases.

209 Communication of the results of the review can follow the approaches indicated in Principle 13 for communicating the consequences of change.

Continuous improvement

210 Most organisations recognise the importance of process improvement if they want to remain competitive. Continuous improvement of the CMS similarly presents business opportunities for the organisation.

211 Actions arising from a management review can be viewed as reactive or proactive. Reactive actions tend to arise from issues of non-compliance, for example, as discovered during verification. But addressing issues only in a reactive way can overlook opportunities to continuously improve the contribution of personnel and hence the competitiveness of the organisation and the career prospects and general well-being of staff.

Implementation

212 The managers involved in operating the competence management system should implement the agreed recommendations for changes to the CMS resulting from the review. The introduction of changes should be monitored, and amendments agreed as required, to ensure recommendations are implemented appropriately and within acceptable timescales. It is important to ensure effective communication at all levels of those managing the competence management system and also among the personnel within the scope of the CMS whose competence is assessed, so that changes are fully understood. The development of such changes of course leads to amendments to Principle 1 and Principle 2 and then throughout the system.

Efficiency

213 As with audits (Principle 14) it is logical and efficient for management reviews of the CMS to be consistent and, where desirable, integrated with existing arrangements for management reviews of other management systems in your organisation, such as those required for a quality management system under ISO 9001.

FURTHER INFORMATION

214 Guidance on continuous improvement of ‘capability maturity’ is provided by the Carnegie Mellon Software Engineering Institute [Ref 2].

215 Guidance on continual improvement is also provided in ISO 9001:2000 Quality management systems – Requirements [Ref 4].

216 Sources of benchmarking data include, for instance, HMRI’s Statistics and Annual report and London Underground’s Safety performance reports.
Appendix 1 – Example competence model

A1.1 This example model is from Safety-related system competence criteria [Ref 3]. It builds on the competence model described in paragraphs 31 to 38 of Managing competence for safety-related systems [Ref. 1].

A1.2 See Figure 2 for an illustration of the concepts and process.

Essentials

A1.3 Members of staff, working either individually or in teams, fulfil some well-understood function – such as ‘safety-related system or services procurement’, ‘safety hazard and risk analysis’, or ‘safety-related system software realisation’.

A1.4 Each function is broken down into a set of tasks, each of which require particular technical skills and knowledge. Example tasks for the function ‘safety-related system software realisation’ are ‘transposing from requirements into design’, ‘coding’ and ‘specifying software tests’.

A1.5 All the tasks in a function also require behavioural skills and underpinning knowledge and understanding, which are expressed as a set of attributes. Example attributes for the software realisation function are ‘application domain knowledge’, ‘team-working’ and ‘openness’.

A1.6 Each task and each attribute has its own set of competence criteria.

A1.7 Each competence criterion can be satisfied at one of three competence levels which are termed: supervised practitioner, practitioner and expert.

A1.8 The competence criteria for the task ‘coding’, for example, can be presented in a table as follows.

<table>
<thead>
<tr>
<th>Safety-related system software realisation – Task 4: Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translates the specified software functional and design requirements into easily understood, analysable source code through the correct use of an appropriate programming language. Pays due heed to the requirements of a relevant coding standard (with particular regard to the safety implications of different constructs and the environment in which the code is to operate).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supervised practitioner</th>
<th>Practitioner</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has coded individual modules using the relevant programming language(s) in accordance with the organisation’s programming style and commenting strategy.</td>
<td>Has coded complete software sub-systems for typical safety-related systems, using a safe sub-set of the relevant programming language in accordance with a defined coding standard.</td>
<td>Is abreast of the latest developments in software engineering research, particularly with regard to unsafe constructs and the circumstances in which they should be avoided, and maintains latest understanding in an organisational coding standard.</td>
</tr>
</tbody>
</table>

A1.9 A function might be fulfilled by an individual, working alone, or by a team. When working in a team, each individual contributes to the team’s performance of the function by performing a role within the team, carrying out part of the function. (If the entire function is fulfilled by an individual working alone, then they do still perform a role, but it is equivalent to carrying out the whole function.)
Specifying and assessing competence

A1.10 A person's role is specified in terms of the different tasks that they must be able to undertake and the attributes that they must have. For each of these, an appropriate competence level is specified. This gives a minimum competence profile for the role, with differing levels of expertise required for the different tasks and attributes. An example competence profile might be presented as follows, where a shaded box denotes the attainment of a particular level for the task or attribute (although more detailed supporting documentation will also be necessary).

<table>
<thead>
<tr>
<th>Level</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td></td>
<td></td>
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<tr>
<td>Practitioner</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Supervised practitioner</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

A1.11 To determine if an individual is competent to perform a role, the individual's competence is assessed and the resultant competence profile is compared against the competence profiles specified for the role. (Note that the assessment would not normally be limited to the tasks and attributes of any specific role.)

A1.12 An individual is deemed competent for the role if their competence profile at least meets the competence profile specified for the role.

A1.13 A team is deemed competent if each individual in the team is deemed competent for their roles.

A1.14 In practice, the competence of staff will often be assessed so as to find out their competence profile independently of any assigned roles. Their competence profile will then be taken into account when putting teams together. This is especially the case when recruiting new staff.
Managing competence for safety-related systems
Part 2: Supplementary material

Figure 2: Example competence model

1. Members of staff, working either individually or in teams, carry out a defined function.
2. A function can be broken down into a set of tasks and attributes.
3. Technical skills and knowledge necessary for a function are defined in a set of tasks.
4. Behavioural skills and underpinning knowledge necessary for a function are defined in a set of attributes.
5. Every task and attribute has competence criteria specified for 3 levels: Expert, Practitioner, Supervised practitioner.
6. Specification of competence
   - The competence required for a function is specified as a set of tasks and attributes, each with an appropriate competence level. This leads to a competence profile for all the tasks and attributes comprising the function.
7. If the results of the assessment for the person, for every task and attribute of the function, meet the specified competence profile for the role, then the person is deemed to be competent for that role.
8. For the team to be competent, all those in the team have to be competent for their individual roles in carrying out part of the function.

Expert
Practitioner
Supervised practitioner

Competence profile for the function

A person, working as an individual, is considered competent to carry out the function if they meet the competence criteria for each task and attribute at the required level. For team working, the person must be competent to carry out the tasks and attributes for their role in the team.
**Context**

A1.15 By separating the core principles of competence criteria from their context, a limited set of common competence criteria can be applied universally in many industry sectors, applications, technologies, and regulatory environments.

A1.16 For example, the competence criteria for the task ‘hardware test specification’ might contain many alternatives for all the different

- types of hardware that may require test specification – smart transmitter, PLC, bespoke logic,
- facets of a test specification – functionality, test coverage requirements, environmental conditions,
- application domains, with their particular operating environments and regulatory requirements – offshore oil-rig, school-crossing traffic lights,
- levels of responsibility that an individual might take – a new and junior member of a team, a senior staff member with full accountability,
- levels of expertise required in different circumstances.

A1.17 The immediate consequence of this approach would be that most organisations and even projects would have their own very specific competence criteria matched to their own context at a particular point in time. An assessment of competence in one context would be quite unusable in another. For example, if an individual had been assessed as competent to design flight control systems, then no benefit could be derived from the assessment when considering them for designing the control system for aircraft landing-gear. The two roles are different, and competence in one domain does not imply competence in the other. However, some competence in one domain will transfer to the other.

A1.18 The recommended alternative is to separate, in the definition of tasks and attributes, generic principles from the context of their application.

A1.19 This approach requires that in an assessment of an individual’s competence the assessor

- interprets the competence criteria in the particular context of the individual’s current work, and
- captures that context (sector, application area, technology, etc.) for which the individual has demonstrated that they have satisfied the competence criteria.
Appendix 2  Guidance for the individual

A2.1  Managing competence for safety-related systems [Ref 1] and this supplementary material are written for those responsible for managing competence in an organisation. However, the application of this guidance will have an impact on you, the individual employee. It clarifies the expectations on you and it will help your career development.

A2.2  The rationale for these publications is that although your organisation might attempt to ensure the quality of your work by checks, supervision, inspections, testing, and so on, these techniques can only sample a fraction of your organisation’s activities. Safe performance depends primarily on the competent performance of the individual – on your competence and that of your colleagues. This is being recognised in many sectors and, as a consequence, requirements for staff to be competent are being incorporated in industrial standards and in legislation.

A2.3  You can help both yourself and your organisation by understanding and preparing for this increased focus on your competence, in particular by

- finding out what is expected of you
- making assessment easier
- identifying your own career development needs.

Find out what is expected

A2.4  Find out the requirements for competence for the type of work that you do. This should have been explained in your induction or training, but if your organisation does not yet have a fully operating competence management system then new requirements may have been introduced without your having been made aware. Or you may have been promoted or otherwise taken on more responsibility.

A2.5  If your trade organisation or professional institution has a code of conduct, get hold of a copy and read it. Often this requires you to be competent and to refuse to do work for which you are not competent.

A2.6  Find out if there are specific competence criteria defined for people in your type of work.

Make assessment easier

A2.7  Most competence assessments review historical evidence, accumulated either by you or your organisation during your training and your work. This should show your experience, your capabilities and the results of any tests you have taken. The evidence is assessed against the competence criteria for your present or prospective work.

A2.8  Your employer may help you by maintaining records in a corporate information system, but you can help yourself by maintaining your own record, in a log-book for example, of your work and training, with an indication of what evidence exists to substantiate this and where that evidence is held.

A2.9  You can even facilitate assessment by undertaking a self-assessment of your own evidence against the relevant competence criteria, in advance of the formal assessment.
Identify your own career development needs

A2.10 Consider where you want to go in your present job and in your career more generally. Find out what the competence requirements and competence criteria are for the kinds of roles that you would like to take on. Consider what training you will need and how you might get the necessary experience. You will then be well-prepared when you come to plan your personal development – whether this happens after an assessment of your competence, or after a routine staff appraisal, or when considering switching jobs (whether within your present organisation or in a move to another).

Gain the credit and get the benefits

A2.11 One of the benefits of a competence management system is that you get formal recognition of the competence you possess. As well as certificates and licenses, your organisation will have records of your competence, its development and the associated workplace evidence.

A2.12 Moreover, the results of a competence assessment using accepted modular competence criteria is portable across industrial sectors, making it much easier for you to transfer to another sector in future.

A2.13 Because of their confidentiality, it is unlikely that you will be able to show detailed work to another employer in order to demonstrate your competence. Normally, even log-books are held by your employer when you move to another organisation because, apart from confidentiality requirements, the organisation may have to retrospectively provide evidence that their work was performed by competent staff. You may therefore find it helpful to retain a duplicate record of just your competence evidence, appropriately censored to exclude confidential information, so that you can demonstrate this competence in future. (Principle 12 encourages your employer to clarify arrangements for confirming the validity of any claims to competence that you make in future employment.)
References

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