COMPETENCE MANAGEMENT SYSTEM ON SAFETY ASPECT
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1. Introduction:

A safety-related system is a system whose correct operation is most important for ensuing or maintaining safety. It uses electrical, electronic and/ or programmable electronic gadgets, software and people. The safety-related system can be classified as:

- protective systems or
- continuous control systems

Examples are from a simple trip-switch to moving machine parts, to flight control for a modern airplane.

Personnel concerned with safety managing competence include:

o persons who are responsible for safety matter in an organization
o persons who are responsible for setting up new safety competence management System
o persons who are responsible for direct operation
o outsourcing staff in an organization that are directly employed or indirectly employed with project that require safety management

The first two groups have an impact on functional safety of any safety-related system during any phase of design, development, manufacturing, operation, maintenance or modification. The other two group where staff who are working on any environment that requires assurance of safety competence.

For many years there has been a trend towards improvement of functional safety of safety-related system such as automobiles, medical devices, industrial process plant, aircraft flight control and many other applications in many sectors. New Technologies have increased design complexity and also low level of work on individual and team competence. Even new technologies require new skills. If new staff does not familiar with new technology, safety competence will fail. For this, the requirement of staff competence is to be upgraded from a recommendation to a mandatory requirement for competence. The organization should carry out training, development and competence assessment.

2. Competence:

Competence plays a very important role in controlling risks. Risk control system is a complex mixture of hardware (automatic guards etc), software (traffic management on road network), human factors (safety culture) and safety management systems.

There are many definitions of what 'competence' is and this probably reflects that it is a complex concept with many components. Most definition includes reference to 'ability', 'skill'

and 'knowledge'. There is also a tacit acceptance that competence develops overtime, indicating that experience is an important factor. These attributes all relate to an individual's ability; whether they are able to do the task. However, an important consideration should be whether the individual chooses to apply these attributes; their willingness to perform.

A simple model of the components of competence could therefore be expressed as shown below:

$$C = S + E + K + A$$

[Competence] = [Skill]+[Experience]+[Knowledge]+[Attitude]

Fig-1: Components of Competence

Competence is still a significant factor in controlling many of the risks associated with safety work. The word 'Competence' state that the persons, departments or organization involved in safety life –cycle activities shall be competent to carry out the activities for which they are accountable.

As a minimum, the following items should be addressed when considering the competence of persons/ departments or organization or other units involved in safety life-cycle activities.

1. Engineering knowledge, training and experience.
2. Knowledge of legal and safety regulatory requirements.
3. Adequate management and leadership skill.
4. Understanding of potential consequence of an event.
5. Safety integrity level of instrumentation.
6. Novelty and complexity of the application and technology.

A professional engineer with responsibility for design or for supervision of work should have a detailed working knowledge of all statutory provisions, code of practice, guidance material and other information relevant to work, awareness of legislation and practices and a general knowledge of working practices in other establishment of similar type.

Thus competence involves much more than technical training, including attitude and behavior as well as experience and knowledge of the application domain.

The possession of competence will not in itself guarantee for safety. It can never guarantee that any particular task is performed properly without an accident.

Competence is also transferable from one work situation to another. At one situation, such as making wiring connection in accordance with a wiring diagram, they may be largely transferable. Such competence can be assessed and certified. At other situation, the extent of knowledge and ability is transferable with very limited situation. For example, an individual who

may possess the knowledge and ability to develop computer software for a vehicle engine management system may not have the knowledge and ability needed to develop software for computer based suspension.

A competence management system developed in accordance with this guidance should enable staff to fulfill responsibilities and to perform activities to recognized standards of competence on a regular basis, in order to

- meet the organization's business objectives
- satisfy legal and regulatory requirements
- enable the organization to meet contractual commitments.

3. Approaches to Managing Competence:

The traditional approach for assessing the competence of front-line workers typically relied on Supervisory Management Role. The approach is successful only on several assumptions-(a) supervisors were themselves experts in field of work and he could demonstrate how the work should be done and (b) supervisors had sufficient time to be able to directly observe their team at workplace. Over the last two decades, there have been significant changes and observed that two assumptions are no longer valid. The definition of competence is the application of knowledge and skills and therefore its measurement requires collection of performance in the work place. Recent guidance to industries on managing competence for safety related matters are

- Identify skills and knowledge for each activity
- Define level of competence required
- Assess resources against the requirements
- Address the differences and manage the short falls

An effective and consistent standard of competence for an individual shown diagrammatically in Fig-2

Not yet competent and unaware of limitation ↑→	Not yet competent but aware of limitation ↓
Individual with new task(but assessed as not competent for that task) ↑	Competent through training, development and practice ↓
Unaware of limitations from changing environment	← Performs competently as a matter of practice

Fig-2: Competence stages for individual

When people begin to acquire competence for a new task, or begin progressing to a higher level of competence, they will be unaware, at least to some extent, of what they can and cannot do. Through training and development activities, they will first become aware of their limitations and then overcome those limitations to become competent. Gradually, their work becomes second nature, and they become well practiced even in situations that they encounter less often. In effect, people reach a level of almost automatic performance to a high standard.

The danger is that, without realizing it, people can again become unaware of their limitations, whether because of developments 'outside'-such as the introduction of new 'best practice' or new technologies-or because of a drift to bad habits in routine work. It is to avoid this-or to detect it and redress it- that monitoring and assessment of performance is required at individual level, and verification, audit and review is needed at the system level.

In the above diagram, the key objectives of a competence management system are presented with some principles in each phase.

This guidance is applicable to all staff whose work activities involve safety-related system which may have an impact on health/or safety. It should be applied to competence of all staff who are directly involved in development, maintenance or use. Also to those who manage the competence management system and to those managers whose contribution to safety is a prime decision making about financial and commercial matters. Through their competence they will all affect safety of the workplace, the public and themselves.

3.1 Fitness:

The intrinsic competence of staff can be evaluated by poor physical, medical or mental fitness. Organizations are expected to have a system in place to monitor staff fitness-as it might affect risk – and be alert and responsive to potential problems.

3.2 Legislative background:

The statutory laws on Health and Safety of the Nation places general duties on employees and the self-employed to ensure that employees and others who may be affected by the work of their undertaking, are not , so far as is reasonably practicable, exposed to risks and hazards.

There should be legal duty on employees to consult safety representatives appointed by them for risk assessment. This in turn requires 'identification of all potential hazards and the estimation and analysis of the associated risks'.

3.3 Industry Standard:

Industry standards and associated published guidance for functional safety of electrical/electronic/programmable electronic safety related system is important. Thus all persons involved in any overall electrical/electronic/programmable electronic safety or software safety cycle activity should have appropriate training, technical knowledge, experience and qualifications relevant to the specific duty they have to perform. In addition, it requires that competence need to be documented and assessed.

3.4 Level of Competence:

Basic (Novice):   Work is done under routine guidance with intermittent checking.

Normal (Competent):   Can work without direct supervision and may supervise others. But itneed some degree of checking.

Senior (Proficient):   Work without supervision with limited guidance. They may take some responsibilities and defined accountability for the work of others. Exercise significant judgment on supervisory functions.

Lead (Mastery):   Works independently in accordance with broad plan and exercise highlevel judgment in planning, design and technical functions.

3.5 Safety Competence Standard:

In 1999, Institution of Engineering and Technology (IET) published 'Competence criteria for safety-related system practitioners'. It covers all activities throughout the entire functional safety life-cycle. The standard was revised in 2007 with minor changes.

3.6 Competence Vs Training:

The question remains, which qualification is the best measure of competence in functional safety? The answer is 'none of them'. There are many essential competencies that are not and simply cannot be covered by any of the training and qualifications. The growing awareness is more competence than passing examinations. Training and examinations address competence only to a limited extent.

3.7 Why worry about competence?

Over past 40 years, we have seen lot of disaster one after another. Out of major incidents, at least 90% were due to multiple systematic failures rather than due simply to random failures of equipments. Most systematic failures result from human error in specification, design, installation and in operation. To some extent, failures might be avoided by providing better training for engineers and technicians.

3.8 Overall frame work for Competency:

Three types of competence require to assess the functional safety are

1. Technical Competence
2. Behavioural Competence
3. Knowledge
   - Safety and engineering
   - Legal and regulatory framework
   - Experience of engineering discipline

3.9 Check list of CMS:
The following checklist can be used to scope the CMS as shown below:

a. Start with job/task not individual
b. Do not rewrite procedure
c. Identify critical tasks
d. Define critical role
e. Define competence standards
f. Compile job description
g. Consider the impact on recruitment, selection
h. Identify gap between existing process and CMS process
i. Document the system and process that contribute to competency management.

4. Continuous improvement:

A competence management system is structured like most management system. In this system, five phases have been identified viz. planning, design, introduction, operation, review.

For each phase, one or more 'principle' and associated guidance that define safety objective are outlined below:

5. STRUCTURE OF THE PHASES AND PRINCIPLES:

Phase-I
•Establish purpose and scope
↓
Phase-II
• Establish competence standards
• Decide processes and method
↓
Phase-III
•Plan and execute
↓

Phase-IV

- Select and recruit staff
- Allocate responsibility
- Monitor competence
- Assess competence
- Deal with poor performance
- Develop competence

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Phase-V

- Verify and Audits
- Review

Fig-3: The phases & principles of a continuously improving Competence Management System.

5.1 Phase-One:

Identify the area of operation of your organization relating to functional safety of safety related system for which you must manage competence in a formal way, and also those areas that you want to include within the scope of competence management system (CMS) for efficient competence management. Establish full range of requirements that you must meet to satisfy relevant legislation and standards.

5.2 Phase-Two:

Select or develop a suite of competence standards that covers all activities within the scope of CMS. These standards should be sufficient to allow a demonstration to customers, assessors and regulators that all staff are competent to perform the tasks allocated to them.

Establish processes, procedures and methods so that the competence management system consistently ensures that all activities within its scope are performed by competent staff.

5.3 Phase-Three:

Plan and execute the introduction of the CMS in a way that is efficient, that causes no undue disturbance to the execution of existing tasks, and that carries the support of staff.

5.4 Phase-Four:

Select internally and recruit externally, staff or potential employment on the activities so that they will have an appropriate competence profile for allocation to the kind of tasks undertaken by the organization.

Establish control processes to ensure that staff and contractors undertake only work that they are competent to do so. Monitor the competence of staff so that they perform competently or if not initiate appropriate corrective actions. Assess the competence of staff to meet both their own needs and organization's needs. Respond to any failure to perform competently in such a way that the impact on safety is minimized and so that the effect on the organization is tolerable. Maintain and extend the competence of staff in accordance with appropriate competence standards.

5.5 Phase-Five:

Verify and audit the competence management system to give confidence of the staff – internally and externally. Identify potential improvements and stimulate appropriate remedial action if weakness found in its operation. A regular management review of the competence management system to give confidence and effectiveness is to be undertaken.

6. Competence Model:

A competence model sets out the relationship between the various concepts used in the management of competence. A competence model explains standards, organizational activities and individual roles.

7. The Organizational Perspective:

The activities that an organization performs can be viewed in a variety of ways. From hierarchy, function-tasks-competence standard are the most important parameters.

In general, functions are performed by teams of individuals and tasks are the smallest unit of activity and the competence standards express some technical skill appropriate to the task.

Safe performance depends primarily on the competent performance of the individual employee.

8. Conclusion:

In this paper, it has been discussed how 'competence' is a complex concept with many organization, each of which must be considered if human performance is to be managed effectively. Experience from the investigation of serious nature of incidents in many industries(Power, Rail, Petrochemical, Nuclear) has confirmed that many operational activities still depends on human competency. Though the organizations conduct various training program for managing the competence of workers involved in industries but the

guidance principles recognize that 'competence' is not just about training only. The effective management of competence requires links to personnel selection, training, assessing risk management, operational management, knowledge, experience, attitudes and safety audit. These valid indicators bring management of any organization to improve competency level of workers and in other managerial layers across functional boundaries within the organization under all working conditions.

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