# COMPETENCE FOR SAFETY-RELATED SYSTEMS PRACTITIONERS

by Carl Sandom and Andrew Cooney

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## Safety and Competence

Safety assurance is ultimately based upon the competence of the people involved in the safety process and individual competence is a vital requirement for assessing the validity of any safety claims. The international safety standard IEC 61508 [1] has normative requirements for demonstrating the competence of those involved in safety-related systems activities across all safety lifecycle phases. IEC 61508 Annex B provides guidance on what should be considered when assessing a person as competent to perform a safety-related role; however, the guidance lacks detail on how the requirements can be satisfied in practice.

Competence is an important issue for those involved in hazardous systems, not just for the system developers, operators and maintainers but also for those providing safety assurance based upon expert opinion and judgement. Despite this, people often use the word 'competence' without really understanding what it means, even when it is vital for safety. While a general definition of competence may be helpful, an examination of its separate elements is necessary to enable us to specify appropriate competence criteria.

Competence generally means the ability to do something successfully or efficiently and many synonyms are used including: capability; ability; proficiency; expertise and skill. The UK Health & Safety Executive (HSE) defines competence as:

> "The ability to undertake responsibilities and perform activities to a recognised standard on a regular basis." [2]

The UK Engineering Council (EC) provides the following definition of competence:

> *"The ability to carry out a task to an effective standard. Its achievement requires the right level of knowledge, understanding and skill, as well as a professional attitude."* [3]

The definition given by the UK Office of Rail Regulation (ORR) is similar:

> *"The ability to undertake responsibilities and to perform activities to a recognised standard on a regular basis. Competence is a combination of practical and thinking skills, experience and knowledge, and may include a willingness to undertake work activities in accordance with agreed standards, rules and procedures."* [4]

An examination of the similarities between the EC, ORR and HSE definitions reveals three common components which are:

1. **Knowledge** which is acquired through training, both formal and on-the-job, and is required to enable people to formulate an accurate plan of action to undertake an activity.
2. **Skills** both physical and mental that experienced people often use subconsciously. Mental skills can be thought of as the abilities brought to bear on the formulation of a plan while physical skills can be thought of as the execution part of a plan of action.
3. **Attributes** associated with personal qualities such as determination, integrity, effective communication etc.

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Competence involves much more than technical training, it includes a person's attitude and behaviour as well as experience and knowledge of the application domain [2]. Competence might be transferable from one work situation to another, but the extent to which this is possible depends very much on the *context* in which apparently similar competence is required. For example, a person considered competent to develop software for an aircraft In-Flight Entertainment system will almost certainly not be considered competent to undertake the development of the Flight Management System (FMS) for that aircraft without the competent person also having the experience and detailed knowledge of FMS functionality, standards and, importantly, how the FMS is used operationally. For a more detailed discussion on competence see [5].

## Competence Management and Criteria

To provide the processes and procedures that will ensure that competence can be successfully acquired and maintained, organisations must implement and operate a formal Competence Management System (CMS). Numerous CMS models are available (see [4] and [6] for two good examples) but generally most models propose an iterative cycle of: planning, design, operation and maintenance (through audit and review). The HSE CMS model [6] is a good example and it is used to develop the processes and procedures required for the operation of the CMS; it is iterative in that system changes or identified deficiencies in the implemented CMS may initiate a further cycle of planning and design to improve the system. This short article does not present a detailed examination of these systems; however, a brief examination of the HSE CMS model shown in Figure 1 is useful to identify where the specific requirements for competence criteria originate and a brief summary is given here.

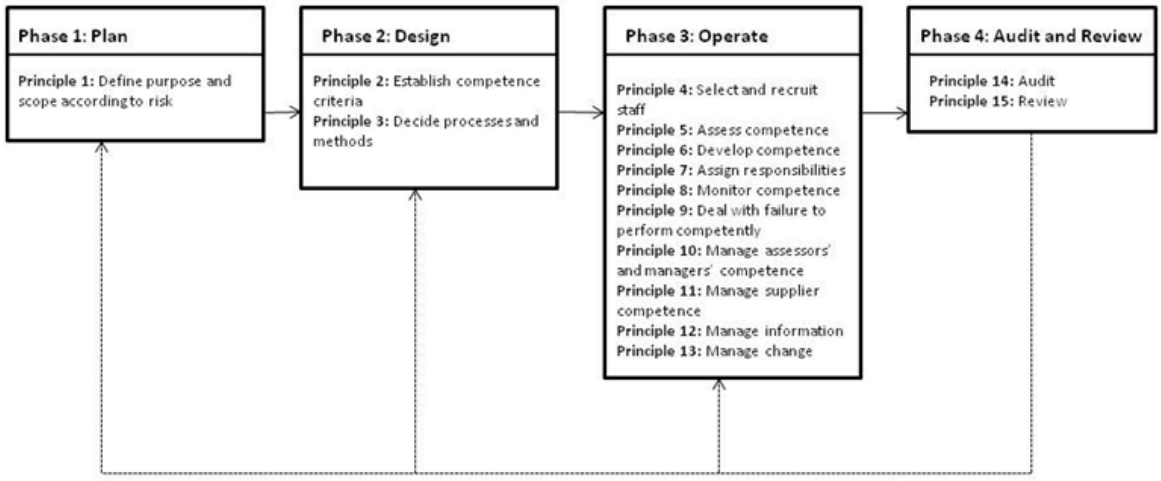


**Figure 1: Competence Management Model (adapted from [6])**

- **Phase 1: Plan**. The planning phase is important to every phase of CMS development as it is used to identify all work activities to be included in the CMS. A key output from the planning phase is the identification of the roles, activities, tasks and attributes for which safety competence is required within a given organisation.

- **Phase 2: Design**. Principle 2 of the design phase requires CMS developers to establish competence criteria that covers all activities within the scope of the CMS and during later phases gives users of the system sufficient confidence that all staff that meet particular criteria are competent to perform the related work activity.

- **Phase 3: Operate**. This phase aims to address all the issues related to the operation of the CMS from staff recruitment to the management of change. All of the underlying principles of the operation phase rely upon the adequate specification and application of competence criteria to the roles, activities, tasks and attributes for which safety-related competence is required within a given organization.

- **Phase 4: Maintain**. This phase aims to verify that the CMS, including the specified competence criteria, is fulfilling the aims and objectives identified and specified in the planning phase. Audits and subsequent review activities may initiate changes to the specified competence criteria which in turn may necessitate some additional management action e.g. recruitment or training.

It can be argued that all four phases and many of the 15 principles of the HSE CMS shown in Figure 1 are equally applicable to any type of management model (e.g. Quality Management, Safety Management etc.); however, some of the principles of the HSE CMS model are explicitly relevant to safety competence management. Principle 2 of the HSE CMS specifies a requirement for the establishment of competence criteria; however, the guidance within the HSE documents purposely does not give detailed guidance on how to specify and assess competence criteria as it is recognised that this task is context dependent.

Clearly, the specification of competence criteria is an important safety management activity and it is unique for different systems and organisations. The requirement to demonstrate safety competence involves the identification of safety-related activities and their associated tasks and attributes each at a specified level of competence for a given organisation; these are referred to collectively as competence criteria and their relationship is shown in Figure 2.

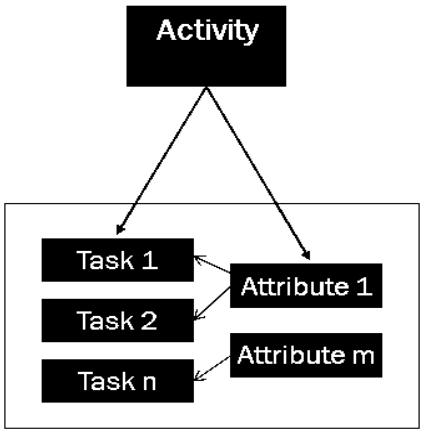


**Figure 2: Competence Criteria**

An *activity* can be carried out by one person or a team of people. A person working in a team performs one or more tasks associated with the activity. Figure 2 shows that each activity is subdivided into a set of *tasks* each of which require particular technical skills and knowledge. All the tasks in an activity also require behavioural skills and underpinning knowledge and understanding which are expressed as a set of *attributes*. Attributes are associated with one or more tasks; for example, a general attribute such a effective communication may be required for multiple tasks. For a more detailed explanation of competence criteria see [7].

Competence criteria for safety-related systems developers are significantly different to those for developers of non-hazardous systems because different technical skills, knowledge and personal attributes are usually required.

The UK HSE published the documents *Managing Safety for Safety-Related Systems* Parts 1 and 2 in 2007 (widely referred to as the Red Book) to describe the core principles for developing a safety-related CMS [2]. The specification of appropriate competence criteria is identified in the HSE Red Book as a critical part of the process for establishing a satisfactory CMS. However, the HSE Red Book does not contain detailed guidance on the specification of competence criteria as this is seen as a context dependent task. The Institute of Engineering and Technology (IET) will in early 2016 publish a new Code of Practice on Competence for Safety-Related Systems Practitioners [8] primarily to provide guidance on the definition and assessment of safety competence criteria; a summary of the document is given here.

## IET Code of Practice

### History

The Institute of Electrical Engineers (the name was changed in 2006 and it will hereinafter be referred to as IET for clarity) published the document *Safety, Competence and Commitment: Competence Guidelines for Safety-Related System Practitioners* in 1999 (widely referred to as the Blue Book) [9]. As mentioned above, the UK HSE published the Red Book in 2007 [2] [6]. A version of the IET Blue Book was released in 2007 as an online document containing material from the 1999 guidelines [10]; in particular the competence criteria and associated assessment guidance which can be used to fulfil the requirements of the HSE Red Book.

It should be made clear that neither the HSE Red Book nor the IET Blue Book on their own could fulfil the safety competence requirements specified in safety standards such as IEC 61508.The HSE Red Book intentionally does not contain either competence criteria or detailed guidance for deriving competence criteria which is recognised as a context specific activity.

### New Blue Book

The new IET Blue Book provides generic competence criteria for organisations involved in the procurement or development of safety-related systems. The main aim of the IET Blue Book is to provide both detailed guidance for deriving and assessing competence criteria specific for a given organisation and to provide competence criteria for typical safety-related activities within a generic organization. To achieve these aims, a competence model is first introduced to establish the relationships between various concepts used when managing competence, in particular the relationships between roles, activities, tasks, attributes, competence criteria, levels of competence and competence profiles both for activities and individuals. The IET Blue Book describes detailed processes for performing competence assessment for which the competence criteria in the document were written.

Finally, the IET Blue Book provides example from the original Blue Book of competence criteria for 12 activities undertaken by a typical organisation developing safety-related systems using an IEC61508 life-cycle. Example competence criteria for operators of safety-related systems are not included since these cannot be generic and must always reflect the specific situation (e.g. sector-specific legislation and practice). The criteria are described in a generic manner so that they may be used in a range of industries and technology areas and they may be tailored to suit specific organisation and industry constraints.

The general guidance provided by the IET Blue Book is equally applicable to any organisation required to establish competence criteria as part of a wider CMS; however, the example competence criteria given within the document are specific to those dealing with safety-related systems. In

addition, the general guidance provided by the IET Blue Book is applicable regardless of the specific national legislation or international standards applied to the development of a specific CMS.

In summary, the new IET Blue Book provides:

- An explanation of defining and assessing safety competence criteria including the identification of activities, tasks and attributes;
- A standard model/process to follow and adapt for a given situation or organisation;
- Competence criteria examples for 12 identified functional safety activities;
- Annexes covering example safety competence criteria and competence assessment forms together with a mapping of example competence criteria to IEC61508 life-cycle phases.

The IET Blue Book focuses on providing guidance for the definition and assessment of safety competence criteria and it includes example safety competence criteria that any organisation using an IEC61508 development life-cycle will find useful for tailoring to their specific needs within the context of a safety-related CMS.

## Conclusions

Organizations with competence deficiencies cannot provide adequate safety assurance as they are simply unaware that a problem exists. Professional judgment is applied by safety engineers during the safety assurance process and the validity of that judgment is critically dependent upon individual competence. The aim of safety-related organisations and individuals should be to attain and maintain effective competence through the specification and assessment of suitable competence criteria within the framework of a proportionate CMS.

The imminent publication of the *IET Code of Practice: Competence for Safety-Related Practitioners* will enable organisations associated with the development and maintenance of safety-related systems to specify and assess safety competence criteria that satisfy the competence requirements of IEC61508 and are an acceptable means of compliance with the HSE Red Book principles.

## References


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