

Call for Interest in publishing a chapter in:

# SEFI Handbook on Engineering Skills – Volume A: Teaching Core Transferable Competencies & Skills in Engineering

Evidence-based Guide for Engineering Education Practitioners

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*This book project is part of the activities of the SEFI Special Interest Group on Engineering Skills. For more information on SEFI, the European Society for Engineering Education, please see [Sefi.be](http://Sefi.be).*

## I. Overview

### Why this handbook?

Transferable competencies and skills are an intrinsic part of Engineering Education, though not directly related to a specific engineering discipline. Whilst a lot of research has been done in this area, this research area is very wide, context-specific and hard to navigate for engineering practitioners, who want to learn more or improve their current teaching of transferable skills. In addition, not all practitioners have access to this research. This is why we intend to create an evidence-based handbook on teaching transferable skills in engineering programmes aimed at engineering education practitioners, curriculum developers, and budding engineering education researchers interested in transferable competencies and skills.

[Click here](#) for more information on the use of the terminology of transferable competencies and skills

## Which transferable competencies and skills are included?

The scope of this handbook is focused to allow for sufficient depth. The transferable competencies and skills in this handbook are centred around three main themes, relevant to the engineering profession:

- I. Responsibility, Project management and Leadership
- II. Communication and interpersonal skills
- III. Professional commitment/Lifelong Learning competencies

To assist authors, each (sub) competency and skill has been operationalised.

[Click here](#) to see the tables of included competencies and skills and [their definitions](#).

[Click here](#) to read more about the raison d'être behind the included competencies and skills and what was excluded.

## Contributions Sought

In this document, we present a content overview of each part and their list of chapters or topics for potential authors to contribute, followed by the Submission Information and a Timeline. We seek contributions for chapters in Parts 2, 3, 4, and 5. Contributions to Part 1 will be by invitation only, the chapter titles have been listed below for information purposes.

*We are aiming for collaborative contributions as we should practise what we preach. The editors reserve the right to invite authors to write collaborative contributions for a specific chapter, based on the expressions of interests submitted.*

## II. Contents

The book consists of 5 distinct parts, with each part concluded by a reflection authored by the part editors and the chapter authors.

### Preface

- 0.1 Foreword
- 0.2 What is SEFI?
- 0.3 SEFI SKILLS POSITION PAPER 2024

## Part 1 - Competencies: Context & Challenges

The objective of this part of the handbook is to explain why competencies and skills are important in Engineering Education, detail the competencies and skills landscape within the context of the different theoretical skills frameworks that exist in Europe, on an (inter)governmental level, engineering level, an engineering education level and accreditation level to land at the framework used and the competencies and skills covered in this handbook.

### Chapters Part 1

- |     |  |                   |
|-----|--|-------------------|
| 1.0 | Introduction including the Importance of Skills and Competences in Engineering Education | [Editors]         |
| 1.1 | The definition of competency and skills in an international context                      | [Invited chapter] |
| 1.2 | Existing competency frameworks   | [Invited chapter] |
| 1.3 | The role of competencies and skills in the accreditation of Engineering Education        | [Invited chapter] |
| 1.4 | Competency and Skills Framework used in this handbook                                    | [Editors]         |

## Part 2 - Embedding competencies and skills in your classes

The objective of this part is to explain how to embed skills and competency development in Engineering Education in an evidence-based way illustrated by successful and unsuccessful interventions from the field. We aim for contributions for each of the competencies and skills as can be seen from the list of chapters. The chapter titles and the accompanying operationalisation of the competencies and skills are to guide authors and do not preclude including related competencies not listed and proposals to adjust the operationalisation of the terms. The aim is for chapters in this part of the handbook to assist practitioners in interventions within a module or subject, or a series of modules, not an entire curriculum.

### Chapters Part 2

- |     |   |                          |
|-----|---|--------------------------|
| 2.0 | Introduction  | [Part Editor]            |
|     | <i>1. Responsibility, Project management and Leadership</i> |                          |
| 2.1 | Project management (on process level)                       | [Contributions welcomed] |
| 2.2 | Meeting skills  | [Contributions welcomed] |
| 2.3 | Risk analysis and risk management skills                    | [Contributions welcomed] |

2.4	Operational Awareness	[Contributions welcomed]
2.5	Leadership Skills	[Contributions welcomed]
<i>II. Communication and interpersonal skills</i>		
2.6	Teamwork	[Contributions welcomed]
2.7	Oral Presentation and Reporting skills	[Contributions welcomed]
2.8	Written Presentation and Reporting skills	[Contributions welcomed]
2.9	Visualisation skills	[Contributions welcomed]
2.10	Interpersonal communication skills incl. Awareness of others (one-on-one and in meetings/groups):	[Contributions welcomed]
2.11	Feedback	[Contributions welcomed]
<i>III. Professional commitment/Lifelong Learning competencies</i>		
2.12	Self-regulation, self-reflection, & self-direction	[Contributions welcomed]
2.13	Adaptability for change/Change Management	[Contributions welcomed]
2.14	Resilience/Ability to cope with changes, failures and success	[Contributions welcomed]
2.15	Information Literacy Skills	[Contributions welcomed]
2.16	Autonomous Motivation	[Contributions welcomed]
2.17	Learning Beliefs and Strategies	[Contributions welcomed]
2.18	Initiative and Perseverance	[Contributions welcomed]
2.19	Reflection	[To be determined]

### Part 3 – Assessing Competencies

The objective of this part is to present evidence-based examples on how to assess skills and competency development in students within Engineering Education. For this part, we are inviting collaborative contributions on evidence-based good practice assessment illustrated by best practice examples that assess the skills and competencies included in this handbook. We are hoping for sufficient contributions to address all potential ways of assessing skills and competencies

## Chapters Part 3

3.0	Chapter Introduction including Overview of Assessment Methods	[Part Editor]
3.1	Peer & Self-Assessment	[Contributions welcomed]
3.2	Rubrics	[Contributions welcomed]
3.3	Portfolios	[Contributions welcomed]
3.4	Observations	[Contributions welcomed]
3.5	Combining assessment methods	[Contributions welcomed]
3.n	Additional assessment methods not included in the above list	[Suggestions for Contributions welcomed]
3.Z	Reflection on Assessing Skills and Competencies	[To be determined]

## Part 4 – Embedding transferable competencies and skills at the curriculum level - the Current State-of-the-Art

This part highlights the current state-of-the-art in skills education in Engineering Education. It aims to provide the reader with examples of how competencies and skills have been balanced in entire curricula. For this part, we are inviting chapters from individual institutes with case studies of how competencies have been embedded in entire engineering degree programmes/curricula using evidence-based best practice examples on skills education to have sufficient contributions that all competencies and skills included in this handbook are covered using a versatility of approaches. We are looking for a minimum of 5 chapters with state-of-the-art examples in this part from all over the world.

## Chapters Part 4

4.0	Introduction	[Part Editor]
4.1	Institution 1 – Programme X	[Contributions welcomed]
4.2	Institution 1 – Programme Y	[Contributions welcomed]
4.3	Institution 2 – Programme Z	[Contributions welcomed]
4.n	Etcetera	[Contributions welcomed]
4.Z	Reflection	[To be determined]

## Part 5– Evaluating needs, interventions, and outcomes of skills and competencies

The objective of this part is to challenge the reader a bit further. This part is the advanced section: Now that new competencies and skills have been implemented or an intervention in a course or curriculum has been staged, how can its outcomes be evaluated? How can one investigate whether the competencies and skills included in your teaching are still relevant? In this part, experienced Engineering Education researchers explain how to scientifically research this and share some of their best practices and top tips. This part also shares how people can disseminate their findings. We are hoping for contributions to assist the reader in their goals.

### Chapters Part 5

5.0	Chapter Introduction on Evaluating needs, interventions, and outcomes	[Part Editor]
5.1	How to evaluate education outcomes?	[Contributions welcomed]
5.2	How to evaluate interventions	[Contributions welcomed]
5.3	How to evaluate relevance of skills & competencies	[Contributions welcomed]
5.4	How to share your findings	[Contributions welcomed]
5.n	Additional suggestions for relevant chapters	[Suggestions for Contributions welcomed]
5.Z	Reflection	[To be determined]

## III. Submission Process

This book project will follow a 3-step review process. Prospective authors are invited to convey their interest to contribute to a chapter, no later than **1 December 2024** using [this form](#).

The expression of interest must contain the following information:

- Name of Authors and their affiliation
- A short description per author of their expertise on the subject
- Which Part they would like to contribute to
- Which chapter or proposed chapter
- When applicable: the addressed competencies and skills.

- Abstract of max. 250 words outlining the chapter

By **31 January 2025**, the editorial team will confirm the authorship and request the authors to submit a chapter. If similar chapter proposals are received, the editors reserve the right to invite authors to collaborate on a joint chapter. We welcome contributions worldwide but ask that the terms of reference used are relevant in a European context and reference framework (Bologna Agreement and European Qualification Framework).

After accepting the authorship request and the copyright conditions, the full manuscript of each chapter should be submitted by **1 September 2025**. Authors will receive guidelines, including a template, upon confirmation of the authorship and copyright agreement. Each chapter is expected to be between 7,000 and 9,000 words but no longer than 9,000 words, including all references, figures, and illustrations. Contributions will undergo a double-blind peer-review process. Authors are expected to peer review one or two chapters for other book sections. Comments to authors on the initial manuscript will be returned by **15 December 2025**. Authors are expected to submit a revised manuscript for a second round of review by **1 March 2026**. Authors will be notified of the final comments by **15 April 2026** and finalised full chapter manuscripts are due **31 May 2026**. The editors reserve the right to reject full-chapter manuscripts and invite contributions to replace rejected chapters. All full chapter submissions will be done via: *To be announced*

It is intended to launch the first edition of the handbook during the 2026 SEFI Annual Conference.

## IV. Timeline

Deadline	Activity	Who
2 September 2024	Invitation for expression of interest for contributions to go out at SEFI 2024 annual conference	Editors-in-Chief
1 December 2024	Deadline for expression of interest	Interested authors
31 January 2025	Invitation to write contributions to authors	All editors
1 September 2025	Deadline submission of chapters for peer review	Authors
1 December 2025	Deadline completion peer review	Peer reviewers
15 December 2025	Peer review comments to authors	Editors
1 March 2026	Revised chapters due	Authors

1 April 2026	Deadline completion second peer review	Peer reviewers
15 April 2026	Peer review comments to authors	Editors
31 May 2026	Final chapter manuscripts due	Authors
September 2026	Launch Handbook at SEFI Annual Conference	All

[Click here](#) for the list of references used

## Additional Information

### Vocabulary Use of Transferable Competencies and Skills

In this handbook, we will use the term ‘transferable competencies and skills’. As already indicated by UNICEF (2019) many different names for transferable skills, such as transversal, 21<sup>st</sup> century, soft skills, etc. exist. In engineering literature (Leandro Cruz et al 2020, Craps et al 2021), other terms used are professional, employability, and non-technical skills. In the context of this handbook, we will use the term transferable competency and skills. UNICEF defines transferable skills and competencies 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). 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 (Kearns et al 2016 and Guerrero & Del Los Rios 2012). As this handbook is intended for an international audience, we will use the umbrella term of competencies and skills.

A background on the many different definitions of transferable competencies and skills and the use of the words: *competence*, *competency*, and *skills* will be discussed in Chapter 1.2 of the handbook.

### Raison d’être behind the selection of included competencies and skills

A quick scan of the literature on competencies and skills in engineering education will show many different frameworks of competencies and skills, which will be addressed in more detail in Chapter 1.3. These frameworks often consist of several subsets of skills and competencies, are not always well-defined (Leandro Cruz et al, 2020) and have many overlaps. Hence, for this handbook, we descoped the transferable competencies and skills to be discussed in this handbook and have defined the competencies and skills we feel should be included to a distinct sublevel as can be seen in table 1.

Although often already implicitly included in some way in engineering curricula from the start, transferable competencies and skills were not included as a formal part of accreditation requirements until 2000 when the Accreditation Board for Engineering and Technology started doing so (ABET, 2000). As a result, since then much more research has been done on how to formally implement competencies and skills in engineering curricula.

For our framework, we used the Chartered Engineer Standard as specified in UK-SPEC: The UK Standard for Professional Competence and Commitment (4<sup>th</sup> edition), as published by the Engineering Council (2020) as our starting point. This framework is similar to the

Chartered Engineer Standards of Engineers Ireland and of the Royal Institute for Engineers (KIVI) in the Netherlands, and in line with the EUR-ING SPEC of Engineers Europe (Previously known as FEANI) and EUR-ACE (Such as, for instance, France and Spain) and developed the individual skills and competencies from there. We selected three main themes to centre the transferable competencies and skills in this handbook around:

- I. Responsibility, Project management and Leadership
- II. Communication and interpersonal skills
- III. Professional commitment/Lifelong Learning competencies

## The list of included competencies and skills

Table 1 Overview of included transferable competencies and skills arranged by themes

<b>I. Responsibility, Project management and Leadership</b>			
I.A	Project management (on process level)		
I.B	Meeting skills		
I.C	Risk analysis and risk management skills		
I.D	Operational Awareness		
I.E	Leadership Skills		
<b>II. Communication and interpersonal skills</b>			
II.A	Teamwork	II.A.1	Collaborative Goal Setting
		II.A.2	Engagement in Teamwork
		II.A.3	Goal Setting in Teams
		II.A.4	Diverse, intercultural, and inclusive teamwork including non-homogeneous, cross-cultural understanding, and inclusive collaboration
		II.A.5	<u>Multi-/Inter/Transdisciplinary teams (beyond STEM and including AHSS)</u>
II.B	Oral Presentation and Reporting skills	II.B.1	Presentations skills
		II.B.2	Quality of Presentation Method
		II.B.3	Pitching skills

II.C	Written Presentation and Reporting skills		
II.D	Visualisation skills		
II.E	Interpersonal communication skills incl. Awareness of others (one-on-one and in meetings/groups):	II.E.1	Listening skills
		II.E.2	Interconnection/interrelation ability
		II.E.3	Adaptive Communication Style
II.F	Feedback	II.F.1	Giving Feedback
		II.F.2	Receiving feedback
<b>III. Professional commitment/Lifelong Learning competencies</b>			
III.A	Self-regulation, self-reflection, & self-direction	III.A.1	Self-regulation
		III.A.2	Self-reflection
		III.A.3	Self-direction
III.B	Adaptability for change/Change Management		
III.C	Resilience/Ability to cope with changes, failures and success		
III.D	Information Literacy Skills		
III.E	Autonomous Motivation		
III.F	Learning Beliefs and Strategies	III.F.1	Learning Beliefs
		III.F.2	Learning Strategies
III.G	Initiative and Perseverance	III.G.1	Initiative
		III.G.2	Perseverance

Using this framework all transferable competencies and skills included in this document have been divided into three categories (See Table 1). In the appendix to this document, the proposed operationalization of each skill and competence is listed.

## What did we not include?

There are of course many more skills and competencies that we could have included. Yet the handbook also has to still be practical. We have explicitly excluded:

- Any skills that are seen to be implicitly or explicitly part of discipline-related engineering, science (e.g., natural sciences, computing), and mathematics courses such as: Analytical skills, Problem Solving skills, Computational Thinking, Design Thinking, Research skills, CAD & Modelling skills
- Creativity which we assumed to be either covered in problem solving or explicit part of the discipline specific programme (e.g., Industrial Design, Product Design, Architecture)
- Innovation & Entrepreneurship, Sustainability skills: by choosing the labels from UK\_SPEC they are not specifically mentioned. Innovation & Entrepreneurship skills and Sustainability skills can be seen as umbrella terms for competency frameworks whose underlying subsets of skills and competencies are also largely covered in the subset of skills of UK-SPEC. Hence, we feel they are sufficiently covered.
- Ethics: covered implicitly under Responsibility and Professional Commitment (doing the right thing) but for the actual teaching of ethics in engineering education the reader is referred to the Routledge International Handbook of Engineering Ethics Education (Chance et al, 2024) which was initiated by the SEFI's Ethics SIG and will be published by the end of 2024.
- Language Skills: Implicitly covered in the oral and written communication and reporting. As the learning of languages is often taught as a separate course by linguists and not an integrated part of the engineering curriculum, it has been excluded.
- Health, Safety and Environment Awareness: covered implicitly under Responsibility and Professional Commitment but the more in-depth teaching of such skills is too discipline and country-specific to be classed as a transferable skill.

## Competency and Skills definitions

*Table 2 Working definitions of competencies and skills*

<b>I. Responsibility, Project management and Leadership</b>			
	<b>Competency/Skill</b>	<b>Operationalization</b>	<b>Source</b>
I.A	Project management (on process level)	Ability to apply processes, methods, skills, knowledge and experience to achieve specific project objectives according to	Association of Project Management (2024)

		the project acceptance criteria within agreed parameters	
I.B	Meeting skills	Ability to plan and run effective meetings by setting the agenda and appropriate audience ahead of time. Facilitating discussion, making decisions and setting actions during the meeting. Circulating minutes and following up on progress after the meeting	The Institution of Engineering and Technology (2015)
I.C	Risk analysis and risk management skills	Ability to carry out a risk analysis and manage and mitigate identified risks in engineering design and operations	NASA (2007)
I.D	Operational Awareness	Knowledge and understanding of operational processes, with the ability to react accordingly whenever there are any unexpected changes.	Coates (2004)
I.E	Leadership Skills	Ability to create the environmental conditions conducive to good performance: support of shared understanding, innovation, problem solving, resilience and learning	SEBOK (2024)
<b>II. Communication and interpersonal skills</b>			
II.A.1	Teamwork - Collaborative Goal Setting	Demonstrates a collaborative working spirit towards common goals	Leandro Cruz et al (2019)
II.A.2	Teamwork – Engagement	Shares information and knowledge with team members and shows engagement with teamwork	Leandro Cruz et al (2019)
II.A.3	Teamwork-Goal Settings in Teams	Ability to establish goals balancing self and team interests	Adapted from: Leandro Cruz et al (2019)

II.A.4	Teamwork - Diverse, intercultural, and inclusive teamwork (including non-homogeneous) including cross cultural understanding and inclusive collaboration	Ability to understand cultural differences, recognizes their importance or benefit and stimulates cooperative teamwork among people of different cultures and the ability to work in teams with people of different abilities, gender, backgrounds, and across hierarchical frameworks	Adapted from: Leandro Cruz et al (2019)
II.A.5	Teamwork - Multi-/Inter/Transdisciplinary teams (beyond STEM and including AHSS)	Ability to collaborate with team members of engineering disciplines as well team members from other disciplines, including clients	Adapted from: Leandro Cruz et al (2019)
II.B.1	Oral Presentation and Reporting skills - Presentation skills	Ability to give a clear, organised and logic speech and answers questions adequately and with elaboration	Leandro Cruz et al (2019)
II.B.2	Oral Presentation and Reporting skills - Quality of Presentation Method	Ability to develop presentation methods and mediums depending on topic and target group	Leandro Cruz et al (2019)
II.B.3	Oral Presentation and Reporting skills - Pitching skills	Ability to convey and persuade audiences within a short 1–3-minute speech	Leandro Cruz et al (2019)
II.C	Written Presentation and Reporting skills	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 et al (2019)
II.D	Visualisation skills	Ability to use and/or create of visual elements to convey ideas and information which include (but are not limited to) signs, typography, drawing, graphic design, illustration, industrial design, advertising, animation, and electronic resources	adapted from Wikipedia (2024)

II.E.1	Interpersonal communication skills - Listening skills	Ability to listen and understand verbal messages, and consequently act on what someone says or does	Leandro Cruz et al (2019)
II.E.2	Interpersonal communication skills - Interconnection/interrelation ability	Ability to build and retain formal and informal relationships or networks	Leandro Cruz et al (2019)
II.E.3	Interpersonal communication skills - Adaptive Communication Style	Ability to communicate properly, adapting style and language to the purpose, context, and environment	Leandro Cruz et al (2019)
II.F.1	Giving Feedback	Ability to give constructive feedback to improve team members' performance	Leandro Cruz et al (2019)
II.F.2	Receiving feedback	the understandings, capacities and dispositions needed to make sense of feedback information and use it to enhance work or learning strategies	Carless and Boud (2018)
<b>III. Professional commitment/Lifelong Learning competencies</b>			
III.A.1	Self-regulation	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	Zimmerman (2002)
III.A.2	self-reflection	examination, contemplation, and analysis of one's thoughts, feelings, and actions	American Psychological Association (2018)
III.A.3	self-direction	An approach where learners are motivated to assume personal responsibility and collaborative	Garrison, (1997)

		control of the cognitive (self-monitoring) and contextual (self-management) processes in constructing and confirming meaningful and worthwhile learning outcomes	
III.B	Adaptability for change/Change Management	A learner's adaptability involves identifying qualities which are critical for future performance and being both willing and able to make personal changes in order to meet those needs in a proactive way	Hall & Chandler (2005)
III.C	Resilience/Ability to cope with changes, failures and success	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	American Psychological Association (2018)
III.D	Information Literacy Skills	Information Literacy empowers people in all walks of life to seek, evaluate, use, and create information effectively to achieve their personal, social, occupational and educational goal	UNESCO (2023)
III.E	Autonomous Motivation	Intrinsic motivation, doing something because it is inherently interesting or enjoyable or motivating oneself by focusing on positive external factors	Ryan & Deci (2000)
III.F.1	Learning Beliefs	A person's subjective judgments about a relation between learning and his or her values or attributes	Ajzen & Fishbein (1975)
III.F.2	Learning Strategies	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	Schumacker & Deshler (1992)

		school as well as in non-academic settings	
III.G.1	Initiative	A new plan or process to achieve something or solve a problem	Cambridge Dictionary (2023)
III.G.2	Perseverance	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 (2023).

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