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Transferable Competencies and Skills: The Framework Underpinning this Handbook

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This final chapter of Part 1 introduces you to the transferable competency and skills framework on which this handbook is based and how it is situated within accreditation requirements and relevant criteria of professional bodies. It explains why we subscribe to the UNICEF definition of transferable competencies and skills as those needed to adapt to various life contexts, which people can potentially transfer to different social, cultural, or work settings. Building on this, we explain the selection and definition of the transferable competencies and skills employed, using the current UK Chartered Engineer Standard as defined in the UK-SPEC as our point of departure. As a result, the following competencies and skills were included: project management, meeting skills, risk analysis and risk management skills, leadership skills, teamwork, oral presentation skills, written communication and reporting skills, visualisation skills, spatial ability, and representational literacy, interpersonal communication skills, feedback skills and feedback literacy, self-regulation, the adaptability for change, resilience, information literacy skills, autonomous motivation, learning beliefs and strategies, and initiative and perseverance. For each included competency and skill, a working definition is provided to aid you when using this handbook. We also address what competencies and skills were not included and why. The chapter contains a reflection on the sustainability of competency frameworks and that revisiting their purpose and context on a regular basis is important, although individual transferable competencies and skills will likely remain a stable component of any future engineering curriculum. The chapter ends with reiterating SEFI's mission to educate holistic engineers and introducing our view on how to use this handbook.

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1 Introduction

As the previous chapters have shown you, the academic discourse on competencies, skills, and competence models has been ongoing for decades in both national and international contexts, employing a variety of terms (e.g., key competencies, core qualifications, transversal skills). This discourse is broad and heterogeneous and has been synthesized in several comprehensive overviews (e.g., Dippelhofer et al., 2025; Johannsen, 2025; Kotsiou et al., 2022), encompassing frameworks that are partly conceptual and partly empirically grounded.

It is important to realise that these frameworks target different audiences (e.g., educators, learners, university leadership, policymakers, industry) and vary in their methodological approaches (e.g., qualitative analyses, Delphi studies, mixed methods), stakeholder involvement (e.g., experts, NGOs, employers), instruments used (e.g., surveys, interviews, scenarios, taxonomies), and other dimensions (see, for instance, Ehlers & Eigbrecht, 2024). This has resulted in national and international discourses that are characterized by plurality and fragmentation. Their thematic focus ranges from competence-oriented continuing education formats to strategic governance frameworks and collaboratively developed future skills, as highlighted in Chapter 1.2 and Chapter 1.3.

As a result of these different frameworks, standards have been developed that we as educators must ensure our graduates can meet when they graduate and start working as engineers in the field. You might have seen in Chapter 1.4 how these frameworks have resulted in these standards and how they are upheld by regulatory and accreditation bodies, be it government-based or professional bodies.

Therefore, for this handbook, we had to decide which framework and terminology to use. In this chapter, we will set out which definition of transferable competencies and skills we will use within the context of this handbook. We will introduce you in detail to the competency framework for transferable skills on which this book is based, and why we selected this framework. We will also detail the underlying competencies and skills that are part of this framework and how we define them within this handbook. Hopefully, this will enable you to place the content of this manual within your context. Finally, we discuss how we envision the competency framework, and the underlying competencies and skills are to be used by you, the reader, to help you get started.

2 Transferable competencies and skills definition

As Chapter 1.2 has explained, many different terms and definitions exist of what we in this handbook call transferable competencies and skills. This is why we decided to select a definition that is universally and widely used, also outside higher education and engineering education, to allow for a broad understanding given the increase in interdisciplinarity and transdisciplinarity within education and the potential global readership of this handbook.

After looking at many definitions, we settled on the definition by the UNICEF as a global leader in promoting the attainment of competencies and skills through education. UNICEF defines transferable competencies and skills as those that are needed to "*adapt to various life contexts and that people can potentially transfer to different social, cultural or work settings*" (UNICEF, 2022, p. 3). It subdivides these into cognitive, social, and emotional skills (UNICEF, 2019). Although in the English language, distinctions in definition can be made between the words *competency*, *competence*, and *skills*, in many other languages, only one word exists for all three terms (Guerrero & Del Los Rios, 2012; Kearns et al., 2016). As this handbook is intended for an international audience, we will use the umbrella term of *competencies and skills* throughout and interchangeably.

3 Competencies and skills framework used in this handbook

As stated before, a vast multitude of competency frameworks exist, for a variety of audiences and purposes, some very broad, discipline-non-specific frameworks, some just specific to engineering. What all frameworks have in common is their aim: to better prepare both the current and future workforce for the challenges that lie ahead.

Many such frameworks only cover transferable competencies and skills and do not always explicitly link or embed their framework within the wider set of competencies and skills in the science and engineering domain that graduates must possess. These new transferable competencies-only frameworks are almost the opposite of what was happening in many engineering programmes prior to the 2000s which focussed mostly on technical competencies and skills. Whilst there were plenty of calls from industry for the need of engineering graduates to possess these competencies and skills, they were not formally included in the accreditation standards of the time.

Transferable competencies and skills were not included as a formal part of accreditation requirements in many engineering programmes worldwide until 2000 when the Accreditation Board for Engineering and Technology, now known as ABET, started doing so (Engineering Accreditation Commission, 2000). The introduction of the ABET 2000 criteria stemmed from pressure from industry to include these competencies explicitly, most notably by John McMasters from the Boeing Company (McMasters & Lee, 1996).

Parallel initiatives to this were taking place in Australia (Engineers Australia, 2013) and among member states of the European Higher Education Area (EHEA), who established a set of common descriptors for education outcomes, known as the Dublin descriptors, which first explicitly mentioned transferable competencies such as communication skills (Bologna Working Group on Qualification Frameworks, 2005). It was then up to every individual EU member state to create its own frameworks for accreditation and recognition purposes.

The creation of the Dublin descriptors and the European Qualification Framework (EQF), an eight-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks, has been instrumental in allowing for a more coherent, comparable, and compatible higher education process within the EHEA, fostering collaboration and exchange. In the Netherlands, for example, a set of criteria for bachelor and master curricula in engineering at Dutch research universities was developed as a result, which explicitly included some transferable competencies as a requirement for the first time (Meijers et al., 2005). These criteria are still in use today.

Internationally recognised accreditation bodies first mandated transferable competencies and skills, driving formal introduction into engineering curricula. This shift subsequently launched an entire field of educational research focused on how to best implement these skills. For those interested in a historic overview of research and development of engineering curricula prior to the establishment of the ABET 2000 criteria, including transferable skills, we refer to the seminal work by John Heywood on engineering education research (2005), in particular Chapter 2 on aim and objectives. We showcase this development in Chapter 1.3 of this handbook, where the authors introduce and discuss different frameworks on transferable competencies and skills developed over the past 20 years.

Whilst the discourse on competencies and skills and the frameworks encompassing them continues, for this handbook, we have decided to narrow our focus to a framework that is directly relevant to engineering graduates in any discipline and has been created by and for engineering professionals. This choice was motivated by the notion that in many countries the engineering profession is actively involved in the accreditation process and in formulating the degree requirements for engineering, as is explained in detail in Chapter 1.4.

The framework within which the transferable competencies and skills were defined also had to include science and engineering competencies and skills to ensure that the necessary interplay between the different sets of competencies and skills that engineers need to have is not overlooked.

To find such a framework, we turned to the many professional bodies in engineering that exist worldwide, be it discipline-oriented, such as IEEE (Institute of Electrical and Electronics Engineers), SAE International (formerly the Society for Automative Engineers), and ASM International (formerly the American Society for Metals), or organised through national bodies, such as Engineers Ireland, the Engineering Council (UK), Ie-Net (Belgium), Ordem dos Engenheiros (Portugal), Verein Deutscher Ingenieure (Germany), Federacja Stowarzyszeń Naukowo-Technicznych Naczelna Organizacja Techniczna (Poland), and Koninklijk Instituut voor Ingenieurs (KIvI) in the Netherlands, who collaborate internationally in networks such as Engineers Europe and the International Engineering Alliance (IEA).

What all these bodies have in common is striving to affirm and develop the professional identity of engineers. Many of these institutions, depending also on local regulations, are involved in the accreditation of their national engineering programmes and the mutual recognition of these accredited degree programmes, as was explained in Chapter 1.4. Many professional bodies in the English-speaking world offer the possibility for their members to become professionally registered with their professional body, with a variety of different types of registrations, with the highest status being that of Chartered Engineer (this titled is used in Ireland, the United

Kingdom and more recently also the Netherlands, in other countries the term Professional Engineer is used). As detailed in Chapters 1.3 and 1.4, having this registration allows the holder to have their qualification recognised as equivalent in other Washington Accord signatory countries. This is often needed if an engineer wants to progress to more senior roles in their career (Engineering Council, 2020).

The requirements one must meet for professional registration have been laid down in official standards in many countries, such as Australia, Canada, Ireland, the Netherlands, and the United Kingdom. These standards are often also used as a basis for the accreditation process of individual engineering programmes and are recognised under the various accords as discussed in Chapter 1.4. Hence, for our framework, we have decided to use the Chartered Engineer Standard as specified in UK-SPEC: The UK Standard for Professional Engineering Competence and Commitment (4th edition), as published by the Engineering Council (2020) is our starting point. This framework is similar to the Chartered Engineer Standards of Engineers Ireland and of the KIvI in the Netherlands, and in line with the EUR-ING SPEC of Engineers Europe (formerly FEANI) and its EUR-ACE label.

The Engineering Council (2020) centres UK-SPECs around five key areas:

A. Knowledge and understanding
B. Design, development, and solving engineering problems
C. Responsibility, management, and leadership
D. Communication and interpersonal skills
E. Professional commitment

For each of these areas UK-SPEC defines demonstrable behaviour and abilities (that is, competencies and skills) that applicants must prove in order to be considered for professional registration. We felt that UK-SPEC was the most suitable framework as a point of reference. Firstly, because it forms a bridging function between higher education and professional practice. Secondly, because it also aligns well with scaffolding effects in the didactical and pedagogical design of competency and skill development. Thirdly, its central focus is on what qualifies someone as an engineer in a discipline-unspecific manner, which sets it aside from thematic competency frameworks in engineering education that focus on what competencies and skills an engineer should have to be competent in a specific area, such as competency frameworks for sustainability or entrepreneurship. Finally, it is publicly accessible, well established, and well-documented, while also compatible and transferable internationally.

For this handbook, we used the last three areas of UK-SPEC as a base for our selection of transferable competencies and skills to be included, as these were the areas which in our opinion focused primarily on transferable skills. We adjusted the wording slightly to eliminate any confusion, which resulted in three themes which form the framework of the handbook.

Theme I. Responsibility, project management, and leadership
Theme II. Communication and interpersonal skills

Theme III. Professional commitment and lifelong learning competencies

Based on the demonstrable behaviour and abilities listed in UK-SPEC, we created the list of individual competencies and skills that have been included in the handbook.

4 Transferable competencies and skills included in this handbook

In this section, we will detail, per theme, the included competencies and skills and how we define them within the context of this handbook. Research has shown that competencies and skills are often not explicitly defined, which causes confusion when wanting to implement competencies and skills in your own context (Leandro Cruz et al., 2019). For a deep dive, we recommend you consult Chapter 1.2. How you could teach each of these competencies and skills will be discussed in dedicated chapters in Part 2 of this handbook. For reference purposes we refer to the relevant chapter with each definition.

4.1 Theme I. Responsibility, project management, and leadership

The theme of responsibility, project management, and leadership, centres on the engineer taking responsibility and being in the lead within an operational and process context. The included competencies and skills in this section are project management skills (on a process level), meeting skills, risk analysis & risk management skills, and Leadership Skills.

For *project management* (on a process level), discussed in detail in Chapter 2.2, we use the definition of the Association of Project Management (2024): "*the ability to apply processes, methods, skills, knowledge and experience to achieve specific project objectives according to the project acceptance criteria within agreed parameters"*.

We define *meeting skills* (Chapter 2.3) as a set of teachable professional competencies that enable engineers to prepare for, participate in, lead, and follow up on meetings effectively. These skills extend beyond generic communication abilities, encompassing technical precision, facilitation strategies, structured decision making, documentation standards, and inclusive participation practices tailored to engineering environments (Changpueng & Pattanapichet, 2024; Galster et al., 2024).

For *risk analysis and risk management skills* (Chapter 2.4), we adopt the definition by NASA (2007): the ability to carry out a risk analysis and manage and mitigate identified risks in engineering design and operations.

Finally, for *leadership skills* (Chapter 2.5), we follow the definition of the Systems Engineering Body of Knowledge (SEBoK, 2024): "*The ability to create the environmental conditions conducive to good performance: support of shared understanding, innovation, problem-solving, resilience and learning"*.

4.2 Theme II. Communication and interpersonal skills

The second theme, communication and interpersonal skills focuses on the competencies and skills engineers need to communicate and work with others. These include teamwork, oral presentation skills, written communication and reporting skills, visualisation skills (in combination with spatial ability and representational literacy), interpersonal communication skills (including awareness of others, one-on-one communication, and participation in meetings and groups), providing feedback, and feedback literacy.

Teamwork (Chapter 2.6) refers to coordinating individual contributions with others when working together in teams. It has many different aspects that can be considered, such as collaborative goal setting, diverse, intercultural, and inclusive teamwork, engagement, goals setting in teams, and multi-, inter- and transdisciplinary teams as defined in detail by Leandro Cruz and Saunders-Smits (2019).

Under *oral presentation skills* (Chapter 2.7), we include *presentation skills*, defined by Leandro Cruz and Saunders-Smits (2019, p. 13) as "*the ability to give a clear, organised and logical speech and answer questions adequately and with elaboration*", *the quality of presentation method*, defined as "*the ability to develop presentation methods and mediums depending on the topic and target group*", and *pitching skills*, "*the ability to convey and persuade audiences within a short 1–3-minute speech*".

We define *written communication and reporting skills* (Chapter 2.8) as "*the ability to develop a logical, accurate, detailed, and organised written product using the appropriate language and style without grammar mistakes and with accurate references*" (Leandro Cruz & Saunders-Smits, 2019, p. 17).

For *visualisation skills* (Chapter 2.9), we derived our definition from Sorby et al. (2013) and Raju and Sorby (2024) as the active, applied processes that draw on spatial ability to construct, interpret, and work with images in order to understand and solve engineering problems. These skills form a core triad with *spatial ability*, defined as the cognitive foundation, and the capacity to generate, retain, and mentally manipulate visual images in two- and three-dimensional space (Buckley et al., 2018; Lohman, 1994) and *representational literacy* which addresses how visual-spatial thinking is externalised, communicated, and refined. It refers to proficiency in creating, interpreting, and working flexibly with the visual language of engineering, such as via technical drawings, schematics, free-body diagrams, and digital models (Johri & Lohani, 2011).

In our definition of *interpersonal communication skills* (Chapter 2.10), we follow Leandro Cruz and Saunders-Smits (2019) by seeing this as the combination of *listening skills*, defined as the "*ability to attend closely to verbal and non-verbal messages to ensure accurate interpretation*", *adaptive communication ability*, defined as the "*ability to build trust and sustain constructive relationships over time*", and the *interconnection/interrelation ability*, defined as "*the ability to build and retain formal and informal relationships or networks*" (Leandro Cruz & Saunders-Smits, 2019, p. 13).

With regard to *providing feedback* (Chapter 2.11), we define feedback as "*a process through which learners make sense of information from various sources and use it to enhance their work or learning strategies*" (Carless & Boud, 2018, p. 1315).

Finally, we refer to *feedback literacy skills* (Chapter 2.12) as "*the understandings, capacities and dispositions needed to make sense of feedback information and use it to enhance work or learning strategies"* (Carless & Boud, 2018, p. 1316).

4.3 Theme III. Professional commitment and lifelong Learning competencies

Finally, the third theme on professional commitment and lifelong Learning competencies, focuses on the engineers themselves. These are the competencies and skills engineers need to be able to continue to develop themselves and grow. This is often referred to as lifelong learning, which encompasses all learning activities undertaken throughout life with the aim of improving knowledge, skills, and competences, within personal, civic, social, or employment-related perspectives (Commission of the European Communities, 2001; Van den Broeck et al., 2024). Competencies and skills included in this theme are self-regulation, self-reflection, and self-direction, adaptability for change or change management, resilience and the ability to cope with changes, failures, and success, information literacy skills, autonomous motivation, learning beliefs and strategies, initiative, and perseverance.

We define *self-regulation* using the well-known definition of Zimmermann (2002, p. 65-66) as "*learners being proactive in their efforts to learn because they are aware of their strengths and limitations with learning and because they are guided by personally set goals and task-related strategies involving self-motivation and behavioural skill development and involves the selective use of specific processes that they will personally adapt to the learning task"*.

For *self-reflection*, we turn to the American Psychological Association (2018c) which defines this as "*examination, contemplation, and analysis of one's thoughts, feelings, and actions"*.

We use the definition of Garrison (1997, p. 18) for *self-direction* as "*an approach where learners are motivated to assume personal responsibility and collaborative control of the cognitive (self-monitoring) and contextual (self-management) processes in constructing and confirming meaningful and worthwhile learning outcomes"*. All three concepts are included in Chapter 2.13.

For the definition of *adaptability for change or change management* (Chapter 2.14), we follow Hall and Chandler (2005, p. 163): "*a learner's adaptability involves identifying qualities which are critical for future performance and being both willing and able to make personal changes to meet those needs in a proactive way"*.

For *resilience* or ability to cope with changes, failures, and success (Chapter 2.15), we again turn to the American Psychological Association (2018b) which defines this as "*the process and outcome of successfully adapting to difficult or challenging life experiences, especially through mental, emotional, and behavioural flexibility and adjustment to external and internal demands"*.

In the context of this handbook (Chapter 2.16), we define *information literacy skills* as "*a set of abilities to identify the need for information, find and evaluate it effectively, and use it in an ethical and legal manner to solve engineering problems. It underpins* *lifelong learning and supports the critical evaluation of automated information sources"* (ACRL, 2006).

Discussed together in one chapter (Chapter 2.17) in Part 2, we define *autonomous motivation* as intrinsic motivation, doing something because it is inherently interesting or enjoyable or motivating oneself by focusing on positive external factors, derived from Ryan & Deci (2000), *learning beliefs* as a person's subjective judgements about a relation between learning and his or her values or attributes (Fishbein & Ajzen, 1975), and *learning strategies* as *"an individual's way of organizing and using a particular set of skills in order to learn content or accomplish other tasks more effectively and efficiently in school as well as in non-academic settings"* (Schumaker & Deshler, 1992, p. 22).

The final two competencies in this theme are perseverance and initiative (Chapter 2.18). Here, *perseverance* is defined as *"the quality or state of maintaining a course of action or keeping at a task and finishing it despite the obstacles (such as opposition or discouragement) or the effort involved"* (American Psychological Association, 2018a), and *initiative* as *"behavior characterized by its self-starting nature, its proactive approach, and by being persistent in overcoming difficulties"* (Frese & Fay, 2001, p. 134).

For easy reference, all definitions can also be found in the Glossary at the end of this handbook.

4.4 What was not included

If you were to go through the list of demonstrable behaviours and abilities of the UK-SPEC, you will notice that we have not included everything listed there. In this section, we explain what we decided not to include and our motivations. We would like to emphasize that our decisions to not include a certain skill or skill set should not be seen as scientific judgement based on undeniable proof of what is and is not a transferable competency or skill, on what is or what is not important, or what is a single competency or skill and what is a subset. That is not the debate we are aiming to settle in this section, nor is it a debate that will likely ever be definitively settled; it will likely always be an ongoing academic discourse. Rather, the aim of this section is to simply set out the choices we made and why, so that you as reader are aware of these choices and our motivations for making them. This information may help you make your own choices if needed.

As this handbook explicitly deals with transferable competencies and skills, we have not included any competencies or skills that are often seen to be implicitly or explicitly part of discipline-related engineering, science (e.g., natural sciences, computing), and mathematics modules, such as analytical skills, problem solving skills, computational thinking, design thinking, research skills, and computer-aided design (CAD) skills. In addition, some of these skills, such as computational thinking, are rapidly developing from what was seen as a technical skill (Aho, 2011) within computer science into its own competency framework with its own set of (technical and transferable) competencies and skills applicable beyond the field of computer science. As suggested by Jeanette Wing in 2006, it includes four pillars: problem decomposition, pattern recognition, abstraction, and algorithmic thinking (Wing, 2006, 2011).

We also did not include creativity as an explicit transferable competency as it is not specifically listed as a competency or skill in the UK-SPEC but rather as a method, in line with observations by Cropley (2015) that many see creativity as a natural part of problem solving within engineering. Cropley expresses concern that by not explicitly including creativity as a method, programmes risk focusing excessively on narrow and deep technical specifications, with little or no room in the curriculum for developing the ability to think and act creatively. This is perhaps also a skill that should fall in the transdisciplinary category of competencies and skills as detailed in the SEFI position paper on Competencies and Skills in Engineering Education (SEFI, 2025). We see these as different from transferable skills with transdisciplinary competencies and skills defined as those that *"[a]fford an outward facing, broader appreciation and active engagement with traditional and non-traditional sources of knowledge from both academic and non-academic domains. These encompass skills related to ethical decision-making, sustainability and social responsibility*" (SEFI, 2025, p. 2). In this handbook, we will not cover transdisciplinary competencies and skills.

We also did not include innovation and entrepreneurship skills or sustainability skills. There are two reasons behind this decision. First, much like creativity, these skills are explicitly categorised as transdisciplinary competencies and skills in the SEFI (2025) Position Paper. Second, in our view, they are not referred to in the UK-SPEC framework as a competency or skill, but rather as a method: *"Chartered Engineers develop solutions to complex engineering problems using new or existing technologies, and through innovation, creativity and technical analysis"* (Engineering Council, 2020). As transdisciplinary skills, they are large umbrella concepts with their own framework of corresponding competencies and skills that deserve attention in their own dedicated handbooks, even though there may be an overlap with the required transferable competencies and skills. An example is the entrepreneurship competence framework of the European Union, EntreComp (European Commission, Joint Research Centre, 2016) and its 'sister' framework GreenComp (European Commission, Joint Research Centre, 2022). We believe teaching and assessing these competencies to be different from the competencies and skills in this handbook and have therefore not included them.

The UK-SPEC also explicitly mentions language skills and more specifically that an engineer must be able to communicate in English as one of the official languages of the United Kingdom. Whilst part of this is implicitly covered in Theme II in the oral and written presentation and reporting skills, the learning of languages, if offered to engineering students at all, is often taught as a separate module in addition to or outside the formal curriculum by linguists who are trained to do so. In many countries where English is not the first language, students will already have been taught English in secondary school to a good level, often enabling them to follow university classes in English. As a result, in many programmes, the learning of languages is not included as a mandatory and integrated part of the engineering curriculum. Hence, we decided to exclude this skill from the handbook.

We also did not include health and safety and environmental awareness as transferable competencies or skills in this handbook. Whilst implicitly covered in certain competencies and skills in Theme I and III, the more in-depth teaching of such skills is too discipline- and country-specific.

Finally, and perhaps controversially to some, we also did not include ethics as a transferable competency or skill. Recently, an excellent handbook on teaching ethics in engineering education has been published. We therefore refer the reader who is interested in the actual teaching of ethics in engineering education to the *Routledge international handbook of engineering ethics education* (Chance et al., 2024). The handbook was initiated and overseen by SEFI's Ethics SIG and is a great resource for anyone interested in teaching ethics.

5 How to use this competency framework and the underlying transferable competencies and skills

If you have read the previous chapters, then you know that this is not the only framework out there. We also would like to stipulate that the framework presented in this chapter is NOT a 'gold standard" that must be adhered to at all costs. We chose this framework because we felt it is the most generic framework within engineering and would resonate with any engineering educator regardless of discipline or background. What we do hope you will take away is that acquiring transferable skills is an important part of the education of engineers, and that this notion is not only supported by scientific research, but also by engineering professionals, their employers and their representatives.

We hope you will see the framework presented as a tool, a scaffolding, a handle or a guide, or all the previous, to help you position all or some transferable competencies and skills within your teaching and your curriculum. We intend for you to use this framework and this handbook to help you identify your needs in helping students reach their educational goals in your context, within your institution, and in your country, within the context of the applicable accreditation requirements for your institution.

5.1 The sustainability of the competency framework and the definitions used in this handbook

As with any framework, ours is a snapshot in time and not a set of eternal truths carved in stone. The same goes for the individual competencies and skills it describes. We live and teach in an era of disruption and sociotechnical transformation. While overarching goals like the Sustainable Development Goals (SDGs), as developed by the United Nations (2015), offer a helpful compass through to 2030, we believe — as outlined in SEFI's position paper — that shaping engineering education to be professional, responsible, impactful, and future-proof requires a blend of technical, transferable, and transdisciplinary competencies and skills.

Each of these categories plays a different role. Technical competencies and skills respond directly to fast-paced technological advancements. Transdisciplinary competencies and skills connect with stakeholders from across society, industry, and politics, and are shaped by various interests and systemic dynamics. Transferable competencies and skills, we believe, offer a kind of persistence as they may be more stable over time.

Of course, even transferable competencies and skills are rooted in ever-evolving theoretical frameworks and shaped by shifting contexts. They reference and reflect knowledge domains and practical demands that change over time or sometimes even abruptly. Still, they represent core human capacities that are not only essential for the engineering profession, but also fundamental for personal growth and development. By strengthening engineers' sense of agency, they also foster a deeper experience of self-efficacy. In that way, they contribute meaningfully to both personal development and the broader skillset engineers need to navigate technical and technological challenges across projects, between organizations, and within societal contexts.

That said, values and goals, both individual and collective, have changed over time, and there is no reason to think they will not continue to do so. For that reason, even though transferable competencies and skills feel more enduring, they too must be continually re-examined. Only the test of time, that will need to be measured against evolving social frameworks and the expectations of professional bodies, will show which aspects prove truly resilient, persistent, and relevant. In Part 5 of this handbook, we offer various chapters on how you can evaluate this.

We expect that our framework, definitions, methods, and examples will continue to be of use in shaping engineering education but will not last in this exact form for eternity. Therefore, we welcome their discourse, contestation, and evolution through original research and new, innovative teaching and learning approaches. We hope that future educators and researchers will make use of the open access status of this publication to update and create relevant future versions of this handbook.

5.2 But my situation is different from yours

At this point, we would like to emphasise that the framework, just like the individual competencies and skills, is an abstraction that must be adapted to be applicable in specific circumstances and situations. This means that this handbook is not a manual to be followed to the letter but rather offers guidance and inspiration on how these competencies and skills can be developed in your own teaching. What matters most is that we do not aim to provide standardised knowledge but to enable students to develop a form of agency that prepares them to be a professional engineer as much as a responsible citizen, i.e., to become an agentic, holistic engineer.

We therefore encourage you to have the courage to leave behind the safety of either right or wrong, black or white, and to step forward into the grey area between those poles. Precisely because there is no single right or wrong, this is a learning journey that we, as educators, embark on together with our students. This handbook offers a wealth of ideas to help you unlock these potentials. At the same time, each situation is as individual as the students we work with. There is no one-size-fits-all solution. This applies to the framework (which is why, as shown in Chapter 1.3, there are many frameworks), as well as to the individual competencies and skills covered in Part 2.

6 In closing

Teaching transferable competencies and skills depends on multiple factors, such as the discipline, the number of participants in a module, room facilities, availability of digital and non-digital tools, study regulations, educators' resources, and many more. This handbook is intended to provide orientation within this resulting diversity of possibilities and to offer suggestions, provide references, enable deeper engagement, raise awareness of potentials, and above all, encourage experimentation and further development of one's own teaching. We implore you to browse the handbook for an inspirational overview as well as delve deeper into any and all matters of interest to you, to build on the expertise and insights offered in this handbook and pursue further readings and resources. Most of all, and we cannot stress this enough, we encourage you to try new ways of teaching beyond the trodden pathways and explore strategies, methods, and tools provided in this handbook. Do let us know how you get on!

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During the preparation of this work the authors did not make use of any AI tools.

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