PAS 525:2018

Framework for assessing professional engineering competence – Specification

Engineering Council

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Contents

Foreword

This PAS (Publicly Available Specification) was sponsored by the Engineering Council, UK. Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 30 November 2018.

Acknowledgement is given to the technical author Dr. Dave Clark, and to the following organizations that were involved in the development of this PAS as members of the steering group:

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Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

This PAS is not to be regarded as a British Standard. It will be withdrawn upon publication of its content in, or as, a British Standard.

The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Where URLs for websites and webpages have been cited, they aim to provide ease of reference for the PAS user and are correct at the time of publication. The location of a webpage or website, or its contents cannot be guaranteed.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

0 Introduction

0.1 Motivation behind the creation of PAS 525

This PAS aims to establish an internationally-applicable framework for assessing the competence and commitment of engineering professionals. Many professional engineering institutions, regulators and licensing bodies would like to develop a globally recognized competence specification that enables recognition of their personal achievements and facilitates mobility of employment. Therefore the Engineering Council, the UK regulatory body for the engineering profession, has worked with BSI to develop the principles behind UK-SPEC (UK Standard for Professional Engineering Competence [1]) into an overarching public framework for competence-based assessment. This can then be adapted to meet local needs by international organizations that want to derive their own national standard.

The aims of PAS 525 are:

- to create an internationally applicable framework for assessing the competency and commitment of professional engineers;
- to provide a framework that could be applied to other professional engineering communities that wish to create national standards;
- to provide internationally applicable guidelines for those involved in educating and training engineers; and
- to provide a framework that could be used to support specifications for engineering projects, products and processes.

As well as reflecting the competence requirements of global engineering within UK-SPEC, the Engineering Council is active within a number of multilateral mutual recognition agreements with national engineering bodies in other countries. These agreements are governed by the International Engineering Alliance (IEA).[1)]

0.2 The benefits of the assessment of professional engineering competence

Today's and tomorrow's engineers play a vital role in finding solutions to key issues facing today's societies, by designing and delivering systems that drive social and economic development. These challenges include environmental protection, climate change, healthcare for all, deforestation, security, including cyber-security, safety, mobility, food supply, clean water and the development of sustainable energy sources. The contribution of competent engineers therefore plays a vital role in enhancing our quality of life and contributes to the United Nations Sustainable Development Goals (SDGs).[2)]

Any competence standard needs to address the knowledge, skills, attitudes and behaviours that are required to build and maintain competence within a changing profession. Factors such as increasing levels of automation, a greater requirement to work globally, skills and resource availability and the development of new forms of information technology are all changing the face of the engineering profession.

Within all of this work, engineers have a responsibility to society, acting in the public interest at all times, upholding standards of safety, sustainability, ethical conduct and risk management. The assessment of competence underpins the systems and processes which ensure that engineers are equipped to address these challenges, and a robust and accessible method of assessing competence is much needed, to provide employers, government and the public with the confidence that registered engineers maintain the highest standards.

Formal recognition of competence, such as registration, sets individual professionals apart from engineers and technicians who are not registered. It confirms their proven knowledge, understanding and competence. In particular, registration demonstrates a commitment to professional standards, and a continuing responsibility to develop and enhance competence.

[1)] IEA website available at: http://www.ieagreements.org/

[2)] United Nations Sustainable Development Goals available at: https://sustainabledevelopment.un.org/

Employers of registered engineering professionals have the assurance of knowing that their employees have had their competence independently assessed, their credentials verified, and their commitment to Continuing Professional Development (CPD) established. The registrants gain the recognition of their peers as meeting established, internationally-recognized standards for knowledge and experience.

0.3 What is competence?

0.3.1 General

Competences (see **3.1**) are the skills, knowledge, practical behaviours and attitudes which inform the way an individual operates in working life to achieve intended results. Competent engineers exercise enhanced professional judgement in a variety of situations, applying and building on previous experience.

Initial professional development of competence consists of a combination of formal, non-formal and informal learning, training and experience. In practice, these elements are not necessarily separate or sequential and they might not always be formally structured.

Competence is developed by:

- learning, which can be formal, non-formal and informal (see **3.9**), or a combination of each;
- training and experience;
- combining knowledge and skills with a professional attitude;
- commitment to the profession; and
- personal development.

The concept of competence as an approach has grown significantly over the last decade and it is now well accepted that competence involves the use of knowledge and skills with the ability to implement them in professional practice. Engineers live and practise in cross-disciplinary environments which are very different from developing knowledge and skills in classroom/laboratory environments. Therefore, the ability to source, process, manage, communicate and apply expert skills across diverse contexts has come to be seen as critical for workplace success [2]. Employers who operate in global labour markets now seek employees who possess not only high-level technical or job-specific competences, but also, high levels of generic competences, such as communication skills, cultural sensitivity, team working and digital skills [3].

In most competence frameworks:

- elements of competence overlap and are interdependent;
- elements can be assessed separately or together; and
- development of competence is not necessarily a linear or formally structured path, but can be recorded, reported and assessed.

The elements of engineering competence shown in Figure 1 are described in more detail in **0.3.2** to **0.3.6**.

0.3.2 Knowledge and understanding

Knowledge, which can be gained as formal or personal knowledge, is considered an essential building block of competence.

- Formal knowledge, also referred to as codified knowledge, is subject to quality control by editors, peer review and debate and is given status by incorporation into educational programmes, examinations and courses. It does not include skills or know-how. An engineering degree is an example of codified knowledge that would provide a basic knowledge of the discipline of engineering.
- Personal knowledge has been defined as the cognitive resource which a person brings to a situation that enables them to think and perform [4]. Personal knowledge is largely acquired through a combination of non-formal and informal learning and workplace experience.
- Skills, which refer to the techniques and approaches that are employed in order to implement the knowledge, allow competence to be demonstrated and developed. As knowledge is implemented, understanding develops. Understanding has been defined as being able to apply the right knowledge appropriately in a variety of contexts [5].

In an assessment of understanding, an engineer is expected to be able to demonstrate the awareness of the connections between pieces of information that are essential to put knowledge to practical use.

0.3.3 Engineering problem solving

The application of practical and theoretical knowledge to the analysis and solution of engineering problems is an important process that can be documented to demonstrate competence. Typically, the use of a concept or idea in a new situation involves:

- understanding the situation, which might require appropriate use of prior knowledge;
- recognizing that concepts or ideas are relevant;
- adapting the concept into a system of work appropriate for the situation;
- integrating that knowledge with other knowledge in the planning and implementation of action;

- assessing the level of uncertainty and identifying missing information; and
- establishing the level of risk and mitigating measures to reduce the risk.

In practice, an engineer needs to develop an appropriate solution that takes into account user requirements, the potential implementation of new and existing technologies, relevant data collection and test protocols. Recommendations for solutions need to take into account factors such as desired quality, cost constraints, reliability, ethical issues (see Annex D), sustainability, security (see Annex E) and safety requirements, applying relevant formal and personal knowledge.

0.3.4 Responsibility, management or leadership

Today's challenges make ever greater demands on individuals' abilities to tackle complex mental tasks, going well beyond the basic reproduction of accumulated knowledge. As well as being able to draw upon cognitive and practical skills, resources such as attitudes and motivation are very important. In the engineering context, responsibility, leadership and management competence is important in drawing together different disciplines and skills.

For example, the Organisation for Economic Co-operation and Development (OECD)'s DeSeCo competence framework (2005) [6] sets out a framework for a well-functioning society. At the centre of the framework of key competences is the ability of individuals to think for themselves as an expression of moral and intellectual maturity, and to take responsibility for their learning and for their actions. Reflective thought and action is another key aspect of developing and demonstrating competence.

The National Occupational Standards (NOS) for leadership and management [7] offer a definition of key leadership and management skills. These are structured around five themes or functional areas which broadly define what leaders and managers do:

- providing direction;
- working with people;
- using resources;
- facilitating change; and
- achieving results.

An engineer is also expected to provide technical leadership, for example in identifying project constraints, risks, training needs and environmental sustainability.

0.3.5 Communication and interpersonal skills

Engineers at all levels require a strong set of communication and interpersonal skills in order to be effective as a professional. They need to communicate complex ideas and technical project information to a variety of audiences and in a variety of ways, including oral and written. Engineers also need to be good listeners, exchanging and receiving information with technical and non-technical audiences in a variety of contexts. Excellent communication skills are essential in the presentation and discussion of project proposals, leading and participating in meetings, business negotiation and people and team management.

Internationalization of business requires communication with groups with different linguistic and cultural backgrounds. Communication needs to be adapted accordingly. Cultural sensitivity, tact, diplomacy, an appreciation of diversity and a willingness to learn are all important factors in a global engineering environment.

0.3.6 Personal and professional commitment

Apparently unrelated issues and conduct can bring the standing of a professional into disrepute. Therefore, the ability to act within the big picture or the larger context is crucial for participating effectively in the workplace, as well as in personal, civil and political life ([6], [7]).

Engineering professionals are required to demonstrate a personal and professional commitment to society, the environment and their profession. In demonstrating overall competence, they are required to show that they have adopted a set of values and behaviours that maintain and enhance the reputation of the profession. This might include:

- complying with codes of conduct, codes of practice and the legal/regulatory framework;
- managing and applying safe systems of work;
- undertaking work in a way that demonstrates a commitment to protecting the environment and contributes to sustainable development;

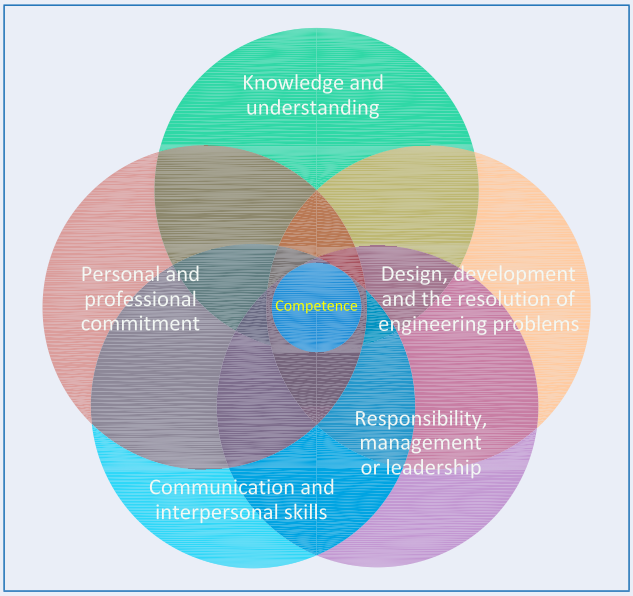
- carrying out the CPD necessary to maintain and enhance competence;
- maintaining public safety;
- adopting a security-minded approach to professional and personal life;
- recognizing inclusivity and diversity;
- actively participating within the profession; and
- exercising responsibilities in an ethical manner.

In maintaining competence throughout professional life a key requirement is the ability of engineering professionals to take responsibility for their learning, development and their actions in support of that. This includes legal duties and obligations. This requires reflective thought and systematic review of past experiences to plan future learning and development goals.

0.4 The underlying principles of this competence framework

Bringing together each element of competence in a framework can be visualized as shown in Figure 1:

Figure 1 – Elements of competence in a framework



All areas of competence are interdependent and each competence can be assessed separately. Examples of ways to demonstrate each area of competence are shown in Annex A and more information about assessment methods is given in Annex B.

Conceptually, engineering competence is regarded as the intersection of all five of the elements set out in **0.3.2** to **0.3.6**. Development of each competence may not necessarily follow a prescribed or formally structured route, but in every case can be recorded, reported and assessed.

Further important underlying principles ensure the integrity and applicability of the competence framework.

a) Open-access to the profession: In order to allow access to the profession for engineers to be as wide as possible, mechanisms for evaluating formal, non-formal and informally-acquired knowledge need to be in place to underpin the assessment of competence. This allows engineers who do not hold accredited or approved qualifications to demonstrate that they have achieved the same level of knowledge and understanding as a candidate with accredited qualifications. The emphasis needs to be on demonstrating competence through assessment of outputs, encompassing all modes of learning.

b) A CPD record with a CPD Code to support it: maintenance and enhancement of competence reflects the needs and career progression of each engineer. Structured activities such as courses, distance learning programmes, presentations, private study and mentoring are combined with non-formal and informal learning gained through the challenges and opportunities of everyday working life. The engineer is expected to employ reflective learning and set appropriate objectives, keeping records that can be assessed during reviews of competence.

c) Engineering professionals have access to codes of conduct, and guidance on ethical principles (see Annex D), security (see Annex E), risk and sustainability.

d) Progressive and differentiated competences for different categories of engineering professional.

It is important that a single competence framework caters for the separate and differentiated levels of knowledge, skills and responsibilities (see Clause **4**), in addition to those required to carry out discipline-specific duties. A pathway should be provided so that applicants can progress by demonstrating that they fulfil all the competence requirements for the next category.

1 Scope

This PAS defines a framework for assessing the competence and professional commitment of engineering professionals.

The specification covers:

a) the principles of a framework for assessing competence and commitment;

b) definitions of competence and professional commitment;

c) assessment of the competence and commitment of engineers in five areas:

   1) use of engineering knowledge and understanding;

   2) design, development and the solution of engineering problems;

   3) responsibility, management and leadership;

   4) communication and interpersonal skills; and

   5) personal commitment to professional standards;

d) supporting guidance for implementation (Annex A to Annex D).

It describes differing categories of competence for the classification of professional engineers depending on the engineer's levels of knowledge, skills and responsibility and indicates the pathways between the categories.

This PAS uses the three categories of engineer recognized by the IEA, namely Engineering Technician, Engineering Technologist and Professional Engineer. Countries might use different titles for similar categories, as shown for the UK in the table below:

Generic title used in PAS 525	UK title
Engineering Technician	Engineering Technician
Engineering Technologist	Incorporated Engineer
Professional Engineer	Chartered Engineer

The adoption of this PAS does not confer the use of these UK titles, which are protected by civil law in the UK. The PAS instead refers to the generic titles for these categories, which are widely adopted internationally.

The PAS is intended for use by professional engineering institutions, regulators and licensing bodies, to assess the competence and commitment of engineering professionals.

This includes organizations that regulate by statute or facilitate voluntary self-regulation. The PAS is also of interest to national engineering accreditation authorities, individual engineering professionals, government agencies, employers and insurers.

This PAS does not cover:

- requirements that are specific to a particular engineering discipline;
- prescribed routes for attainment of knowledge and understanding; or
- specific qualifications or levels of engineering qualifications.