NCCA

An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

Background paper and brief for the review of Leaving Certificate Engineering

C:21.03.24:5h
March 2024

Contents

Introduction

The Senior Cycle Review: Advisory Report (NCCA 2022a) was published in March 2022 following the response from the Minister for Education, Norma Foley, TD. Actions outlined in the Advisory Report include a review of existing curriculum components - subjects, modules, and programmes. In March 2022, the Minister for Education requested that NCCA undertake a series of actions to support the realisation of her vision for a redeveloped senior cycle as set out in Equity and Excellence for All (Department of Education, 2022.) One key action set out in this plan was that a schedule of senior cycle subjects and modules for redevelopment be prepared for approval by the Minister.

NCCA subsequently prepared a schedule of subjects for review, which was organised into a number of tranches. The redevelopment of Tranche 1 subjects will be completed in 2024 for introduction to schools in 2025. The redevelopment of the specification for Leaving Certificate Engineering is included in Tranche 2, which will be completed in 2025 for introduction to schools in September 2026.

This paper provides a context for the review of Leaving Certificate Engineering and has also been informed by the views of teachers, school leaders and students gathered through a schedule of school visits conducted in a representative sample of schools.

The paper begins by considering the background to Leaving Certificate Engineering with Section 1 presenting an overview of the current context, including consideration of relevant policy developments. Section 2 sets out how Leaving Certificate Engineering is currently provided for within the Irish curriculum before focusing in more detail on the current Leaving Certificate Engineering syllabus. Section 3 details insights gained from the school visits into the lived experience for teachers, students and school leaders, while Section 4 considers similar education opportunities internationally and presents an overview of Engineering education in three different jurisdictions. Section 5 draws on the previous three sections to categorise and briefly discuss issues identified for consideration in the redevelopment of Leaving Certificate Engineering before finally setting out a proposed brief for this work in Section 6, which will guide the work of the development group.

1. Background and context

This section sets out some of the significant developments relevant to the redevelopment of Leaving Certificate Engineering. It also outlines the policy initiatives and developments over the last decade both within education and in the engineering field which are most relevant to the review of Leaving Certificate Engineering.

The current Leaving Certificate Engineering syllabus was introduced in 1983. The curriculum was reviewed in the early 2000s and a revised syllabus for Engineering was approved by NCCA Council in 2006. The implementation of the revised syllabus was suspended, which may have been the result of the economic downturn in the country at the time. The revised syllabus changed the name of the subject to Engineering Technology the aims of which were to:
to provide a learning environment in which students identify problems, needs or opportunities, and realise appropriate solutions or products through the design process.

- to enable students to appreciate the contribution of engineering and the role of engineering materials in the shaping of world history and commerce.
- to enable students to appreciate the artistic and cultural heritage of native craft skills.
- to encourage students to implement appropriate health & safety practices.
- to stimulate students appreciation of environmental issues, particularly those that are engineering related.
- to offer a progression from junior cycle technological subjects and provide a platform for further studies.

The subject intended to offer opportunities for students to combine creativity, problem-solving, and practical skills in engineering contexts. The syllabus was engineering based, developed with a core area of study and optional areas of study, reflecting the different topics and sections within the subject area. There were two assessment components: A project (50%) and a terminal examination paper (50%).

Evolution of engineering

Since the introduction of the 1983 syllabus, the world of engineering has undergone significant evolution with advancements and changes in various engineering domains. Examples include:
Digital Transformation: The integration of digital technologies into engineering processes has been a major trend. This includes the use of digital twins, simulation tools, and advanced modelling techniques, allowing engineers to design and test systems in virtual environments before physical implementation.
Artificial Intelligence (AI) and Machine Learning (ML): AI and ML have become integral to engineering, providing solutions for data analysis, predictive modelling, and optimization. These technologies are applied in various fields such as robotics, manufacturing, and design to enhance efficiency and performance.
Additive Manufacturing (3D Printing): 3D printing has evolved significantly, enabling the production of complex and customised components with reduced waste. This technology has been adopted in aerospace, healthcare, automotive, and other industries.
Renewable Energy and Sustainability: There is a growing emphasis on sustainable engineering practices, with a focus on renewable energy sources, energy efficiency, and environmentally friendly materials.

Autonomous Systems: Advancements in robotics and control systems have led to the development of autonomous vehicles, drones, and robotic systems. Engineers are working on improving the reliability and safety of these systems for various applications.
Biotechnology and Bioengineering: The intersection of engineering and biology has led to breakthroughs in medical devices, bioinformatics, and genetic engineering. Engineers are actively involved in developing technologies to address healthcare challenges and improve patient outcomes.
Augmented Reality (AR) and Virtual Reality (VR): AR and VR technologies are increasingly being used in engineering for design visualization, training, and maintenance. Engineers can use these technologies to create immersive and interactive experiences.

The engineering industry in Ireland continues to evolve, driven by innovation, sustainability, and emerging technologies, with current trends emerging such as:
Ireland's commitment to sustainability: The transition to a greener economy has fuelled the demand for engineers with expertise in sustainable practices and renewable energy. With the government's ambitious target to achieve 70% renewable electricity by 2030, there has been a surge in job opportunities within the renewable energy sector.
Tailored skill sets: Several key skill sets are in high demand within the engineering industry in Ireland. According to recent data, some of the most sought-after skills include proficiency in computer-aided design (CAD), experience in project management, knowledge of sustainable engineering practices, expertise in automation and robotics, and strong problem-solving and analytical abilities.
Digital advancements: Engineering in Ireland is undergoing a digital transformation, with an increasing reliance on advanced technologies such as artificial intelligence (AI), Internet of Things (IoT), as well as automation. Engineers with expertise in software development, data analytics, and cybersecurity are highly sought after to support these digital initiatives.

Industry 3.0 to 5.0

The evolution of industry has been marked by distinct phases, each characterised by significant technological advancements and shifts in the way production is carried out. From the mechanisation of Industry 1.0 to the automation of Industry 3.0 and the advent of smart manufacturing in Industry 4.0, the landscape of industry has continuously evolved to embrace the capabilities of computers, electronics, and information systems.

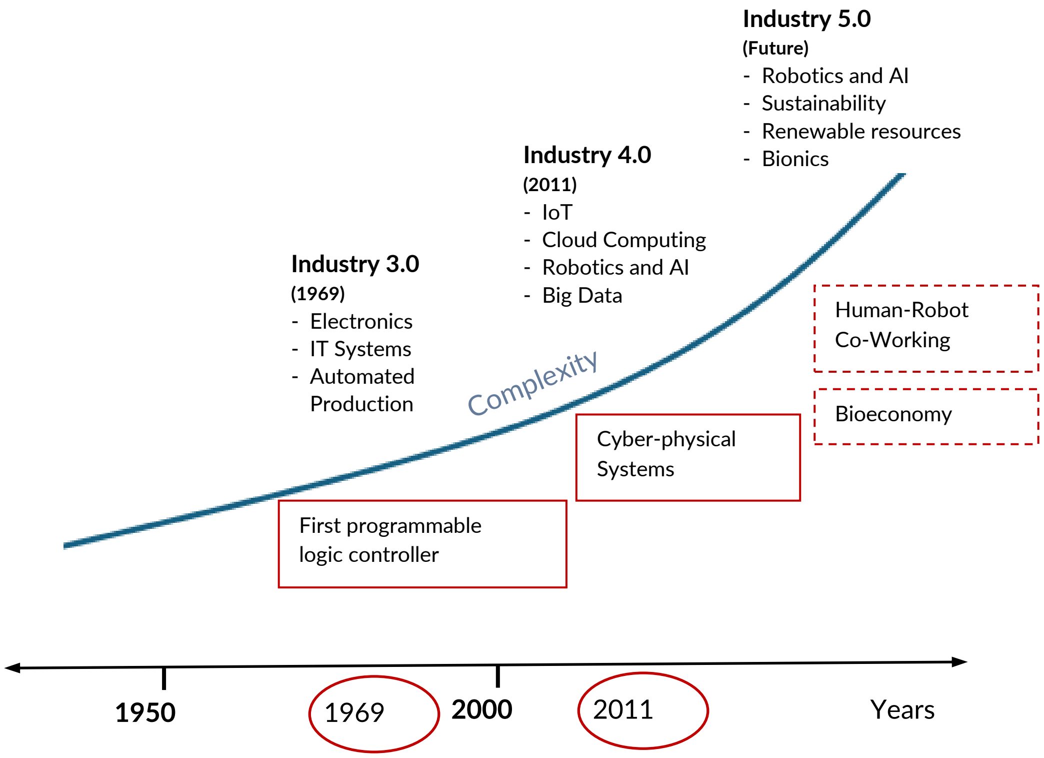

Figure 1: The timeline of developments in Industry from 3.0 to 5.0

Industry 3.0 witnessed a shift with the widespread adoption of computers, electronic systems, and automation, announcing the age of robotics where tasks traditionally performed by humans were increasingly delegated to machines. Yet, during this automation, human involvement remained integral, signalling a coexistence of man and machine in the industrial sphere.

With Industry 4.0, often termed as smart manufacturing, we find ourselves at the face of a new era, where automation, information technology, and cyber-physical systems meet to redefine industrial processes. At the heart of Industry 4.0 lies the concept of cyber-physical systems – mechanical devices driven by computer systems, underscoring the deepening integration of technology into industrial operations.

However, as we look forward to Industry 5.0, another shift is on the horizon. Predictions suggest a revival of human involvement in the industrial framework, emphasising collaboration and synergy between humans and machines to enhance production efficiency. Unlike its predecessors, Industry 5.0 is anticipated to unfold at an accelerated pace, propelled by rapid advancements in artificial intelligence and robotics.

Curriculum developments

From a curriculum perspective, there have been many significant developments. At senior cycle, the publication of the Senior Cycle Review: Advisory Report (NCCA, 2022) set out an agreed purpose for senior cycle education and outlines a vision for the redevelopment of senior cycle that is underpinned by a set of guiding principles. Responding to this report, Minister Foley initiated a programme of senior cycle redevelopment. As part of this redevelopment, a set of student key competencies are being embedded across learning outcomes in new and redeveloped subjects and modules.

In line with the Framework for Junior Cycle (DE, 2015), revised subject specifications for Junior Cycle Applied Technology, Engineering, Graphics and Wood Technology were introduced in schools in September 2019. These subjects replaced the four technology subject syllabuses in Materials Technology (Wood), Metalwork, Technical Graphics and Technology which were introduced in 1989. One of the main changes was the introduction of Classroom-Based Assessments as part of the implementation of the Framework for Junior Cycle.

The STEM Education Implementation Plan to 2026 was published in March 2023. The vision for STEM education is that Ireland will be internationally recognised as providing the highest quality STEM education experience for learners that nurtures curiosity, inquiry, problem-solving, creativity, ethical behaviour, confidence, and persistence, along with the excitement of collaborative innovation (DES, 2023 p.4). The technology subjects are part of the four pillars of STEM education in Ireland. Technology subjects and Engineering will continue to provide opportunities for students to develop skills and competencies that align to the vision for STEM education. A recent report on STEM education highlighted the need to actively promote and develop students' creative and critical thinking skills, skills that are essential for the next generation. Not only does STEM education promote these skills, but it also supports the development of life skills, ingenuity and problem-solving and it promotes empathy for issues including sustainability and the natural environment (Government of Ireland, 2020 p.7).

Also, within the education policy landscape, the Digital Strategy for Schools to 2027 focuses on the potential of digital technology within the curriculum and places an increased emphasis on the role of digital technology in supporting and enhancing teaching, learning and assessment and in fostering the development of 21st century skills. Appropriate use of digital technology can enhance teaching and learning in the Engineering classroom, support student skill development and provide opportunities to engage with a wide range of topical engineering-related content.

Ireland's National Skills Strategy 2025 is a government plan to enhance the skills of the Irish workforce and increase the supply of skilled workers to meet the current and future needs of the economy and society (Government of Ireland, 2016). The engineering sector is one of the key sectors that can benefit from the implementation of the strategy, as it faces significant challenges and opportunities in terms of skills development. In addition, expansion of the existing range of programmes offered under the apprenticeship system, will see new apprenticeships in the areas of Information Technology, Manufacturing and Engineering.

Such broad-ranging and dynamic changes mean that a redevelopment of Leaving Certificate Engineering is timely, providing an opportunity to ensure that learning in Engineering is relevant for students in terms of their daily lives, their local community and the environment, and the world of engineering, both nationally and internationally.

Section Summary

- The current Engineering syllabus was introduced in 1983. A revised syllabus was developed in 2006 but a decision was taken at the time not to implement it.
- Since the introduction of the current syllabus (1983), the world of engineering has experienced significant changes in terms of Digital Transformation, Artificial Intelligence (AI), Machine Learning (ML), Autonomous Systems, Biotechnology and Bioengineering, Augmented Reality (AR) and Virtual Reality (VR).
- Evolution of Industries 3.0 to 5.0 impacts greatly on the requirements placed on the subject of Leaving Certificate Engineering.
- Four new curriculum specifications for technology subjects have been introduced in junior cycle, including the introduction of Classroom-Based Assessments (CBAs).
- The vision for STEM education is that Ireland will be internationally recognised as providing the highest quality STEM education.
- Recent national and international policy priorities place a significant emphasis on protecting the environment, striving for sustainability practices cognisant of environmental needs. A significant emphasis is also placed on developing the skills and competencies of learners that are relevant for the current and future needs of the economy and society.
- The redevelopment of Leaving Certificate Engineering is timely and provides an opportunity to ensure that learning is relevant for students' daily lives, local communities, and the environment, as well as the broader world of engineering.

2. Engineering in the curriculum

This section provides an overview of post-primary engineering education in Ireland and concludes with the most recent Chief Examiner's report on Leaving Certificate Engineering.

STEM education in post-primary

STEM education is offered through subjects and cross-curricular activities. The availability and choice of STEM subjects at post-primary level varies from school to school. Maths is compulsory and some schools also require all students to study Junior Cycle Science. Technology subjects are typically optional in junior cycle and senior cycle.

Technology education in junior cycle

Junior Cycle Engineering

A new Junior Cycle Engineering specification was introduced to schools in 2019 replacing the Junior Certificate Metalwork syllabus.

The specification aims to:

- enable students to develop the disciplinary skills and knowledge to engineer an end product.
- enable students to engage in goal-oriented problem solving, creating an awareness of engineering processes.
- develop the necessary skills and apply engineering processes to manipulate material to manufacture a product with efficiency, accuracy, precision and a high-quality finish.
- develop an engineering mindset through the exploration of contemporary engineering developments.

Engineering focuses on developing students' understanding of, and skills in, the applications and impact of technologies in the world around them. This will be achieved through three interconnected contextual strands: Processes and principles, Design application and Mechatronics. Throughout each of the strands, the use of four elements—Engineering Knowledge and Awareness, Innovation and Exploration, Developing and Manufacturing and Communicating—creates a framework for learning that ensures a coherent learning experience for students. This framework sets the context for the learning outcomes.

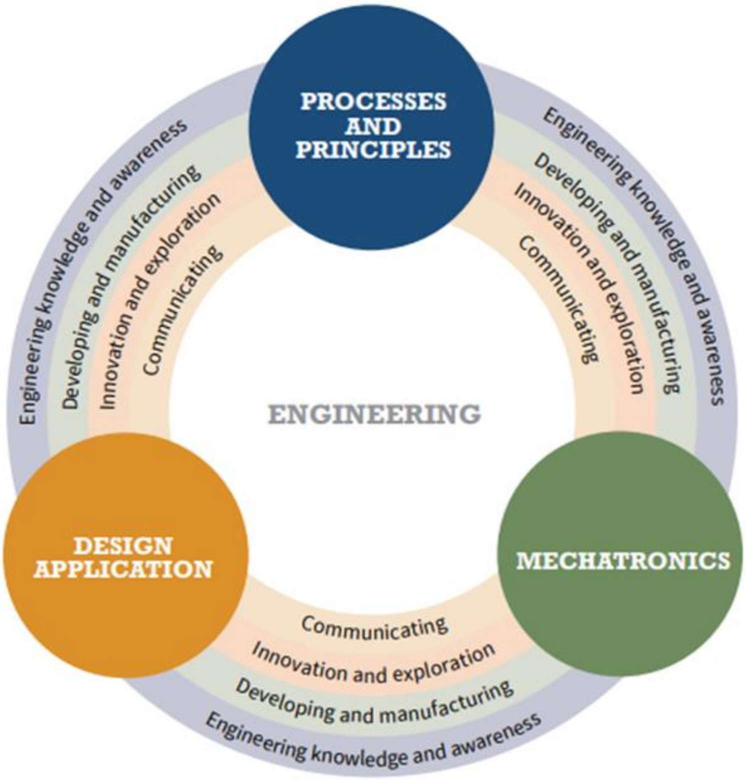

Figure 2. The strands and elements of Junior Cycle Engineering

Assessment in Junior Cycle Engineering includes two Classroom-Based Assessments: Engineering in action, and Research and development. The final assessments, which are externally assessed by the State Examinations Commission, consist of a project and a written examination.

Other areas of junior cycle

Students also have opportunities to further develop knowledge, understanding, skills and values related to technology education in other junior cycle subjects and short courses such as Mathematics, Science, Visual Art, Coding, and through other areas of learning such as competitions.

Technology education in senior cycle

Students in senior cycle have opportunities to study technology-related subjects and modules across the Leaving Certificate Established (LCE) and Leaving Certificate Applied (LCA) programme. In Transition Year (TY), technology education is a suggested area of experience for students with schools having a high degree of autonomy in designing their own programme.

Leaving Certificate Established

Schools may offer Construction Studies, Design and Communication Graphics (DCG), Engineering and Technology to LCE students. New syllabuses for Leaving Certificate DCG and Leaving Certificate Technology were published in 2006 and examined for the first time in 2009.

As noted in section 1, the current syllabus for Leaving Certificate Engineering was introduced in 1983 and examined for the first time in 1985 making the syllabus forty years old. Leaving

Certificate Engineering is the study of mechanical engineering for students in senior cycle. Students develop the skills and initiative in the planning, development and realisation of technological projects in a safe manner.

General aims

The course represents a study of a wide range of mechanical engineering materials, processes and technological applications integrated with the acquisition of the manipulative skills and techniques necessary for practical resourcefulness, creativity and design realisation in the execution of work. It aims to promote an educational knowledge of the materials; an understanding of the processes; ability in safely using the skills and tools to achieve objectives through practical work; initiative in the planning and development of technological projects (DES, 1983, p.2).

The syllabus is presented in two sections: Workshop Processes, and Materials and Technology. In the workshop processes section, students learn about benchwork, heat treatment of metals, plastics processing, fabrication and finishing of metals, machining and technology.

In the materials and technology section, students learn about health and safety, classification and origin of metals, structure of metals, iron and steel, non-ferrous metals, heat treatment of metals, corrosion of metals, materials testing, plastics, joining of materials, machining, metrology, manufacturing processes and technology.

The Leaving Certificate Engineering syllabus was designed to provide continuity from the Intermediate Certificate but can also be studied ab initio. The areas of learning identified above are in general, common to ordinary and higher levels with some designated for assessment at higher level only.

Assessment

Achievement in Engineering is assessed through three components.

1. Design Project (150 marks)
2. Practical skills examination (150 marks)
3. A written examination (Ordinary level: 200 marks, Higher level: 300 marks)

The areas of learning designated for assessment at higher level only, include: structures of metals, corrosion of metals, materials testing and other aspects of workshop processes.

Transition Year

During TY students have opportunities to explore different career options and develop some of the skills needed to access more diverse pathways. TY can raise awareness of further, adult and higher education pathways enabling students to make more informed choices of possible career options (NCCA, 2023). In this context, the suite of technology subjects can offer students a balanced and broad set of learning experiences through subject sampling and engagement with TY specific modules. The new Transition Year Programme statement is due to be introduced in schools in 2024. The Student Dimensions include a focus on career exploration which provides an opportunity to promote and encourage engineering-related careers. Industry 4.0 and the continuously evolving landscape has shifted the focus to the advent of smart manufacturing in industry embracing the capabilities of computers, electronics and information systems. Within TY, there are flexibilities and opportunities for students to engage in experiences relating to these developments giving them a further understanding of the evolving trends in engineering.

Leaving Certificate Engineering in focus

This section explores participation rates in Leaving Certificate Engineering drawing on statistics from the State Examinations Commission (SEC) and provides an overview of assessment for certification and some insights into student engagement with different areas of the current Leaving Certificate Engineering syllabus based on the most recent report of the SEC Chief Examiner for Engineering (2017).

Student participation

Engineering is the 2nd most popular of the suite of four technology subjects at senior cycle. Participation rates have grown in line with the increasing number of Leaving Certificate candidates annually.

Year	Higher Level	Ordinary Level	Total Candidates	Total LC candidates	Engineering as a % of total candidates
2019	4765	650	5415	56,071	9.7%
2020	5326	779	6105	57,668	10.6%
2021	5555	691	6246	57,952	10.8%
2022	5354	675	6029	58,056	10.4%
2023	5624	699	6323	58,006	10.9%

Table 1: Number of students sitting Leaving Certificate Engineering at higher and ordinary Level 2019-2023

Insights from the Chief Examiner's Report 2017

The most recent Chief Examiner's Report for Engineering was published after the 2017 examination and provides data on the popularity of each question in the written examination that year. This data gives an insight into the choices made by students in the examination and provides observations from the Chief Examiner. The report also provides data relating to the coursework and day practical examination.

Notable recommendations to students included having a greater understanding of the 'command words' used in examination questions and to use freehand sketching, drawing line diagrams, when possible, to support answering (SEC, 2017).

For the practical skills examination, the majority of students had little difficulty in interpreting the drawings provided, demonstrating an understanding of the inherent component and assembly detail. Many candidates demonstrated, to good effect, in the practical skills examination that they had acquired a high level of proficiency in manipulative practical skills.

Some of the key recommendations made to students highlighted the importance of accuracy, finish and function of the test piece, as they are important criteria for grading. It was also recommended for candidates not to use any machinery other than that specified in the equipment list (SEC, 2017).

Regarding the Project Coursework, many candidates carried out extensive research with a clear focus and this guided them in the completion of the project. Many candidates demonstrated to good effect in the technology project that they had acquired a high level of proficiency in manipulative practical skills. The importance of consulting the teacher when selecting appropriate levels and approaches to the technology project was highlighted. At ordinary level, some students followed the format of the Higher-level folio. Candidates using this format did not satisfy the project brief and their work in some instances could not be adequately rewarded.

Key recommendations made to students highlighted the importance of time management, the completion of the design folio in accordance with the SEC instructions, a focus on finish and presentation, the importance of evaluating and reflecting with regard to the design challenge, the use of CAD as a design tool and the need to integrate ICT into the folio (SEC, 2017).

Section Summary

- Students have multiple opportunities to engage in engineering-related learning across senior cycle.
- The Junior Cycle Engineering specification focuses on developing students' understanding of, and skills in, the applications and impact of technologies in the world around them.
- Engineering places a significant focus on the development of practical skills as well the development of skills in problem-solving, innovation, exploration, communication, and collaboration. The development of these skills is also supported through the Classroom-Based Assessments.
- The study of Engineering at junior cycle develops the foundations for a student to continue their studies in the suite of technology subjects at senior cycle.
- Assessment in the current Engineering syllabus is based on three components: the design project, a practical skills examination and a written examination at both Higher and Ordinary level.
- Engineering is the 2nd most popular of the four Leaving Certificate technology subjects in terms of student uptake.

3. Insights from school visits

A schedule of school visits was conducted as part of the scoping work for this Background Paper. The representative sample of six schools was selected from the 27 schools that expressed an interest in becoming involved in Leaving Certificate Engineering curriculum developments. The six schools were selected using criteria relating to DEIS status, gender, school size and type. Visits to these schools took place in January 2024 and involved focus group meetings with 40 senior cycle students, eight Leaving Certificate Engineering teachers and eight school leaders. The following section provides an overview of the insights gathered through these visits.

Strengths and challenges in Engineering

All participants highlighted the popularity of Engineering as a subject, stressing the importance of learning relevant knowledge and skills. Students found hands-on activities to be the most enjoyable aspect of their learning experiences, finding them both interesting and fun. They valued collaboration and the freedom to design and work on projects, which contributed significantly to the popularity of engineering among students. Sketching and design were areas to which students felt more time might be given to introduce the basics and allow for in-depth understanding and development of skills and techniques. Students expressed concerns about the level of understanding and time required to become proficient in using software such as SolidWorks. SolidWorks is seen as a fundamental requirement for Engineering. Teachers and students highlighted the absence of coding in the curriculum as a deficiency, suggesting a need for curriculum updates to better align with industry demands and technological advancements. In this context, students felt that it would be beneficial to have access to work experience relating to Engineering.

Given the low number of female students studying Leaving Certificate Engineering, the need to broaden the appeal of the subject to address this imbalance was identified as a significant issue for the review of Leaving Certificate Engineering. This suggested a need for improved efforts to encourage more females to pursue engineering. Participants felt that the practical aspects of engineering, which appeal to all students and provide tangible understanding of real-world applications, could be further enhanced.

Participants expressed concerns about the visibility of engineering within STEM education and advocated for increased promotion of the subject. They emphasised the need for a stronger focus on robotics and control to better prepare students for future education and careers. Suggestions for inclusion in a redeveloped engineering specification included more diverse content with additional topics such as electronics and electrical applications in the real world. Developing an awareness of industrial or plant machinery was also recommended.

Teaching and learning

Some students identified a disconnect in how engineering theory and the practical element were taught and suggested that learning theory through real-life and practical experiences would be more engaging and suitable. They proposed providing opportunities for cross-curricular activities to highlight common areas with subjects like Mathematics, Physics, Chemistry, and Computer

Science. This approach could enhance the overall learning experience and demonstrate the importance of Engineering as a subject of study.

Students also highlighted a desire for more discussion opportunities, within the curriculum itself, on potential careers within the field of engineering. They highlighted the future applicability of engineering skills within in their careers and expressed a desire for more real-life applications in the curriculum. They also emphasised the relevance of understanding engineering history, from industry 2.0 to present day developments, as integral to their education.

Participants felt that it would be beneficial if further opportunities could be offered to students to develop manipulative skills in 5^{th} year. This approach could further support students engaging with the Additional Assessment Component (AAC) in 6^{th} year.

Resourcing

The popularity of the subject presents staffing, resource and timetabling challenges for school leaders. They also felt that there is an absence of equality in funding between different types of post-primary schools when it comes to the provision of practical subjects such as Engineering. The nature of the subject places significant expense on schools which requires additional funding.

Teachers and school leaders noted that CAD and CAM skills were valued. An increased emphasis on advanced technologies like CAD and CNC would improve students' readiness for modern engineering. Students expressed a desire for more exposure to technologies such as 3D printing, laser cutting, coding, and robotics.

Assessment in Leaving Certificate Engineering

The practical examination was highly valued by participants as an assessment component. It was deemed a fair assessment and a welcome opportunity to demonstrate practical skills in a time-sensitive manner. From the student's perspective, this experience reflected what industry would look like, yet regrettably there was no opportunity to demonstrate skills developed during this experience in post primary after the examination at the end of 6^{th} year. Teachers and students suggested this examination could take place at the beginning of 6th year.

While projects and practical examinations offer students the opportunity to demonstrate learning that cannot be captured in a written examination, many participants felt that these components warranted reconsideration in terms of balance and relevance. Students advocated for a rebalancing of theory and practical components in the subject, prioritising the practical components over the theory examination.

Some teachers and students identified the disconnect between theory and practice in assessment as an area for improvement. They advocated for a more cohesive approach that seamlessly integrates both elements into the learning experience. This gap was particularly highlighted when discussing ‘The Special Topic’, where students found themselves struggling with a disconnect between the subject matter and its real-world relevance. They emphasised the potential for bridging this gap by linking the special topic more directly to project-based learning, thereby fostering a more seamless integration of theory and practice.

Participants recommended that the use of technologies, such as extended or virtual reality, to assess skills should be explored in the context of both formative and summative assessment.

Section Summary

- Students valued collaboration and the freedom to design and work on projects and found engineering fun. Participants noted the importance of more opportunities to develop skills in Sketching, Design, CAD.
- Students recommended theory and practical content to be taught hand-in-hand to promote in-depth understanding. They also suggested a greater focus on careers development within the field of engineering as part of teaching and learning within the subject.
- The nature of the subject places significant expense on schools which requires additional funding. The popularity of the subject presents staffing, resource and timetabling challenges for school leaders.
- The practical examination was highly valued by school leaders, teachers and students as an assessment component. While projects and practical examinations offer students the opportunity to demonstrate learning that cannot be captured in a written examination, many participants felt that these components warranted reconsideration in terms of balance and relevance.

4. International trends in upper secondary engineering education

In reading this section, technology education refers to the subjects and modules provided in post primary education in Ireland. Technical education holds a historical importance, emphasising skills development. Technological education adopts a broader perspective with a focus on developing students' knowledge, skills, values and dispositions.
Ireland is almost unique in presenting its technology education at senior cycle as four, stand-alone subjects. Other jurisdictions take different approaches due to varying contexts and situations. To explore similarities and differences, it is useful to consider international trends relating to engineering education. The review considers upper secondary engineering education in three jurisdictions: Sweden, USA and New Zealand.

Introduction

Technical education has evolved both nationally and internationally to the more commonly used term technology education. Initially, it focused on vocational training to develop specific technical skills needed for the workforce. This emphasis on mastering practical skills often led to apprenticeships or direct employment. Over time, there has been a shift towards recognising the broader value of technical education, emphasising the importance of technological literacy and capability for future careers. Viewing technological education solely as vocational or general education can limit its perceived value. Instead, technological education should be seen as adaptive, creative, and practical, emphasising the importance of design and make activities. In this context, this section examines international approaches relevant to technological education, although their direct applicability to Irish education may vary due to different contexts and situations.

Sweden

Swedish upper secondary education, which lasts three years, resembles Ireland's senior cycle and serves students who seek further education after completing compulsory schooling. It offers two types of programmes: university preparatory and vocational. There are eighteen programmes available: twelve vocational programmes and six higher education preparatory. Table 2 outlines vocational programmes related to Engineering. Each vocational programme must include the study of courses in general upper secondary subjects: English, History, Mathematics, Sports and Health, Science, Civics, and Swedish language.

Technology is offered as a programme in the suite of six higher education preparatory routes. Table 2 displays some examples of specialisations within the Technology area, offering students opportunities for in-depth study alongside core content.

Higher Education *Preparatory* Programmes	Vocational Programmes
The Technology Programme	The Electrical and Energy Programme

Note: There are various treatments of engineering within the technology subject area where students can specialise in a range of areas such as: Electronics Aviation Engineering Marine Education Industrial Engineering.	The Vehicle and Transport Programme
	The Handicraft Programme
	The Industry Engineering Programme
	The Natural Resources Programme

Table 2: Technology Subject Specialisms- Sweden

Teaching should integrate theoretical and practical knowledge effectively, supported by pedagogical strategies and assessments. It should foster creativity, problem-solving, and initiative skills through individual and collaborative tasks.

The Swedish education system highly values crafts education, viewing crafting and material processing as avenues for thought and self-expression. Their approach blends manual and intellectual work, generally through designerly activity, fostering creativity and skills through a process integrating thinking, sensory experiences, and action. This emphasis on material manipulation can enrich curriculum development in the area of Engineering.

USA

The USA is a relevant context to explore because of its diverse learning pathways and the connections observed across a wide range of technology and built environment curricula. STEM education is strongly emphasised, focusing on mastering conceptual knowledge and critical thinking. Similar to Ireland, high school (equivalent to senior cycle) serves students aged 14 to 18. Each state regulates its school curricula, resulting in variability. Common elements include addressing industry knowledge and skills needs. Beyond second-level education, trade schools and university degree programmes offer career entry pathways to the industry.

Many curricula focus on specific vocational areas related to traditional construction systems, carpentry, joinery, civil engineering, and other construction-related roles. These subjects offer pathways to apprenticeships and trade schools for construction careers. Additionally, some curricular options allow dual pathways to vocational apprenticeships or tertiary education. High school credits in math, science, languages, and technology, along with construction-related subjects, form the basis for matriculation to majors in Engineering. Efforts to enhance STEM subjects have led to frameworks like the Engineering Content Taxonomy and the Standards for Technological and Engineering Literacy (STEL), which inform curricular design.

Standards	Practices	Contexts
Nature and characteristics of technology and engineering	Systems Thinking	Computation, Automation, Artificial Intelligence, and Robotics

Core concepts of technology and engineering	Creativity	Material Conversion and Processing
Integration of knowledge, technologies, and practices	Making and Doing	Transportation and Logistics
Impacts of technology	Critical Thinking	Energy and Power
Influence of society on technological development	Optimism	Information and Communication
History of technology	Collaboration	The Built Environment
Design in technology and engineering education	Communication	Medical and Health-Related Technologies
Applying, maintaining, and assessing technological products and systems	Attention to Ethics	Agricultural Technologies

Table 3: Standards for Technological and Engineering Literacy

When examining curricula related to Engineering, practical skill development is emphasised. This helps learners to understand the complexities of engineering-related projects and fosters problem-solving abilities. These curricula expose students to diverse career pathways, including apprenticeships and university degrees. Courses address the significance of Technology and Engineering, emphasising sustainability, economic impact, and resource considerations. Assessment methods vary, but often include practical problem-solving and formal examinations. Additionally, framing the learning through the use of thematic briefs enhances technology and engineering literacy, focusing on competencies like design, modelling, systems, resources, and human values.

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New Zealand

In New Zealand, technological subjects have a similar historical evolution to Ireland. The current subject, called Technology, has evolved from vocational education focused on woodwork and metalwork. During the 1980s and 1990s, the subject shifted from purely skills-focused programmes to a more design-oriented approach, incorporating a wider range of materials. This transition from technical to technological education broadened access for learners and helped address gender imbalances in subject choices. Over the years, there have been several iterations of the subject, with the most recent reforms implemented in 2020. New Zealand's national curriculum at the secondary level is guided by principles, values, and key competencies similar to those in Ireland's senior cycle redevelopment. Technology education encompasses strands such as Technological Practice, Technological Knowledge, and the Nature of Technology. While these strands are presented separately, they are meant to be integrated in teaching and learning programmes. Associated learning outcomes are achieved through technological areas that provide context for learning.

Technological Areas New Zealand
Designing and developing materials outcomes
Designing and developing processed outcomes
Design and visual communication
Computational thinking for digital technologies
Designing and developing digital outcomes

Table 4: Technological Areas New Zealand

The structural similarity between New Zealand's curriculum and the new Leaving Certificate specifications is valuable for planning the Engineering equivalent. The structure is guided by a clear understanding of knowledge and capability, which drives the desired learning outcomes. The technological areas or contexts for learning can align with the needs outlined by educational, societal, and industrial agendas.

In New Zealand, the subject is assessed both internally by the school and externally by the New Zealand Qualifications Authority for credit awards. Assessments focus on specific subject outcomes, where students demonstrate their capabilities against a set of achievement standards. These assessment activities involve contextual student-directed projects, allowing flexibility in collecting and presenting evidence. Comprehensive standards and guidelines are provided to guide students and teachers through the assessment process.

Section Summary

- Technical education has evolved, both nationally and internationally, from a focus solely on vocational training to a broader recognition of its educational value, emphasising technological literacy and capability for future careers. This evolution highlights the importance of viewing technological education as adaptive, creative, and practical, emphasising design and make activities.
- Swedish upper secondary education offers university preparatory and vocational programmes, some of which relate to Engineering. The Swedish education system highly values crafts education, integrating manual and intellectual work to foster creativity and skills through designerly activity.
- The USA is significant for its variable learning pathways, STEM emphasis, and curricular alignment with industry needs. Trade schools and university programmes offer pathways to industry beyond secondary education. High school credits in relevant subjects are essential for majors in Engineering. Frameworks like the Engineering Content Taxonomy and STEL inform STEM curricular design.

- In New Zealand, technological subjects evolved from purely skills-focused programmes to a design-oriented approach incorporating a wider range of materials. This evolution has broadened access for learners and addressed gender imbalances in subject choices. Technology education is organised into separate strands, which are integrated in teaching and learning through contextual technological areas. Assessment activities involve contextual student-directed projects, allowing flexibility in collecting and presenting evidence.

5. Issues for consideration

This section sets out a number of issues for consideration in the development of a new specification for Leaving Certificate Engineering. These arise from the nature of the subject itself, the influence of emerging technologies and the evolution of engineering, in addition to drawing on themes emerging in the previous sections of this background paper.

The nature and scope of Leaving Certificate Engineering

Much has changed over the last decades since the current curriculum was introduced to schools. The redevelopment process offers a timely opportunity to reflect on the nature and scope of Engineering as a senior cycle subject within the Irish post-primary school system. This will involve establishing clear boundaries for the subject to ensure its relevance for now and into the future; emphasising the development of an engineering mindset through exploration of contemporary developments in the field; and prioritising and encouraging solutions that address environmental and ethical concerns.

Engineers play a vital role in addressing the social and economic needs of society, and the specification should reflect this by remaining flexible and adaptable to evolving demands. As engineers continually learn, unlearn, and relearn, it will be necessary to consider how the design of the curriculum can accommodate this dynamic nature. Additionally, the influence of convenience on innovation and our interactions with the world must be taken into consideration in shaping the Engineering specification.

Developing an engineering mindset

Developing an engineering mindset is crucial in today's rapidly evolving engineering world, where innovation and problem-solving skills are highly valued. An engineering mindset goes beyond traditional engineering disciplines. It encompasses a systematic approach to analysing and solving complex problems, regardless of the engineering discipline. Education plays a critical role in fostering an engineering mindset. In redeveloping the Engineering specification, careful consideration will need to be given to providing opportunities for hands-on learning, exposing individuals to real-world problems, systems thinking and encouraging engineering-related experimentation, all of which are essential components of cultivating an engineering mindset.

Emerging trends in engineering

There are rapidly changing trends in engineering that will continue after the curriculum is redeveloped. During the redevelopment process, it will be important to consider how to design the curriculum so that it can stay relevant into the future. An engineering concept and principles based approach to the development of the new specification, may provide the mechanism to keep the subject relevant and up-to-date.

Appropriate selection of materials with a sustainability mindset needs to be at the forefront of any solution provided. Reuse rather than recycle needs to be an approach reflected throughout this specification. Appropriate processes need to be selected when exploring solutions to problems. A redeveloped specification needs to allow for all potential processes to be engaged with, old or new.

Graphical representation is key for engineering. Sketching and design followed by CAD/CAM promotes the potential for students to be more creative in their design and realisation of solutions to problems. Modern graphical communication tools enhance the potential of students realising their solutions and communicating their design ideas through an engineering mindset.

All pedagogical approaches and strategies associated with teaching and learning need to be considered by teachers when enacting a specification. Students have highlighted that a separation between theory and practice is not an attractive approach for them as learners.

Technology in teaching, learning and assessment

Technology has the potential to have a revolutionary influence on teaching, learning and assessment of Engineering, enabling students to develop and demonstrate their learning by creating immersive and enhancing learning experiences. Currently, Augmented Reality (AR) and Virtual Reality (VR) can be used to provide students with interactive tasks and challenges that are tailored to their individual learning level in a safe environment and reduce risk to the students and potential damage to equipment in a controlled setting. This approach could provide for measurement of the students' understanding of a topic more accurately and provide feedback in a timely fashion.

The importance of technological literacy and capability

Acknowledged nationally and internationally, the shift from technical to technological education offers broader applications and enhanced educational value. Defining technological capability as the ability to create "meaningful practical solutions to real problems framed within an appropriate set of values and underpinned by appropriate knowledge", calls for designerly activity as a foundational feature (Gibson, 2008). Essential to this transition is raising awareness of the importance of technological literacy and capability in subject disciplines such as Engineering.

The NCCA paper on Senior Cycle Key Competencies (NCCA 2023) notes that the development of students' literacies contributes to the development of competencies and vice-versa. Expanding on this, the paper notes that the key competencies are supported when:

- students' literacies are well developed, i.e., when they can meaningfully and effectively read, watch, write, speak, listen, interpret and mediate meaning in a range of contexts.
- students make good use of various tools, including technologies, to support their learning.

Participation

It's essential that the subject experience appeals to both male and female students. In March 2022, the Department of Education published recommendations on gender balance in STEM education. To make STEM careers more appealing, particularly for females, students should be exposed to exciting opportunities and see individuals like themselves actively engaged in these fields.

The progression from junior cycle to senior cycle must consider various factors, like the stigma of engineering been predominantly male and peer subject choices, affecting female participation in STEM. Any curriculum changes should address these factors positively. For example, incorporating exposure to diverse STEM professionals and career paths can be integrated into specifications such as the redeveloped specification for Engineering.

Section Summary

- The redevelopment process offers a timely opportunity to reflect on the nature and scope of Engineering as a senior cycle subject within the Irish post-primary school system.
- Engineers play a vital role in addressing the social and economic needs of society, and the specification should reflect this by remaining flexible and adaptable to evolving trends and demands.
- As the subject continues to evolve, careful consideration must be given to the breadth and depth of the specification. One challenge in redeveloping the specification for Leaving Certificate Engineering lies in framing its boundaries.
- A principle-based approach to the development of a new engineering specification could provide the mechanism to keep the subject relevant and up-to-date.
- Graphical representation is key for Engineering. Sketching and design followed by CAD/CAM promotes the potential for students to be more creative in their design and realisation of solutions to problems.
- Augmented Reality (AR) and Virtual Reality (VR) can be used in teaching, learning and assessment by providing students with interactive tasks and challenges that are tailored to their individual learning level in a safe environment, and reduce risk to the students and potential damage to equipment in a controlled setting.
- The shift from technical to technological education offers broader applications and enhanced educational value. Defining technological capability as the ability to create “meaningful practical solutions to real problems framed within an appropriate set of values and underpinned by appropriate knowledge”, calls for designerly activity as a foundational feature (Gibson, 2008).
- Opportunities for skills progression from junior cycle to senior cycle should be provided, emphasising problem-solving, creation, innovation, communication, collaboration, and exploration in an active learning environment.
- It's essential that the subject experience appeals to both male and female students.
- Exposure to diverse STEM professionals and career paths can be integrated into subjects such as the redeveloped specification for Engineering.

6. Brief for the review and redevelopment of Leaving Certificate Engineering

NCCA has established a development group to undertake the task of redeveloping the curriculum specification for Leaving Certificate Engineering. The work of the Development Group is, in general terms, agreed by the NCCA Board for Senior Cycle and approved by the Council in the form of the brief set out below.

This brief is designed to provide the basis for redeveloping the Leaving Certificate Engineering curriculum specification. While the brief is derived from the key insights and issues for consideration identified in the previous sections of this paper, it is also guided by the parameters for the design of assessment arrangements in the development of specifications for all Tranche 2 subjects (Appendix 1).

The redevelopment of the new specification for Leaving Certificate Engineering will take account of current research and developments in the field of engineering education. It will remain student-centred and outcomes-based and in general terms, the specification should be aligned with levels 4 and 5 of the National Framework of Qualifications.

The specification will align to the template, agreed by Council, for curriculum specifications as set out in the Technical form of curriculum specifications for subjects and modules in a redeveloped senior cycle (NCCA, 2023).

The Senior Cycle Key Competencies will be embedded in the learning outcomes. Leaving Certificate Engineering will be available at both Higher and Ordinary level. It will be designed to be taught and assessed in a minimum of 180 hours. The development will be completed in Q2, 2025.

More specifically, the updating of the specification will consider and address the following:

- How the specification aligns with the guiding principles of senior cycle and the vision for senior cycle education.
- How the specification can support continuity and progression, including how to connect with and build on related learning at junior cycle, transition year and in other senior cycle subjects and modules as well as future learning in life, study, entrepreneurship, further education and training, higher education, apprenticeships, traineeships, and the world of work.
- The rationale for Leaving Certificate Engineering making it transparent and evident to students, teachers, and parents and how to further widen the appeal of the subject and continue to promote broader uptake of the subject.
- How the specification can embrace and promote students in developing a systems thinking approach to Engineering.
- How the specification can support the development of a range of student key competencies and the development of a range of digital skills relevant to future life, work, and study.
- How the specification, in its presentation and language register, can be strongly student-centred and have a clear focus on how students develop and demonstrate their knowledge, skills, values and dispositions.
- How the specification can embrace new trends in Engineering and be flexible to adapt to the ever changing environment presented.

- The assessment of Leaving Certificate Engineering that is aligned to the parameters for the design of assessment arrangements in the development of specifications for all Tranche 2 subjects and modules (Appendix 1). Typically, as noted in appendix 1, there should be two assessment components: one written examination and one other assessment component. However, there may be exceptions to this that are justified even after extensive consideration of the overall assessment load on students.
- How the specification, in its presentation, can support teachers in planning for teaching, learning and assessment.
- How to embrace and embed technology in teaching, learning and assessment.
- How the specification can support students in engineering to develop a design think mentality.
- Establishing clear boundaries for Engineering such that teaching, learning, and assessment methods are suitable for the students' learning experience.
- How the specification for Engineering can support the development of students' technological literacy and capability, as applied through the subject discipline.
- How the specification can support the development of students' practical skills as they engage with all stages of a design journey, from initial concept to final realisation.
- How the specification can support the development of students' communication skills as they present their designs through Sketching, CAD, prototyping, modelmaking or any other appropriate medium.
- How the specification can foster greater awareness and appreciation among students for the diverse fields within Engineering and STEM- related professions.

The work of the LC Engineering Development Group will be based, in the first instance, on this Brief. In the course of the work and deliberations of the Development Group, elaborations of some of these points and additional points may be added to the brief.

Appendix 1: Overarching parameters for the design of assessment arrangements in the development of specifications for all Tranche 2 subjects.

Executive summary

- The Minister for Education announced an update on September 20, 2023, on the approach to be taken to the introduction of new and revised subject specifications including how assessment would be addressed in those specifications. Specifically, each subject shall have an assessment component in addition to the terminal written examination.
- This assessment component will be worth at least 40% of the total available marks.
- Each subject is to have one written examination; typically marks for the written examination will be 60%,
- Typically, there should be two assessment components: One written examination and one other assessment component. However, there may be exceptions to this that are justified even after extensive consideration of the overall assessment load on students.

Introduction

This document outlines the overarching assessment arrangements and parameters to guide the design of specifications for all Tranche 2 subjects/ modules. These subjects/modules are:

- Accounting
- Construction Studies
- Engineering
- English
- Geography
- LCVP Link Modules
- Physical Education.

This advice is informed by ongoing work with Tranche 1 subjects and will be amended, as appropriate, for future tranches which may take account of their subject areas and existing assessment arrangements.

The arrangements as detailed here reflect the policy direction issued by the Minister of Education that all subjects will have an assessment component, to be in a form that is not a traditional written examination, for those components to be set and assessed by the SEC and thereby lead to a reduced emphasis on final examinations in June of 6th year.

Specifically, the arrangements for all assessment components as outlined in this document are framed by the Minister's announcement(s) on March 29, 2022, and subsequently on September 20th, 2023. Underpinned by the following understandings, the assessment components:

- will not take the form of traditional written examinations.
- will be set and marked by the SEC.

- will be subject to SEC arrangements for their completion, authentication, and submission.

In developing the arrangements outlined below, the following rationale for moving towards all subjects having another assessment component is central. This rationale is informed by deliberations on research commissioned by the NCCA and the SEC, and on the assessment literature more generally. From this work, it is evident that these components have the potential to:

- **Reduce dependence** on written summative examinations and therefore provide for a **broader assessment system**; written examinations have an important role but can be seen as a 'snapshot' of learning and can lead to teaching and learning having an excessive focus on examination preparation; other forms of assessment can mitigate the potential for this narrowing of learning by assessing aspects of student learning better and/or more comprehensively than written examinations alone can do; or assess learning that is not readily assessable through written examinations.
- Support and enhance teachers' understanding and assessment of **key competencies** by contributing to a greater understanding of how students' knowledge, skills, values, and dispositions are assessed.
- Provide opportunities for students and teachers to **reflect on student learning,** boost students' motivation to learn and enhance opportunities for formative feedback practices.
- Extend the range and diversity of assessment opportunities; **spread the assessment load** and thus contribute to a reduction in or spreading of pressure on students.
- Build and develop **teachers' assessment skills and assessment literacy** as teachers support students in working through the assessment activities as detailed within assessment briefs or guidelines.
- Generate student assessment data which can help reduce the vulnerability of the system to future unprecedented or unexpected system shocks such as COVID.
- Allow for assessment opportunities that are more **authentic** than a system relying on terminal written examinations solely.

It is also important to note that a review of the assessment literature more generally also indicates that when introducing other assessment components, it is necessary to consider how to mitigate risks, for example, of:

- over-assessment of students
- over-rehearsal of assessments
- the assessments becoming overly structured, compartmentalised, repetitive, and routine.
-

As is already the case where other forms of assessment apply, the new assessment arrangements will be guided by the overarching principles of equity, fairness, and integrity.

Table 1 below sets out the general parameters and processes to guide the work of the subject development groups (SDG) as they consider the most appropriate assessment for every subject. The specific parameters for each of the Tranche 2 subjects are set out in Table 2.

Table 1: Assessment parameters and processes – general application to tranche 2 subjects

Considerations	Parameters to guide the work of the development group.

Nature	The purpose and nature of the assessment component will be clearly outlined in the subject specification and accompanying guidelines to support the completion of the assessment. Details will be provided on the nature of the component. Existing examples include: • research project/extended essay • oral assessment • performance assessment • portfolio assessment • creation of an artefact • field study • experiment/ proof of concept/ practical investigation. The subject specification and the accompanying guidelines will articulate clearly what the students are required to do, the form(s) in which it can be carried out and submitted, and the workload expectations associated with the assessment. The alignment of the assessment component to a particular set of learning outcomes from the subject specification will be provided, as well as details on which key competencies and associated learning outcomes will be assessed. This does not preclude the same LOs from being assessed in the final examination.
Weighting	The assessment component in each subject will be worth at least 40% of the total available marks. There will be the option for this weighting to be worth 50% in the cases of Construction Studies, Engineering and PE, and up to 60% for the LCVP Link Modules.
Timing	The SDG will advise on the time required for the carrying out of the assessment component. While the SDG may suggest when this may occur, the final decision will need to be made following consideration of the overall schedule of completion dates for all assessments across all subjects and this will be finalized by the SEC further to collaboration with NCCA and DE. The date for completion of the assessment component by the student will be published by the SEC and this detail will not be included in the subject specification.
Design	The majority of assessment components will result in an artefact/document being transmitted to the SEC and assessed by the SEC. In some instances, the design of the assessment may require examiners to visit schools to conduct the assessment but manageability at school and system level will need to be considered.

Guidance	Guidelines to support the assessment components will be specific to each subject. These guidelines will be developed collaboratively by the NCCA and SEC. They will be informed by the deliberations of the SDG during the development of the specification and will detail: • the purpose of the component concerned i.e., what it is intended to assess. • the nature of the assessment component/activity. • descriptors of quality in the form of a graduated rubric and details on assessment standards at higher and ordinary levels if deemed necessary by the assessment method. • details on the timing of the assessment (its duration and when it could happen). • guidance on the processes that may be used for the administration of the assessment.

Table 2: Parameters for assessment arrangements for each Tranche 2 subject

Subject	Current arrangements	Parameters for new assessment arrangements
Accounting	One written examination. (3 hrs)	Written examination: 60% weighting. Assessment component: 40% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.
Construction Studies	Written examination (OL: 40%; HL: 50%) 1 paper (OL: 2.5 hours; HL: 3 hours) Coursework (artefact and portfolio) (OL: 30%; HL: 25%) Practical skills test (OL: 30%; HL: 25%) Coursework and practical are examined at a common level. Written examination is examined at higher and ordinary levels.	Written examination: 50% weighting. Assessment component: 50% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.

Engineering	Written examination (OL: 40%; HL: 50%) 1 paper (OL: 2.5 hours; HL 3 hours) Coursework (artefact and portfolio) (OL: 30%; HL: 25%) Practical skills test (OL: 30%; HL: 25%) Coursework is assessed at Higher and Ordinary levels. Practical skills test is examined at a common level. Written examination is examined at higher and ordinary levels.	Written examination: 50% weighting. Assessment component: 50% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.
English	Two papers with a 50/50 % split. Paper 1: Broadly essay and comprehension focused (2 hours 30 + 20 minutes reading time). Paper 2: Poetry, Literature focused (3 hours + 20 minutes reading time).	Written exam: 60% weighting. Assessment component: 40% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.
Geography	Written examination: 80% weighting (2 hours 30 + 20 minutes reading time). Geographical Investigation: 20% weighting.	Written exam: 60% weighting. Assessment component: 40% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.

LCVP Link Modules	Portfolio: 60% weighting. Written examination: 40% weighting Portfolio submitted with written exam in March of 6th year. Written examination has 3 aspects: Case study, audio visual and extended answer questions. Portfolio has combination of core and choice aspects and completed under supervision of class teacher.	Portfolio: 60% weighting. Written exam: 40% weighting.
Physical Education	Physical Activity Project: 20% (to a common brief) Performance assessment: 30% (to a common brief) Written examination: 50% (at Higher and Ordinary Level) PAP: over an 8- to 10-week period and submitted as digital format. PA: choose one of 3 physical activities; submit as digital artefact.	Written examination: 50% weighting. Assessment component: 50% weighting. Written examination will be set at higher and ordinary levels. Assessment component would be based on one submission to SEC based on a common brief.

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