2.14

Adaptability in Engineering Education

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Adaptability is a core professional capability for engineers working in complex, rapidly changing environments. This chapter defines adaptability as the capacity to anticipate and respond to change by adjusting knowledge, skills, behaviours, and attitudes in ways that sustain performance and long-term growth. Drawing on psychology, career development, and engineering education, it frames adaptability as a multidimensional, learnable capacity encompassing cognitive flexibility, emotional regulation, motivation, collaboration, sociotechnical awareness, and reflective practice. For engineering educators, the focus is practical. The chapter translates theory into design principles and worked examples drawn from authentic teaching contexts, demonstrating how adaptability can be intentionally cultivated through project-based learning, teamwork, intercultural engagement, mentoring, and structured reflection. It also provides guidance on recognising adaptive processes in student work, including observable indicators, artefacts, and formative cues that make adaptability visible without reducing it to a single metric. By making adaptability explicit, visible, and equitably supported, you can help students develop the judgement, resilience, and professional agency needed to navigate uncertainty and lead change throughout their careers.

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1 What is adaptability?

Adaptability has been defined across multiple fields, but this chapter begins with SEFI's framing: *"a learner's adaptability involves identifying qualities that are critical for future performance and being both willing and able to make personal changes in a proactive way"* (Hall & Chandler, 2005, p. 163). This definition emphasises two essentials: learners must recognise what is changing and why it matters, and they must be both willing and able to adjust their skills, attitudes, and behaviours accordingly. Adaptability is therefore not passive reaction, but adjustment grounded in initiative.

The SEFI (2025) Skills Position Paper situates adaptability within professional commitment and lifelong learning, alongside resilience and reflective practice. In this sense, it is not an isolated trait but part of how engineering education prepares students to navigate complexity and change. To clarify what adaptability entails in practice, it is helpful to consider three complementary perspectives.

1.1 Conceptual foundations

Workplace psychology frames adaptability as the ability to adjust thinking and behaviour in response to new, changing, or uncertain demands (Martin & Rubin, 1995; VandenBos, 2007). Pulakos et al. (2000, 2006) describe adaptive performance as observable behaviours such as solving ill-defined problems, managing stress, learning new tasks, and working effectively with diverse others, making adaptability visible in action. Ployhart and Bliese's (2006) Individual Adaptability (I-ADAPT) theory conceptualises adaptability as a multidimensional construct encompassing cognitive, interpersonal, cultural, physical, and learning-related forms of adaptation. It emphasises that successful adaptation depends not only on ability but also on motivation and disposition.

Career development research approaches adaptability through the lens of transitions. Career Construction Theory defines career adaptability as the psychosocial resources individuals use to navigate change, summarized in the four Cs (Savickas, 2005; Savickas & Porfeli, 2012): concern (future orientation and planning), control (agency and responsibility), curiosity (exploring alternatives), and confidence (belief in one's ability to solve problems). These resources are learnable and predictive of how individuals manage uncertainty, decision points, and setbacks. Like workplace psychology, this perspective shifts adaptability from a vague personality trait to a structured set of developable capacities.

Engineering adds further nuance. Because engineering work is inherently dynamic, adaptability appears in reframing problems as conditions shift, managing ambiguity and stress, collaborating across differences, and continuing to learn as tools and technologies evolve (Brunhaver et al., 2024; Sajadi, 2022). The concept of adaptive expertise clarifies the balance between efficient application of knowledge and innovation in unfamiliar situations (Hatano & Inagaki, 1986). Design adaptability similarly emphasises anticipating change and building flexibility into systems from the outset (Fletcher et al., 2010). In engineering, adaptability is therefore both reactive (responding effectively) and proactive (designing for change).

Bringing these perspectives together, adaptability in engineering education can be defined as the capacity to anticipate and respond to personal, technical, organisational, or cultural change by adjusting knowledge, skills, and behaviours in ways that sustain performance, learning, and professional growth. It draws on multiple forms of reasoning and judgement, is enacted individually and collaboratively, and can be developed intentionally through educational experience. Rather than a fixed trait, adaptability is a professional capacity that can be deliberately cultivated.

2 Why adaptability matters

Adaptability matters because engineering is practised in dynamic and evolving conditions. Requirements shift, constraints emerge unexpectedly, and collaboration across disciplines and cultures is routine. Thriving in such environments requires more than technical competence; it calls for judgement, flexibility, and the capacity to adjust when circumstances change. Professional bodies have consistently identified adaptability as central to engineering formation. The Engineer of 2020 report (NAE, 2004) and SEFI's Skills Position Paper (2025) position it alongside resilience, reflection, and lifelong learning as foundational to professional identity rather than as a transient workplace trend. This section outlines four reasons why adaptability is essential in contemporary engineering education.

2.1 Professional and workforce context

Engineering now operates within rapidly shifting technological, environmental, and geopolitical conditions. Automation, climate transitions, demographic shifts, and global interdependence continually reshape professional practice and redefine what expertise looks like in context. Roles evolve as quickly as the tools and systems that engineers design. Employers therefore increasingly seek graduates who can make decisions under pressure, collaborate across boundaries, and continue learning as industries evolve (World Economic Forum, 2025).

In volatile contexts, organisations that can pivot and reconfigure are more likely to outperform those built on rigid models (Bennett & Lemoine, 2014). For engineers, this means technical expertise must be accompanied by the ability to integrate new information, reframe problems, and adjust strategies in real time. At the workforce level, adaptability supports employability, organisational resilience, and innovation.

2.2 Engineering practice under uncertainty

Engineering practice routinely involves ambiguity and constraint. Client priorities shift mid-project, testing reveals unanticipated failure modes, and regulatory or budget pressures compel redesign. Research on adaptive performance identifies behaviours such as managing stress, solving ill-defined problems, learning new tasks, and collaborating across difference as central to effective performance (Pulakos et al., 2000, 2006). These behaviours are visible in everyday engineering work: revising assumptions after a failed prototype, adjusting designs in response to stakeholder input, or redistributing team roles when expertise gaps emerge.

Studies of early-career engineers reinforce this pattern. Preparedness often means not having immediate answers but knowing how to proceed productively in unfamiliar situations (Brunhaver et al., 2024; Deters et al., 2024). In practice, adaptability is frequently expressed as resourcefulness and composure under pressure rather than dramatic innovation. For you as an educator, this matters because the conditions that define professional competence, including ambiguity, shifting constraints, and incomplete information, cannot be removed from engineering practice and must instead be navigated.

2.3 Lifelong learning and professional growth

Beyond responding to immediate workplace demands, adaptability sustains long-term professional growth. While specific technical knowledge may become obsolete, the capacity to extend, reinterpret, and transfer knowledge across contexts endures. The distinction between routine and adaptive expertise illustrates this balance (Hatano & Inagaki, 1986). Routine expertise supports efficient performance in stable situations; adaptive expertise supports innovation and learning in unfamiliar situations.

Professional growth depends on developing the ability to learn from disruption rather than merely react to it. Research on growth-oriented beliefs shows that individuals who treat ability as developable are more likely to persist and refine their competence over time (Yeager & Dweck, 2012). Adaptability, in this sense, underpins lifelong development by enabling engineers to expand their professional repertoire rather than simply maintain it.

2.4 Equity and inclusion

Adaptability has important implications for equity. Students do not encounter engineering from equal starting points. First-generation students, women, students of colour, international students, and others navigating systemic barriers often experience greater instability within educational systems. In such contexts, adaptability can function as a protective capacity. Career adaptability research highlights the four resources — concern, control, curiosity, and confidence — that support agency in the face of constraint (Savickas & Porfeli, 2012). Growth-oriented classroom climates have likewise been shown to strengthen adaptive responses and resilience, particularly in institutions serving historically underrepresented populations (Verdín & Pérez Leon, 2025).

At the same time, adaptability should not be framed as an individual responsibility to compensate for systemic inequities. Educational environments must be designed to support adaptive growth equitably. When supported intentionally, adaptability strengthens persistence, belonging, and long-term professional mobility.

2.5 Why this matters for engineering education

In summary, adaptability matters because it enables engineers to function effectively amid evolving conditions, supports innovation in dynamic technological and organisational contexts, sustains lifelong learning, and contributes to persistence across diverse pathways. Like technical competence, it requires deliberate cultivation. When left implicit, its development is uneven; when made visible, it strengthens both professional formation and educational equity.

3 Developing adaptability in engineering education

Adaptability develops when students must exercise judgement rather than follow routine procedures. Because it spans multiple aspects of learning and professional development, it cannot be cultivated through a single intervention. Research suggests that adaptive capacity strengthens when learners must interpret evolving conditions instead of applying predetermined responses (Hatano & Inagaki, 1986; Pulakos et al., 2000). The domains that follow represent complementary contexts in which adaptability can be intentionally developed.

To make these domains concrete, this section includes practice-based examples drawn from the author's teaching and programme design experience at Arizona State University, USA, situated within specific modules or programmes. While the examples reflect a single institutional context, they are intended to illustrate instructional approaches that can be adapted across engineering education settings. Each outlines the educational context, targeted dimension of adaptability, activity structure, evidence generated, and observable indicators of adaptive development. Together, they illustrate how adaptability can be intentionally designed for, made visible in student work, and supported across multiple stages of engineering education.

3.1 Experiential learning and project-based learning

Experiential and project-based environments foster cognitive adaptability by embedding complexity directly into technical problem solving. In experiential learning contexts, students engage with authentic tasks that require applying, testing, and revising knowledge in response to feedback from real or simulated situations. Project-based learning similarly situates students within sustained, open-ended challenges. When students confront shifting requirements, incomplete data, or ill-structured problems, they must reassess assumptions and refine strategies rather than rely on fixed solutions. Research on project-based learning shows that open-ended tasks increase tolerance for ambiguity and support iterative reasoning (Akinci-Ceylan et al., 2018; Hertz, 2018), while adaptive performance research highlights the value of practising responses to changing conditions (Pulakos et al., 2006).

Early exposure to open-ended design and problem-framing tasks helps students recognise iteration as a normal feature of engineering practice. As complexity increases, capstone and industry-based projects require reallocating resources, revising timelines, and redesigning in response to stakeholder feedback, particularly when constraints shift after substantial investment in an initial solution, as illustrated in Example 1. Experiential formats such as simulations and crisis scenarios further intensify these demands by introducing time pressure and competing constraints (Andrijcic, 2016; Audunsson et al., 2018). In this domain, adaptability becomes visible when students refine models, abandon ineffective approaches, and improve solutions based on new evidence.

Example 1. Mid-semester design constraint shift in capstone design

In a senior engineering capstone design module involving industry-sponsored teams of four to six students, a mid-semester constraint shift was introduced to develop both cognitive and technical adaptability under changing conditions. During week 6 of the 15-week semester, after completing a preliminary design review with their instructor, classmates, and industry sponsors, they received a formal "client update" memo introducing two new constraints: a 20% budget reduction and an additional regulatory requirement related to safety or environmental compliance, depending on the project focus. Teams were given ten days to submit a revised design brief (maximum eight pages), a structured change log with invalidated assumptions, alternatives considered, and resulting trade-offs documented, and a 600-word team reflection explaining how their reasoning evolved in response to the new conditions. Assessment prioritised the quality of revision and justification rather than improvement of the final design alone.

Annotated design revisions, structured change logs, trade-off matrices, and team reflections provided evidence of how students responded to disruption and uncertainty. Students demonstrated adaptive development when they identified flawed or outdated assumptions, abandoned sunk costs, articulated trade-offs transparently, and clearly linked revised constraints to redesign decisions. Because students often treat early design work as something to defend, introducing disruption after substantial investment created authentic cognitive tension similar to professional engineering practice. In this setting, adaptability became visible not only in the revised product but also in how students reframed their reasoning. One implementation insight was that students initially resisted abandoning prior work; explicitly normalising iteration reduced defensiveness and encouraged deeper analysis. Requiring a dedicated "Invalidated Assumptions" section also strengthened the quality of student reflection and justification.

3.2 Teamwork and peer learning

Adaptability in engineering is rarely individual. Team settings foreground interpersonal adaptability: the ability to adjust communication, coordination, and role distribution in response to others. Professional practice requires integrating of diverse expertise and managing disagreement productively (Boelt et al., 2023; Pulakos et al., 2000). Industry-sponsored projects similarly show that students rely on peer knowledge sharing and mentorship when navigating ambiguous situations (Misra et al., 2023).

Collaborative structures involving shared decision making, rotating leadership, and structured feedback create conditions for interpersonal adjustment. In these contexts, adaptability is evident when teams renegotiate direction, redistribute responsibility, and maintain cohesion despite competing perspectives, as demonstrated in Example 2. Over time, such experiences reinforce adaptability as a shared professional responsibility shaped through interaction and negotiation rather than an individual attribute.

Example 2. Role reversal and conflict analysis in a design module

To disrupt routine team dynamics and encourage perspective-taking, students in a Year 2 engineering design module participated in a structured role-rotation activity focused on developing interpersonal and collaborative adaptability. Conducted at two checkpoints during the semester (weeks 4 and 9), the activity required each student to temporarily assume a role they had not previously held (e.g., a technical lead became a stakeholder liaison). Teams were also presented with a short tension scenario, such as conflicting performance priorities or deadline compression. They then submitted a 2-3-page decision log documenting points of disagreement, alternatives considered, and how resolution was reached, along with a 300-500-word individual reflection analysing how their reasoning or communication shifted in the new role.

Student responses reflected adaptability when participants adopted alternative viewpoints, adjusted communication strategies, redistributed responsibility without escalation, and explicitly documented negotiated decisions. The activity generated role documentation, decision logs, and individual reflections that made collaborative adjustment processes visible. Disrupting established team hierarchies destabilised routine interaction patterns and required students to reconsider how they justified decisions and coordinated across difference. In this context, adaptability emerged through collaborative recalibration rather than technical revision alone. A key implementation insight was that students tended to avoid meaningful disagreement without structured prompts; explicit tension scenarios therefore deepened engagement and strengthened analysis. Requiring individual reflection also increased accountability and reduced the likelihood that dominant voices would shape the team narrative.

3.3 Cultural and global learning

Engineering practice increasingly spans geographic, disciplinary, and value boundaries. Intercultural adaptability involves reconsidering assumptions, communication styles, and evaluative criteria across difference. Studies of international collaboration show that students build adaptive capacity when navigating unfamiliar norms, time zones, and stakeholder expectations (Lord et al., 2013; Mthombeni et al., 2024). Integrating sociotechnical reasoning, i.e., balancing technical feasibility with ethical and social considerations, likewise requires perspective shifting (Czerwionka et al., 2025).

In this domain, adaptability is visible when students modify communication strategies, interrogate implicit values, and incorporate diverse viewpoints into technical decisions, a process reflected in Example 3 through students' reconsideration of context-dependent engineering priorities. Rather than treating difference as an obstacle, they learn to treat it as a prompt for reassessment, an increasingly central capability in global and interdisciplinary engineering contexts.

Example 3. Cross-case structural analysis across contexts

Students in a Year 2 engineering mechanics module enrolling approximately 60 students compared two structurally similar bridge systems situated in contrasting sociotechnical contexts to develop intercultural and sociotechnical adaptability. Conducted mid-semester during the application of structural analysis to real systems, the activity contrasted an urban US pedestrian bridge prioritising minimal deflection and long service life with a rural, flood-prone river crossing prioritising local materials, repairability, and community labour. After completing a simplified structural analysis, students wrote an 800-1000-word memo explaining how a design optimised for one context would need to adapt for the other, and vice versa. They were required to identify context-dependent assumptions, shifts in performance criteria, and implications for material choice and maintenance.

The resulting comparative modelling summaries, lists of context-dependent assumptions, and cross-case transfer memos revealed how students reconsidered what counted as an 'optimal' design under changing stakeholder priorities. Adaptive development became visible when students revised modelling assumptions in response to economic or cultural conditions and incorporated maintenance capacity and material access into their reasoning. Because mechanics problems are often treated as context-neutral, the activity highlighted the socially embedded nature of engineering judgement and encouraged students to recalibrate definitions of success rather than simply recalculate technical solutions. One design feature that strengthened the activity was the inclusion of a clearly labelled "Context-Driven Assumptions" section, which deepened analysis beyond simple cost comparison. Requiring individual submission prior to discussion also strengthened the quality of classroom dialogue.

3.4 Mindset and reflective practices

External disruption alone does not guarantee development. Psychological adaptability concerns how students interpret and regulate their responses to challenge. Growth mindset research shows that viewing ability as developable strengthens persistence under difficulty (Yeager & Dweck, 2012). Career adaptability research similarly highlights the importance of concern, control, curiosity, and confidence in navigating transitions (Savickas & Porfeli, 2012).

Educational practices such as iterative design, structured debriefs, reflective documentation, and low-stakes reframing exercises support this internal dimension, while tools including learning journals and online portfolios help students consolidate insight from experience. Example 4 highlights how recurring reflective checkpoints can help students recognise patterns in their responses to challenge and develop more intentional adaptation strategies over time. Here, adaptability is not simply in behavioural change, but in how students integrate challenges into their emerging professional identity.

Example 4. Adaptive reflection portfolio checkpoint

Across three checkpoints in a Year 1 engineering student success seminar enrolling approximately 20 students, learners engaged in a structured reflection process designed to support psychological and transitional adaptability. At weeks 4, 8, and 12, students wrote a 500-word reflection describing a specific academic challenge, their initial response, a strategy they adjusted or could adjust, and resources they used or avoided. At the final checkpoint, students reviewed earlier entries to identify patterns in how they responded to difficulty and developed a short adaptation plan for the following semester. The four Cs framework of concern, control, curiosity, and confidence was discussed explicitly to guide reflection and interpretation.

Timestamped reflection entries, pattern analyses, and forward-looking adaptation plans provided evidence of how students interpreted and responded to challenge over time. Students demonstrated adaptive development when they shifted from fixed-ability language toward strategy-focused analysis, engaged more readily in help-seeking behaviour, and transferred strategies across modules. The activity was particularly effective because early setbacks can threaten students' sense of belonging; by emphasising strategy adjustment rather than flawless performance, the seminar reframed difficulty as a normal part of transition and positioned adaptability as an identity-level skill. Providing anonymized model reflections improved analytical depth, while short, recurring entries supported stronger metacognitive growth than a single end-of-term reflection. Using low-stakes, completion-based grading also encouraged more candid reflection and reduced the tendency for students to tailor responses to perceived grading expectations.

3.5 Structured modules and transitional support

While adaptability often emerges within embedded learning experiences, it can also be cultivated deliberately through structured modules and mentoring programmes. Targeted interventions are particularly effective at strengthening transitional adaptability, the capacity to anticipate and navigate periods of change. Research suggests that these structured supports can strengthen the planning behaviours, agency, and confidence that underpin adaptive development (Cheung & Jin, 2016; Green et al., 2019).

Programmes may draw on frameworks such as the four Cs model of career adaptability (Savickas & Porfeli, 2012), while integrating reflective practice, goal setting, scenario planning, or resilience training. They are especially valuable at key transition points, such as the transition from secondary education to university, pre-capstone preparation, entry to professional practice, or the beginning of graduate study, when expectations shift and ambiguity increases (Koen et al., 2012). Example 5 demonstrates how structured peer mentoring can support students in navigating uncertainty, recalibrating expectations, and developing confidence during periods of transition. Even brief interventions can increase perceived adaptability, while sustained engagement tends to yield more durable effects (Janeiro, 2014). In this context, adaptability involves preparing for change as much as responding to it.

Example 5. Peer mentorship for doctoral transition

Because doctoral study is characterised by prolonged ambiguity and evolving expectations, incoming students in an Engineering Education doctoral programme were paired with advanced peer mentors to support the development of transitional and professional identity adaptability. Conducted throughout the first academic year, the programme unfolded in three stages. During the first month, students mapped anticipated and unanticipated uncertainties, including evolving adviser expectations and research ambiguity. In the second stage (months 2-4), mentors facilitated structured discussions focused on recalibration after proposal rejection, shifts in research direction, or teaching missteps. In the final stage, students and mentors co-developed a two-page plan for their adaptive development, outlining strategies for navigating evolving expectations. Guided prompts were used throughout to anchor discussion and reflection.

Transition mapping worksheets, mentor discussion summaries, and adaptive development plans documented how students interpreted and navigated uncertainty over time. Adaptive development became visible when students recognised that research directions evolve, proactively clarified expectations, responded constructively to critique, and demonstrated increased comfort with intellectual uncertainty. Peer mentorship was especially valuable because it normalised recalibration as part of scholarly practice rather than as evidence of failure, making adaptability visible as part of professional formation. In practice, structured prompts produced deeper conversations than informal mentor pairings alone, while early-semester implementation proved critical, because waiting until challenges escalated reduced effectiveness. Clear mentor role definitions also helped maintain the relationship as developmental rather than supervisory.

3.6 Cross-cutting developmental patterns

Although the domains above emphasise different aspects of adaptability, they share a common developmental structure. In each case, students encounter disruption, interpret what it means, and refine their response. The disruption may be technical (a failed design assumption), interpersonal (team disagreement), sociotechnical (competing stakeholder priorities), or transitional (shifting expectations). What matters is how students process and respond to it.

Across contexts, adaptability develops through repeated cycles of (1) exposure to change or ambiguity; (2) interpretation of its implications; (3) adjustment of reasoning, strategy, or behaviour; and (4) consolidation through reflection or feedback. When you design for these cycles intentionally, adaptability becomes visible and developable rather than incidental. Early experiences often focus on cognitive and psychological adjustment, while later experiences integrate interpersonal, sociotechnical, and professional identity dimensions. Over time, students move from reacting to change toward anticipating and managing it.

The sections above introduced these dimensions separately. Table 2.14.1 consolidates them into a single practitioner reference to support recognition and formative feedback in your own context.

Table 2.14.1: Observable indicators of adaptability in student work

Dimension	*Observable behaviours*	*Artefacts*	*Formative cues*
Cognitive/technical	Revises assumptions; reframes problems; compares alternatives	Design revisions; change logs; modelling memos	Identifies invalidated assumptions; uses conditional reasoning; justifies trade-offs
Interpersonal/ collaborative	Renegotiates roles; integrates perspectives; adjusts communication	Team decision records; peer feedback; conflict reflections	Documents disagreement and resolution; shows perspective-taking; redistributes responsibility productively
Sociotechnical/ intercultural	Reconsiders performance criteria across contexts; adapts priorities	Stakeholder analyses; comparative case memos	Recognises context-dependence of 'optimal'; integrates social and technical constraints
Psychological/ motivational	Adjusts learning strategies; seeks feedback; persists under uncertainty	Reflection entries; adaptation plans	Moves from fixed-ability language to strategy analysis; articulates transfer to future situations
Transitional/ professional	Clarifies expectations; recalibrates goals after critique	Development plans; revision narratives	Interprets feedback constructively; plans proactively for uncertainty

These indicators function as formative reference points rather than grading criteria. The emphasis is less on the product itself and more on the reasoning and adjustment it makes visible. When reviewing a change log or reflection, pay attention to how students explain their decisions, recalibrate strategies, and connect present learning to future action. Making these expectations explicit helps students understand that adaptability is demonstrated through process, not just outcome. For more formal assessment approaches, refer to Part 3 chapters on peer assessment, self-assessment, rubrics, observations, portfolios, and inclusive and ethical assessment.

4 Designing for adaptability

Because adaptability develops through cycles of adjustment and refinement, it must be designed intentionally. While some students acquire adaptive habits through experience alone, most benefit from explicit guidance, feedback, and support. Research shows that adaptive capacity strengthens when challenge is paired with structured feedback and reflection (National Academies of Sciences, Engineering, and Medicine, 2018; Pulakos et al., 2006). The principles below translate the developmental patterns described in Section 3 into practical decisions you can make in your curriculum.

4.1 Name adaptability explicitly

Students are unlikely to prioritise adaptability unless it is clearly identified. Define it explicitly in your course materials. Include it in learning outcomes, project briefs, and assessment criteria. Describe what it looks like in your discipline; for example, revising assumptions, responding to new constraints, managing ambiguity, or adjusting roles within a team.

Established frameworks such as adaptive performance (Pulakos et al., 2006) can provide students with shared language and structure. When adaptability appears in grading rubrics, feedback conversations, and milestone reviews, it becomes part of the evaluative architecture of the module rather than an implicit expectation. The goal is alignment, ensuring that goals, activities, and assessment consistently reinforce adaptability as a professional capability.

4.2 Design for productive complexity

Adaptability grows through meaningful challenge, but unmanaged challenge can erode confidence. Learning experiences should introduce complexity progressively rather than all at once. Early activities might involve open-ended problem framing or low-stakes ambiguity. As students gain experience, constraints can become tighter, timelines shorter, and stakeholder demands more varied, culminating in higher-pressure capstone or industry contexts.

Research on adaptive expertise indicates that novelty supports growth only when learners have sufficient scaffolding to interpret and respond constructively (Hatano & Inagaki, 1986). Mentoring, modelling, and structured opportunities to reconsider approaches are essential supports (Brunhaver et al., 2024; Misra et al., 2023). The aim is not to eliminate complexity, but to calibrate it so students develop confidence in engaging with evolving conditions rather than withdrawing from them.

4.3 Embed reflective processing

Exposure to challenge alone does not produce adaptability; interpretation does. Students need structured opportunities to examine how they responded to disruption. After design revisions, team conflict, or unexpected constraints, require brief analytical reflections focused on reasoning and adjustment.

Short, recurring reflection cycles are often more effective than a single end-of-term reflection. Iteration logs, post-milestone debriefs, or targeted peer discussions help students consolidate what they learned from disruption (Liu & Wan, 2024). Reflection should focus on patterns, asking how reasoning evolved, what prompted the shift, and what lessons will inform future action. When processing is deliberate and repeated, adaptability becomes transferable rather than context-bound.

4.4 Structure intercultural engagement

Intercultural adaptability does not emerge automatically from diverse groupings or international exposure. Research suggests that intercultural development depends on intentional framing, guided interaction, and structured processing (Lord et al., 2013; Mthombeni et al., 2024). Designing for adaptability in this domain requires clarity about purpose. Students should understand that navigating differences in communication styles, assumptions, and values is an expected dimension of professional competence.

Structured debriefing is essential. After intercultural interactions, prompt students to analyse how differing perspectives influenced their decisions, where misunderstandings arose, and how they adjusted their approach. Make this analysis visible in project documentation or assessment criteria. Without guided interpretation, intercultural encounters may reinforce existing habits rather than broaden them (Downey et al., 2006). When examined deliberately, intercultural engagement fosters sustained perspective-taking rather than surface coordination.

4.5 Reinforce through assessment and feedback

If adaptability is never acknowledged in assessment, students may perceive it as peripheral. What is evaluated shapes what students prioritise. Make adaptive processes visible alongside technical outcomes by clarifying that responsiveness, revision, and thoughtful adjustment are part of professional performance. This does not require complex measurement systems, but rather transparency about what is being evaluated and why it matters.

Mechanisms such as design revision logs, team decision records, or brief self-assessments can document adaptive thinking. Feedback should address not only final products but also how reasoning, roles, or strategies evolved. Timely, specific feedback strengthens adjustment behaviours (Pulakos et al., 2006), and structured reflection paired with feedback enhances transfer (Liu & Wan, 2024).

4.6 Design equitable access to challenge and support

Promoting equity requires that opportunities to develop adaptability be distributed intentionally across the student cohort. If demanding tasks are unevenly experienced, or if access to guidance depends on informal networks, adaptive growth may concentrate among those who are already comfortable navigating uncertainty. Research on career adaptability suggests that students benefit most when opportunities to exercise agency are paired with structural guidance (Savickas & Porfeli, 2012).

To advance equity in practice, ensure that all students engage with substantive complexity and that support mechanisms are predictable and accessible. Make revision pathways transparent, embed regular feedback cycles, and provide mentoring structures that are visible rather than optional (Tomlinson, 2017). When access to both challenge and support is consistent, adaptability becomes a shared curricular outcome rather than an unevenly acquired advantage.

4.7 Integrating the design principles

Adaptability becomes a deliberate outcome of engineering education when you design for it intentionally. It does not emerge reliably as a by-product of project work or collaboration alone. It develops when it is named explicitly, scaffolded progressively, reinforced through feedback, and supported equitably. The six principles outlined above — making adaptability explicit, sequencing complexity, embedding reflection, structuring intercultural engagement, reinforcing through assessment, and ensuring equitable access — are most powerful when they operate together. Introducing ambiguity without reflection may overwhelm students. Reflection without authentic challenges produces limited growth. Assessment without clarity may obscure what you intend students to develop. When aligned, these elements transform adaptability from an implicit expectation into a coherent curricular one.

In practice, integrating these principles means designing environments in which adjustment is visible, expected, and examined. In this way, students revise rather than merely complete. They explain how their reasoning changed, not just what they produced. They encounter complexity that stretches them, but with sufficient support to interpret and respond constructively. Over time, they begin to anticipate change rather than simply react to it. A simple implementation check can help ensure alignment (Table 2.14.2). When these conditions are in place, adaptability becomes part of professional formation rather than a hidden or unevenly acquired advantage. Students leave not only with technical competence, but with judgement and confidence to navigate evolving conditions throughout their careers.

Table 2.14.2: Implementation checklist for designing for adaptability

- Have I named adaptability explicitly in learning outcomes, assessment criteria, or project briefs?
- Does the module include structured moments of uncertainty, ambiguity, or constraint shift?
- Are students required to make their reasoning visible by documenting how and why it changes?
- Is feedback directed at adaptive processes (revision, recalibration, strategy shifts) as well as final products?
- Are opportunities for challenge and support distributed equitably across the cohort?

4.8 Resources and further reading

In addition to the literature listed in this chapter, I would recommend Hatono and Inagaki (1986), Plyhart and Bliese (2006), Pulakos et al. (2006) and the work by the National Academies of Sciences, Engineering, and Medicine on adaptability of the US engineering and technical workforce (2018)and the Engineer 2020: visions of engineering in the new century by the National Academy of Engineering (2004).

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AI statement

During the preparation of this manuscript, the author used generative AI tools to assist with editing portions of the text, including improving clarity, organisation, and conciseness. After using these tools, the author reviewed, edited, and revised the content as needed. All decisions regarding the conceptual framing, selection of examples, interpretation of literature, and final arguments were made solely by the author. She takes full responsibility for the content of the publication.

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