‘CHANGING HOW WE EDUCATE ENGINEERS IN THE INDUSTRY’

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CHANGING HOW WE EDUCATE ENGINEERS IN INDUSTRY

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1. Introduction

All professional engineers make a commitment to maintain and enhance their competence by undertaking 'Continuing Professional Development (CPD)'. CPD is the process of managing, and documenting the skills, knowledge and experience that a member of staff gains both formally and informally. It is not simply training (learning how to do something, such as a skill) as it includes knowledge (understanding gained through experience or study), and experience (experience is the process of obtaining knowledge and skills from doing and/or participating in relevant projects).

Most of this CPD is informal learning during a working life, complimented by structured activities such as training courses [1]. This professional development is important to staff: professional development is the third most important factor for employees when evaluating their role [2].

Traditionally, this CPD has been provided by employers, but during periods of recession, there is often reductions in structured activities such as training courses; for example, the recent recession in the oil and gas industry has seen training course numbers and attendances plummet by over 75%. Add to this problem the continuing widening of the skills/experience gap in this industry as baby boomers retire (Figure 1), and it is not surprising that 36 per cent of employers say that a lack of succession planning for knowledge transfer and skills retention is the contributing cause of their skills shortages [2].

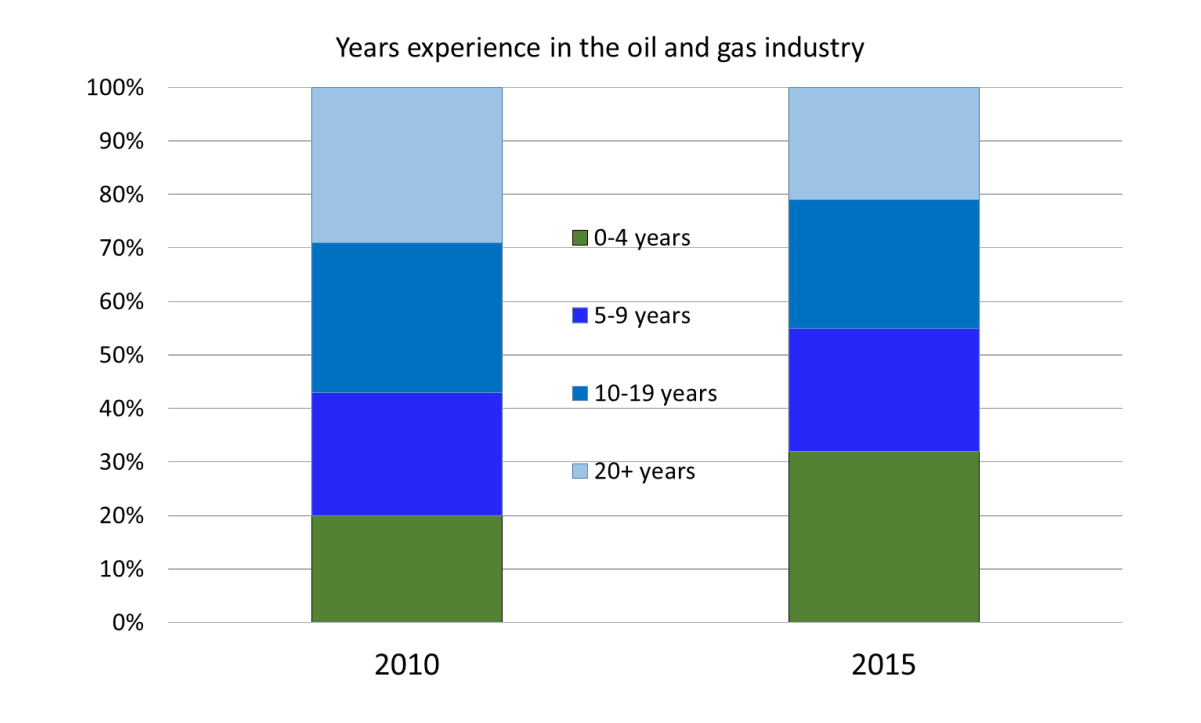

Figure 1. Increasing Skill/Age Gap in the Oil and Gas Industry [2].

Knowledge transfer seems an obvious attraction to workers, and a means to solve skills shortages. But it is not that easy… the current younger generations of engineers are more inclined to move jobs more often: in the USA, the average tenure of workers aged 55 to 64

was 10.1 years, more than three times the 2.8 years of workers aged 25 to 34 [3]. This short tenure can both disrupt CPD, and also make employers cautious about spending time and money on knowledge transfer and CPD. This means that management of competence through CPD is becoming more and more difficult, in parallel with it becoming more important.

2. Competence and Education

Competence is the ability to undertake responsibilities, and to perform activities to a recognised standard. It is a combination of practical and thinking skills, experience, and knowledge, with a heavy bias on experience in engineering professions, Figure 2 [4-6]. Developing and maintaining competencies involves training, mentoring (coaching), and experience: typically this is made up of 10% training, 20% mentoring, and 70% experience, Figure 2. The definition of competence must also include 'values' or 'behaviours'. All these components of competency have overlap and dependency; for example, 'knowledge' is understanding gained through experience or study.

The role of CPD is to maintain competencies, and it is clear that this involves a mix of training, mentoring, and experience: it is not training alone.

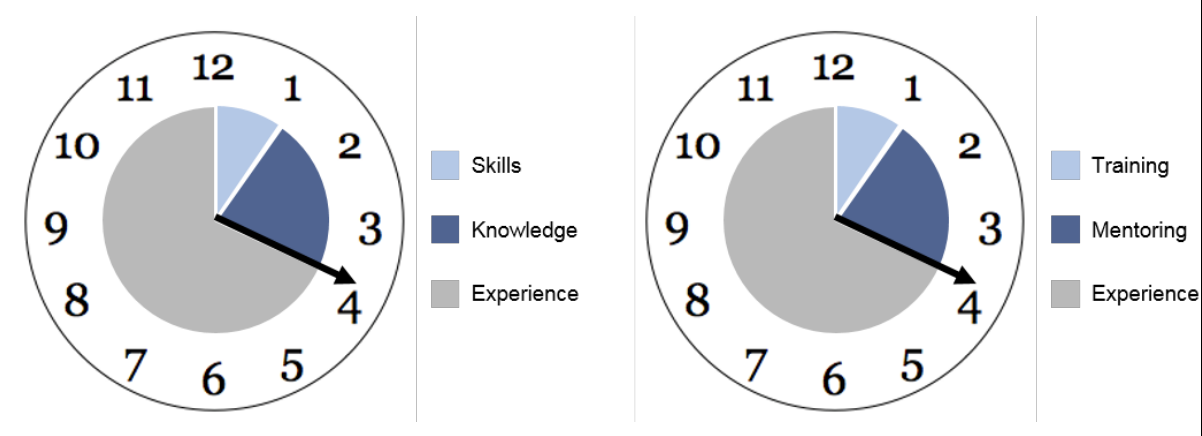

Figure 2. Key Elements of Competency and how it is Gained.

3. Educating our Engineers is Important…

Inadequate management of competence has contributed to disasters; therefore, competency management is critical [7]. Accordingly, industries are now requiring a more formal approach to competence and CPD. For example, engineering standards (e.g., [8]) and federal regulations (e.g., [9]) explicitly require engineers to be both competent and qualified for all the tasks they perform.

These requirements are supported by past major incidents: they show that the lack of certain skills or knowledge led to errors that contributed to the incident [10]. It had been assumed that:

- an individual with a certain level of experience or training would be competent; and/or,
- the dissemination of a procedure would be sufficient.

4. Changing How we Educate our Engineers in Industry: 'Competency Standards'

Competency is a statement of desired knowledge, skills, and behaviours, but a competency:

- must meet an agreed standard;
- must be updated as competencies can deteriorate, or become dated with time, leading to a drift into incompetence ('competency decay'); and,
- must be continually assessed, as evidence is needed that it is being absorbed by personnel ('demonstrable competencies').

Therefore, staff must:

- have their competencies assessed against a standard; and,
- 'demonstrate' they are competent ('demonstrable' means supported by tangible evidence).

The assessment could be by examination, interview, performance, etc., but it must be formal and recorded. This means our CPD must be related to a 'competency standard' (e.g., [11-19]), that captures all the skills, knowledge and experience requirements of the competency.

Competencies of a job holder need to be assessed against this defined standard to ensure validation. 'Competency standards' provide a common definition of a competency, with its minimum requirements. It is best to keep these standards simple, measurable, and auditable. Hence, the competency standard must detail 'outcomes'[1]: what the job holder will be able to do in some measurable way (there may be more than one measurable outcome defined for a given competency). These outcomes should cover:

- 'ability'… is able to do a task (this is 'skill');
- 'understanding'… is able to understand and explain the task (this is 'knowledge');
- 'supervision'… is able to manage staff with these abilities and/or understanding;
- 'training'… is able to train staff with these abilities and/or understanding, and/or supervisory abilities.

The outcomes should be clear, detail the expected characteristics of the competency, and be phrased to allow an assessment: the outcomes imply the assessment criteria.

A typical competency standard would contain the detail presented in Table 1 [11-19]. The standard will also require the method of assessment (e.g., by examination), and how long the competency is valid (i.e., when does it require reassessment).

A simple approach to writing competency standards allows an easy guide and rapid adoption; therefore, competency standards need to be short; for example, limit competency descriptions to a single sentence.

5. Assessment using a Competency Standard

Staff can be assessed against the competency standard. First, the assessment of a competency will require the candidate to provide evidence of competencies, achievement, and qualifications. This evidence is essential, and should be tangible (e.g., examination results, or references), rather than intangibles only (e.g., self-assessment).

Where evidence is not sufficient, the member of staff will require a formal assessment. The assessment should be conducted by comparing the required competencies for the job, with those possessed by the candidate. Competency standards give the necessary detail of the competency, and its level (e.g., Awareness to Expert). This allows a simple assessment against the standards.

[1] A (learning) outcome identifies what the candidate knows and is able to do, or, will know, and be able to do by the end of a course or programme. The outcomes are measurable, and are used in assessing candidates.

The assessment should be conducted by a suitably qualified, and independent body. There are various methods of assessing competencies, including: Self-assessment; Performance; Examination; and, Interview. The competency standard will recommend a suitable assessment method.

Competency number	
Competency title	
Competency level	e.g., 'Awareness, Foundation, Practitioner, or Expert' [4-6].
Competence description	
Competence purpose	
Competency outcomes	Knowledge, understanding, skills, etc., are summarised in 'outcomes'. 'Outcomes' state what the holder should know, understand, value, or be able to do when they gain the competency.
Academic and professional qualifications	The qualifications required to be considered before attempting to satisfy this standard; e.g., BSc or MSc, CEng or PEng.
Pre-requisites	The required knowledge or conditions that should be satisfied before being considered for this competency (e.g., other competencies). A pre-requisite is a recommendation before attempting the competency, and may contribute to the competency being considered; for example, it may satisfy elements of the competency being taken.
Co-requisites	A co-requisite is a recommendation that should be taken at the same time (e.g., other competencies). Co-requisites usually contain information needed to allow the specified competency to be achieved, and may contribute to the competency being considered; for example, it may satisfy elements of the competency being taken.
Skills and knowledge elements of the competency	
Training/mentoring /experience recommended to gain competency	Specify type, and timeline.
Assessment method	Self-assessment, examination, performance, interview, etc..
Reassessment interval (years) and method	
Supervision	Can the individual work on this competency with or without supervision?

Table 1. Typical Contents of a Competency Standard.

6. Summary

Continuing Professional Development is the process of managing, and documenting the skills, knowledge and experience that a member of staff gains both formally and informally. This wide remit can be simply described as developing and maintaining a staff's competence: competence is the ability to perform a task to a specified level and it is demonstrated by appropriate levels of training, knowledge, skill, and experience.

Engineering standards and government regulations are now explicitly requiring engineers to be both competent and qualified for all the tasks they perform. This means that CPD has both a wide scope, and an increasingly important scope.

'Competency standards' provide a common definition of a competency, with its minimum requirements. Competencies can be assessed against these standards.

The contents of a competency standard should clearly state its purpose and outcomes, and detail the knowledge, training, mentoring, and experience requirements, and an assessment method. Individuals who pass the assessment are qualified in this competency (as they have been assessed and have tangible evidence).

CPD using competency standards satisfies both the ethos of CPD, and requirements in standards and regulations. It will also assist in transferring knowledge to future generations and address a recognised skills gaps in many industries.

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