

Chartered Engineer: competence statements exemplar

What do we mean by competence?

Professional competence combines knowledge, understanding, skills and values. It's about more than just being able to perform a specific task; it's being able to do it correctly, safely, effectively and consistently.

These competence requirements are specified by the Engineering Council in the UK Standard for Professional Engineering Competence (UK-SPEC).

What characteristics are we looking for?

Chartered Engineers are characterised by their ability to develop appropriate solutions to engineering problems, using new or existing technologies, through innovation, creativity and change.

They might develop and apply new technologies, promote advanced designs and design methods, introduce new and more efficient production techniques, marketing and construction concepts, or pioneer new engineering services and management methods. Chartered Engineers are variously engaged in technical and commercial leadership and possess effective interpersonal skills.

A: Optimise the application of technology

Use a combination of general and specialist engineering knowledge and understanding to optimise the application of existing and emerging technology

A1: How have you maintained and extended a sound theoretical approach to enabling the introduction and exploitation of new and advancing technology and other relevant developments?

You could reference your ability to: Identify the limits of own personal knowledge and skills / Strive to extend own technological capability / Broaden and deepen own knowledge base through research and experimentation

A2: How have you engaged in the creative and innovative development of engineering technology and continuous improvement systems?

You could reference your ability to: Establish users' needs / Assess marketing needs and contribute to marketing strategies / Identify constraints and exploit opportunities for development and transfer of technology within own chosen field / Promote new applications when appropriate / Secure the necessary intellectual property rights / Develop and evaluate continuous improvements systems

Since graduating I have gained in depth knowledge of using carbon fibre composite materials for the construction of aircraft wings and other structural components. To do this, I worked with a senior composite materials engineer in our company to identify the gaps in my knowledge. I then attended relevant courses at Bristol University to address the knowledge gaps which had been identified. As part of the development programme I designed wing structural components, known as 'stringers' and access panel frames made from a carbon fibre composite. These component parts are highly stressed and are required to maintain their structural integrity throughout an operational temperature range of -60 > + 150 deg C. I modelled the design using the Catia V5 3D CAD software program (following attendance at a course on Advanced Catia 3D Design) and devised a series of physical tests on samples. The results of the physical tests and those modelled came within a few percentage points and thus I was able to validate the model.

I was a member of the cross functional composite wing programme repair team tasked with developing carbon fibre composite damage repair solutions. The repair methods I developed depended upon the extent and type of damage sustained either in flight or on the ground. The size and location of the defective area needed to be established as it is not always visible and the failure or impact damage can have wide spread hidden de-lamination. I developed a series of inspection procedures using ultrasonic, x-ray or infrared thermography inspection techniques.

A: Optimise the application of technology (continued)

I defined a series of repair scenarios that were replicated using sample panels and tested under simulated operating conditions. The results from these series of tests helped me to develop the repair solutions. Once the extent and type of damage had been ascertained the repair methods I developed were undertaken. These repair procedures have now been adopted as a company standard.

B: Analysis and solution of engineering problems

Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems

B1: Have you identified potential projects and opportunities?

You could reference your ability to: Explore the territory within own responsibility for new opportunities / Review the potential for enhancing engineering products, processes, systems and services / Use own knowledge of the employer's position to assess the viability of opportunities

B2: How have you conducted appropriate research and undertaken design and development of engineering solutions?

You could reference your ability to: Identify and agree research methodologies / Assemble the necessary resources / Carry out the necessary tests / Collect, analyse and evaluate the relevant data / Draft, present and agree design recommendations, taking account of cost, quality, safety, reliability, appearance, fitness for purpose, environmental impact / Undertake engineering design

B3: How have you implemented design solutions and evaluated their effectiveness?

You could reference your ability to: Ensure that the application of the design results in the appropriate practical outcome / Implement design solutions, taking account of critical constraints / Determine the criteria for evaluating the design solution / Evaluate the outcome against the original specification / Actively learn from feedback on results to improve future design solutions and build best practice

Whilst working in the design department on composite layup simulation, I identified a potentially more accurate way of simulating the reinforcement layup process. For example, the stiffness of a composite panel will often depend upon the orientation of the applied forces and/or movements. Panel stiffness is also dependent on the design and construction of the panel. For instance, the fibre reinforcement and matrix used, the method of panel build, thermoset versus thermoplastic, type of weave, ply and orientation of fibre axis to the primary force. Aircraft structural components are designed to withstand a range of uni-directional forces and magnitudes. I identified those forces that mainly influence wing design and suggested testing the parameters that are input into the simulation software. I am tasked with leading this project and once it has been fully tested and validated it could be used to reduce construction costs and improve wing and other aircraft control surface designs. Early indications are that the method I have proposed will bring cost saving of approximately 1.5% while maintaining structural integrity.

Winglets are the near-vertical extension of the wing tips designed to reduce the aircraft's drag by partial recovery of the tip vortex energy. Wingtip devices can also improve aircraft handling characteristics, reduce fuel consumption and enhance safety for following aircraft. I was asked to investigate the process used to assemble the winglet rib to the wing as the process required shimming to meet the required dimensions. As composite parts cannot be manufactured as accurately as machined parts it has been necessary to use shims of various thicknesses to fill the gaps on assembly between the winglet rib and the wingtip. This was a costly and time consuming task. I investigated and calculated the gap that required shimming due to predicted detail part manufacturing tolerances and wing build philosophy. Now, only one thickness shim is required reducing assembly time and costs.

B: Analysis and solution of engineering problems (continued)

Aircraft fuel tanks are housed in the wings and over time small amounts of water will accumulate at the bottom of these tanks. A water outlet valve is fitted to the lowest part of the tank and needs to be accessed regularly to remove any water present as it will freeze at high altitude and could block fuel pipes. I designed a carbon fibre fuel valve access panel for a high performance military aircraft. A rigorous design specification required the access panel to be easily accessible from the ground and to seal and lock effectively in flight. I designed this assembly to fit the space available using a 3D CAD system and analysed structural integrity using a finite element analysis model. I then arranged for a prototype to be built and tested and the results of these tests were used to modify and finalise the design. This revised access panel has now been incorporated into our wing designs and is operating satisfactorily.

C: Provide technical and commercial leadership

C1: How have you planned for effective project implementation?

You could reference your ability to: Identify the factors affecting the project implementation / Lead on preparing and agreeing implementation plans and method statements / Ensure that the necessary resources are secured and brief the project team / Negotiate the necessary contractual arrangements with other stakeholders (client, subcontractors, suppliers etc.)

C2: How have you planned, budgeted, organised, directed and controlled tasks, people and resources?

You could reference your ability to: Set up appropriate management systems / Agree quality standards, programme and budget within legal and statutory requirements / Organise and lead work teams, co-ordinating the lead work teams, coordinating project activities / Ensure that variations from quality standards, programme and budgets are identified and that corrective action is taken / Gather and evaluate feedback and recommend improvements

C3: How have you led teams and developed staff to meet changing technical and managerial needs?

You could reference your ability to: Agree objectives and work plans with teams and individuals / Identify teams and individual needs and plan for their development / Lead and support team and individual development / Assess team and individual performance and provide feedback

C4: How have you brought about continuous improvement through quality management?

You could reference your ability to: Promote quality through the organisation and its customer and supplier networks / Develop and maintain operations to meet quality standards / Direct project evaluation and propose recommendations for improvement

When planning a project I use the 'MS Project' software programme which enables me to identify the necessary resources, plan activities both in series and in parallel, produce and implement procurement plans and monitor progress against the agreed timescale and budget. An example of this was the creation of a new, more effective, worldwide engine build specification. I led and managed all project planning activities, negotiated the availability of human resources, monitored progress against the project plan and agreed the procurement programme. The development of an engine build specification required modifications to the existing assembly jigs, lifting equipment and control systems. I specified the work needed and carried out all the project risk assessments before work started and arranged for sub-contractors to undertake the bulk of the work. The project was delivered on budget, to time and to the specified quality standard.

C: Provide technical and commercial leadership (continued)

The water outlet valve panel design project required that the design specification be agreed by various departments within the company before starting. Once agreed, I prepared a project plan, including the use of other company specialists, a budget, timescale, quality plan and contingency fund. I gave a presentation to management proposing a £75,000 budget and a timescale to completion and acceptance by the client within seven months. This was eventually agreed and the funds made available from the proposed start date. The project was completed on time, to budget and to the quality required. Once completed, I carried out a post project review and informed my management that although project targets were met several areas for improvement were identified.

The project, aimed at improving the department's composite layup simulation, required a multi-disciplinary team including specialists from design, structural engineering, materials engineering, inspection and manufacture. I currently lead this team and at our first meeting gave them a demonstration on how the simulation software package works and my ideas on how the simulation could be improved. We then 'brainstormed' and agreed the project objectives. Line managers of the various discipline teams have subsequently asked me to provide feedback on the input and performance of individuals once the project has been completed.

I am a member of the design liaison team and one of the roles we undertake is to investigate when a non-conformance report indicates that a design drawing is in error when associated parts do not fit as intended. Elimination of such non-conformances is an integral part of our 'Achieving Excellence' quality programme and it is our job to identify drawing errors and their root cause and to undertake the necessary corrective action. I am responsible for producing the departmental weekly statistics for non-conformance reports associated with certain aircraft. This information is used as a measure of our performance and to determine man-power levels required.

D: Demonstrate effective interpersonal skills

D1: How have you communicated in English with others at all levels?

You could reference your ability to: Contribute to, chair and record meetings and discussions / Prepare letters, documents and reports on complex matters / Exchange information and provide advice to technical and non-technical colleagues.

D2: How have you presented and discussed proposals?

You could reference your ability to: Prepare and deliver presentations on strategic matters / Lead and sustain debates with audiences / Feed the results back to improve the proposals

D3: How have you demonstrated personal and social skills?

You could reference your ability to: Know and manage own emotions, strengths and weaknesses / Be aware of the needs and concerns of others / Be confident and flexible in dealing with new and changing interpersonal situations / Identify, agree and lead work towards collective goals / Create, maintain and enhance productive working relationships and resolve conflicts

As a member of the design team and I am required to write design specifications for aircraft components and assemblies. I am also required to write project proposals, post project reports and minutes of project meetings. I communicate with colleagues and external contacts by email, letters, technical reports and engineering drawings and diagrams.

D: Demonstrate effective interpersonal skills (continued)

My project work requires me to liaise with our procurement department and visit suppliers on their behalf to assess their facilities, technical capability and quality management system. These visits are always followed up with a visit report which is distributed to senior engineering and supply chain management within our organisation and used to support high value sourcing decisions.

When I am appointed to lead a project I always call the team together to give them a presentation on the project strategy, aims and objectives and timescale. At this meeting I seek their input, as appropriate, into the detailed project planning, costing and define their technical input. I see it as essential that every team member shares the ownership of the overall plan and its success. As a member of a team appointed to improve the design department's employee recognition, I presented the team's proposals to the entire department to obtain feedback which was then used to redefine our mission and purpose.

As part of post project reviews I always ask team members to give me feedback on my performance as a project leader. This feedback has helped me to identify my strengths and weaknesses and to take appropriate corrective action. My role as a design liaison engineer requires me to have regular contact with staff from other disciplines. This role has helped me to understand an extensive range of technical and personal challenges people from other departments have to deal with and to balance my requirements accordingly.

E: Commitment to professional standards

Demonstrate a personal commitment to professional standards, recognising obligations to society, the profession and the environment

E1: How have you complied with relevant codes of conduct?

You could reference your ability to: Comply with the rules of professional conduct of the Institution / Lead work within all relevant legislation and regulatory frameworks including social and employment legislation

E2: How have you managed and applied safe systems of work?

You could reference your ability to: Identify and take responsibility for own obligations for health, safety and welfare issues / Ensure the systems satisfy health, safety and welfare requirements / Develop and implement appropriate hazard identification and risk management systems / Manage, evaluate and improve these systems

E3: How have you undertaken engineering activities in a way that contributes to sustainable development?

You could reference your ability to: Operate and act responsibly, taking into account the need to progress environmental, social and economic outcomes simultaneously / Use imagination, creativity and innovation to provide products and services which maintain and enhance the quality of the environment and community, and meet financial objectives / Understand and secure stakeholder involvement in sustainable development

E4: How have you carried out continuing professional development (CPD) necessary to maintain and enhance competence in own area of practice?

You could reference your ability to: Undertake reviews of own development needs / Prepare action plans to meet personal and organisational objectives / Carry out planned (and unplanned) CPD activities / Maintain evidence of competence development / Evaluate CPD outcome against action plans / Assist others with their own CPD

I am familiar with the IMechE's Code of Conduct for professional engineers and with the legislative and regulatory regimes which apply to my current role. I endeavour to maintain a professional approach to my work at all times and will contribute to sustainable development.

E: Commitment to professional standards (continued)

I will maintain and extend my professional competence and will support the development and promotion of the engineering profession. In addition, I comply with my company's commitment to relevant legislation, technical codes of practice and standards and social and employment law. More recently, I have contributed to promoting the profession to school children through the STEM initiative.

In our industry we are very conscious of our environmental impact and the importance of reducing that. In my role I am constantly working to reduce the weight of the components and assemblies we design in the knowledge that every weight saving contributes to greater fuel efficiency. We work constantly with the engine design companies to identify opportunities for further fuel efficiency.

I am leading a project within our company to reduce the carbon footprint of our procurement through localisation of our sourcing and elimination of avoidable business travel while maintaining operational effectiveness.

Health, safety and environment (HS&E) issues are fundamental to our industry and are considered at every stage of aircraft design and development. As a design engineer I am required to conform to company HS&E standards and demonstrate compliance with aviation authority regulations, standards and codes of practice. I have received formal Health and Safety training that is regularly updated as new legislation is introduced and this includes fire fighting and building evacuation procedures. I am often required to conduct visitors around our manufacturing sites and I am responsible for informing them of our H&S rules including ensuring that they wear appropriate personal protection equipment and what to do in the event of a building evacuation.

My company is registered to the ISO 14000 Environmental Management System and consequently all staff are required to conform to this standard. I am often required to carry out environmental impact and risk assessments before testing and evaluating wing repair methods or testing prototype designs. As an aircraft design engineer I need to design structures and components to meet strength criteria whilst keeping their mass to a minimum to meet a company imposed target of a 20% reduction in aircraft fuel consumption.

I maintain a record of my CPD activities and in collaboration with my line manager, I have enrolled on a short course on advanced composite materials run by a local University which I will attend shortly. In addition, I have learnt much about carbon composite repair techniques whilst working with materials and structural experts on the job and by attending seminars on composite materials. I maintain my technical knowledge and understanding by reading relevant literature on aircraft structural materials and for general engineering information, the Professional Engineer magazine. Recently, my manager recommended me to attend a stage one management course run by the company.