FINNISH EDUCATION
EVALUATION CENTRE

ACCREDITATION OF THE DEGREE PROGRAMME IN ENERGY AND ENVIRONMENTAL ENGINEERING AT TAMPERE UNIVERSITY OF APPLIED SCIENCES

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1 Description of the accreditation process and of the programme

1.1 Aim of the accreditation

The aim of FINEEC's Engineering Programme Accreditations is to support the enhancement of quality in engineering programmes and to provide higher education institutions with the means of deciding whether an engineering study programme provides its graduates with the academic qualifications necessary for a career in the engineering profession.

The accreditation assesses the way an engineering degree programme is planned, delivered and developed to ensure that the students reach the programme outcomes and how the programme outcomes align with the reference programme outcomes set in the FINEEC Engineering Programme Accreditations manual. The reference programme outcomes describe the knowledge, skills and competencies that engineering students should have acquired by the time they have completed a degree programme in engineering.

The accreditation evaluates the extent to which the set standards for programme's planning, implementation, resources and quality management are met.

1.2 Degree programme in Energy and Environmental Engineering at Tampere University of Applied Sciences

The engineering programme under review was the Degree programme in Energy and Environmental Engineering at Tampere University of Applied Sciences (TAMK), located in the city of Tampere in southern Finland.

The degree awarded from the programme is a Bachelor of Engineering of 240 European Credit Transfer System (ECTS) credits. The programme is delivered over 4 years of full-time study, including 30 ECTS credits of practical training. It is an international programme and the language of tuition in the programme is English. The expected intake for the programme is 30-35 students per year.

The degree programme was established in 1996 as a Degree Programme in Environmental Management but already four years later, in 2000, the name of the degree programme was changed to Environmental Engineering and the degree awarded became Bachelor of Engineering. This was followed by the addition of Energy to the name of the programme after the curriculum renewal in 2013.

According to the self-evaluation report, the programme is designed to educate internationally oriented energy and environmental engineering professionals for industry, public administration and non-governmental organisations.

1.3 The accreditation process

The accreditation was conducted in accordance with the principles set in the *FINEEC standards and procedures for engineering programme accreditation* document. The schedule of the accreditation was the following:

- The accreditation team was appointed by the FINEEC Committee for Engineering Education on 8 February 2018.
- Tampere University of Applied Sciences submitted the self-evaluation report on 23 February 2018.
- A site visit to the programme was conducted on 27-28 March 2018. The programme of the visit is given in table 1.
- Decision making meeting of FINEEC Committee for Engineering Education on 14 June 2018

Table 1: Schedule of the site visit

First visit day		Second visit day	
8.45—9.15	Short presentation of the evidence room	9.00—09.50	Interview of external stakeholders
9.15—10.15	Study of evidence provided by the programme		
10.15—11.15	Interview of the management of the HEI and of the programme	10.00—10.50	Interview of alumni
11.30—12.30	Interview of academic staff of the programme	11.00—12.00	Interview of students
13.30—14.15	Interview of support staff members	13.00—16.00	Study of evidence provided by the programme and private meeting of the accreditation team
14.30—15.45	Evaluation visit to the relevant facilities		
15.45—17.00	Study of evidence provided by the programme	16.00—16.30	Preliminary feedback to the management

1.4 The accreditation team

Chair of the accreditation team:

Mark G. Richardson, Professor Emeritus, former Deputy Vice-President for Global Engagement at University College Dublin, Ireland.

Members of the accreditation team:

Riku Merikoski, analyst, SKM Market Predictor, Helsinki, Finland.

Liv Teresa Muth, Master's student in Biotechnology at University of Muenster, Germany.

Lotta Saarikoski, Head of the Mechanical, Energy, Environmental and Civil Engineering Department at VAMK University of Applied Sciences, Vaasa, Finland.

1.5 Evidence used in the accreditation

The results of the accreditation and the analysis in the accreditation report are based on the following evidence

- Self-evaluation report of the programme with appendices including:
  - curriculum analysis
  - CV's of key teaching staff
  - report of the audit of the quality system of TAMK conducted by FINEEC in 2016
  - key statistics regarding the programme's performance
  - analysis of the development needs of the programme, carried out with stakeholders of the programme

- Online access to
  - TAMK online study guide / curriculum
  - TAMK intranet
  - course implementations (teaching material, assessed student work)
  - thesis work

- Additional material requested by the team
  - exchange destinations that are available for the students
  - table showing which courses of the programme are included also in other study programmes
  - budget of the programme
  - information regarding internal allocation of funding at TAMK

- further statistics: distribution of grading on essential courses, distribution of study progress, drop-out rate, share of students completing the double degree,
- information regarding definition of contact hours per ECTS credit
- latest programme level student feedback results
- list of conferences, trainings and projects participated by the staff
- annual work plans of teachers, showing the workload balance between teaching and other duties

- Additional material obtained during the site-visit
  - follow-up table for the strategic action plan
  - explanation of how the strategic aim of sustainable development is realised at the university
  - practical placement reports
  - further examples of courses and projects where design and simulation skills in particular are developed
  - examples of RDI projects with student involvement

- Visits to the relevant facilities:
  - laboratories
  - a learning environment for renewable energy production ("Opi enempi")
  - library
  - student services "the service street"
  - sports services

- Interviews of programme management, teaching staff, support staff, external stakeholders, alumni and students.

2 Evaluation of the fulfilment of the accreditation standards

2.1 Planning of the programme

Standard 1: The programme aims, which describe the educational task and purpose of the programme, are consistent with the mission of the higher education institution and reflect the identified needs of employers and other stakeholders.

The Study Guide presents the following as the Key Learning Outcomes of the programme:

This degree programme is designed to educate internationally oriented environmental engineering professionals who are needed in private sector, public administration and NGOs.

After graduating as Bachelor of Engineering you will:

- *Be able to plan and implement surveys and field studies involving environmental monitoring and remediation, form conclusions and make suggestions for further actions.*
- *Be able to steer the processes of industrial and public production and services in a sustainable manner.*
- *Have skills and competence to construct and develop quality, environmental and sustainability management systems for organisations.*
- *Know how to monitor emissions into air, water and soil, treat and monitor contaminated soils, wastewater or water, and carry out environmental sampling and analyses in field and laboratory.*

The Study Guide also describes the Occupational Profiles of Graduates:

Our graduates typically work in consulting companies engaged in projects requiring skills in environmental monitoring and soil remediation. Other examples include titles like environmental coordinator and environmental manager. Field of employers interested in our graduates is diverse, ranging from everywhere between regional and state environmental administrations, private companies and NGOs.

Reference to programme aims and programme learning outcomes are intermixed in the text of the Self Evaluation Report, being a reproduction of the text in the Study Guide and as they are presented on the TAMK website. For the purposes of this evaluation the introductory paragraph, before the bullet points, together with the description of the Occupational Profiles, are taken to be the intended reference to *programme aims* (Standard 1) and the four bullet points are taken to be the intended reference to *programme learning outcomes* (Standard 2). Thus, the programmes aims are taken to be the following:

This degree programme is designed to educate internationally oriented environmental engineering professionals who are needed in private sector, public administration and NGOs. Our graduates typically work in consulting companies engaged in projects requiring skills in environmental monitoring and soil remediation. Other examples include titles like environmental coordinator and environmental manager. Field of employers interested in our graduates is diverse, ranging from everywhere between regional and state environmental administrations, private companies and NGOs.

The aims have been informed by contact with stakeholders through the board of TAMK ltd., a programme Advisory Board that includes four industry/professional representatives and by ongoing contact with host organisations for the practical training of students. Also, policy documents, both national and European, were used to inform the programme aims in respect of future environmental strategies.

The curriculum was updated following a significant review between 2010 and 2013. The curriculum revisions were also conducted mindful of the requirements of FEANI (European Federation of National Engineering Associations), in respect of knowledge and understanding in the natural sciences. The change also involved the introduction to staff and students of new approaches to teaching and learning with a greater prominence of student-centred and communal learning, which requires team teaching.

The programme clearly supports the HEI's strategic commitment to sustainable development and the education of internationally-orientated professionals to work in the public and private sector, engaged in environmental monitoring, management and remediation.

The aims reflect the origins of the programme, which was a degree programme in environmental management (1996) and later environmental engineering (2000). However, the aims do not include any reference to energy engineering, part of the title of the programme since 2014. The title was changed in 2014 after the renewed operating licence of TAMK, given by the

Finnish Government, specified the field of "energy and environmental engineering" as one of TAMK's educational responsibilities. Based on the interviews, this has somewhat confused the picture regarding the relationship between title of the programme and its aims, to the potential disadvantage of external stakeholders such as prospective international students.

Furthermore, even accepting a focus on environmental engineering in the programme, the accreditation team sees that the overarching intent of the programme needs a refinement of the programme aims to more clearly underpin a programme intended to shape the combination of knowledge, skills and attitudes required of engineering graduates. These shortcomings cascade into programme learning outcomes on which to found the curriculum (see Standard 2), especially in respect of design thinking skills, which form the core of an engineer's problem solving competence. Although reflecting the short-term needs of employers for early-career technically proficient operators, the programme aims are less ambitious than they could be for first cycle engineering graduates. The programme aims should be revised to express the programme's commitment and ambition to produce an engineer in a stronger way.

When revising the programme aims, the accreditation team recommends paying attention also to the aimed breadth of the programme. Although the diverse stakeholder interaction and use of policy documents from various sources serves well as a positive control for definition of the programme aims, the overall effect has been to stretch the programme rather widely. The programme aims need to be clearer in their emphasis on the engineering basic skills sufficient to form a foundation for more advanced or specialist engineering courses. The current aims, in the team's view, have allowed some drift in the implementation of individual courses to be over-reactive in respect of the wide landscape of 'environment' to the detriment of developing strong core engineering disciplinary judgement skills. Also, the industry's satisfaction with the graduates as 'environmental co-ordinators' and 'environmental managers' may have undermined more ambitious aims when the programme title and curriculum changed most recently. The team holds that depth rather than breadth would be important in programme aims at bachelor's level in respect of generic design and innovation skills so that future interdisciplinary working is built on graduates from a range of strong disciplines.

Based on the team's assessment, the programme **meets standard 1 only after the following conditions are met:**

- There needs to be greater clarity on the relationship between the title of the programme and the programme aims in respect of energy engineering.
- The programme aims need to be stronger in respect of the ambition of the programme to produce professional engineers with the combination of knowledge, skills and attitudes expected of engineering graduates, guided by the expectations outlined in the FINEEC programme outcomes.

Standard 2: The programme learning outcomes, which describe the knowledge, understanding, skills and abilities that the programme enables graduates to demonstrate, are consistent with the programme aims, with relevant national qualifications frameworks (if applicable) and with the FINEEC reference programme learning outcomes.

The current curriculum, in use since 2013, was planned in the context of the Finnish National Qualification Framework (NQF 6) and the European Qualification Framework (EQF 6). It conforms also to TAMK's common curricula criteria, defined as TAMK's programme learning outcomes, which include working life competences. However, these do not specifically refer to the knowledge, understanding, skills and abilities that a given programme enables graduates to demonstrate. Thus, as discussed under Standard 1, for the purposes of this evaluation the programme-level learning outcomes that the Standard 2 refers to, are taken to be the following four bullet points, where a graduate:

- *Is able to plan and implement surveys and field studies involving environmental monitoring and remediation, form conclusions, and make suggestions for further actions.*
- *Is able to steer the processes of industrial and public production and services in a sustainable manner.*
- *Has skills and competence to construct and develop quality, environmental and sustainability management systems for organizations.*
- *Knows how to monitor emissions into air, water and soil, treat and monitor contaminated soils, wastewater or water, and carry out environmental sampling and analyses in field and laboratory.*

Despite the programme title of 'Environmental and Energy Engineering', the emphasis in these programme outcomes is solely in the general sphere of 'environmental' to the total exclusion of aims in respect of 'energy' with no mention either of the word 'engineering'.

Although consistent with the programme aims discussed under Standard 1, these outcomes do not specifically articulate engineering graduate attributes that are typically associated with an internationally-accredited engineering programme that would reflect the FINEEC reference programme learning outcomes. For example there is no mention of abilities related to identifying and applying fundamental engineering science principles to a range of practical situations in environmental engineering. Equally one might expect reference to knowledge of the theory and application of design methodologies used in environmental engineering, or to the ability to research, analyse and propose solutions to prescribed topics/problems in the field.

Overall, the number of programme outcomes listed is low. This prevents detailed reference also to the expected general attributes of an engineering graduate, that in the FINEEC outcomes are listed under topics 'Multidisciplinary competences' and 'Communication and team-working'. These include, for example, understanding of the professional, ethical, social and environmental responsibilities of engineers to society. Although these outcomes may

be achieved through the current curriculum, their absence from the list of programme-level outcomes leaves them vulnerable to later unwitting exclusion during incremental programme changes.

As an aside, the programme-level learning outcomes are also not yet future-proofed in the context of the University's internationalisation ambition. Given the existing high proportion of international students on the programme, the programme could be used as a pilot when internationalising the University's curricula, as part of its internationalisation strategy, 2015-2020.

Given the limited scope of the programme outcomes, the following paragraphs examine the coverage of the FINEEC reference outcomes also through the structure of the programme.

Knowledge and understanding: The programme workload in the natural sciences is biased towards chemistry (16 credits) compared to physics (9 credits). This is appropriate for the 'environmental engineering' stream but it should be noted that a deeper foundation in physics would be required if parity was envisaged for an 'energy engineering' stream.

Engineering practice – Analysis, Problem-solving, Design, Practice: Regarding 'analysis', the programme structure contains a significant number of courses which aim to teach the students to analyse engineering products, processes and systems and interpret the results of such analysis. Such courses are mainly concentrated in *Structure and Function of Natural and Industrial Environments, Environmental and Civil Engineering*, *Environmental Forensics* and *Consulting and Energy Technology and Management* parts of the curriculum.

Regarding 'problem-solving', the combination of mathematics, physics and chemistry in the basic studies and the large number of courses in professional studies section can be expected to teach problem-solving skills to a reasonable level, but only in respect of addressing existing known issues and technologies. A matter of concern however is the students' ability to address as yet unforeseen issues and technologies, a key differentiating attribute of engineering graduates based on design skills (design thinking and engineering design).

Regarding 'design', the curriculum part labelled *Environmental and Civil Engineering* would have been expected to teach the students how to develop and design complex products, processes and systems, to apply relevant design methodologies and to develop their specialisation in design. However, it cannot meet this ambition, representing as it does only ten per cent of the programme and with only six courses, none of which includes the word 'design' even once in the module learning outcomes. During the site visit attention was drawn to examples of ten courses and projects where design and simulation skills are developed but only two of these (*Infrastructure and Community Development; Industrial Emissions and Monitoring*) appear to address the team's concern. In one case students plan and implement a public participation process; in the other they design and implement a relatively complex measurement setting. These are closed questions rather than the open questions required to develop deep engineering design and judgement skills. Project topics were also presented as evidence of the learning environment for developing design skills

but this did not allay the team's concerns regarding the depth of design skill formation experienced by every student on the programme, as it depends on which projects they will conduct.

Regarding 'practice', the curriculum parts labelled *Engineer's Working Life Skills and RDI*, Environmental Management and Administration and Energy Technology and Management can be expected to fulfil the requirements for introducing the engineering practice part of applying existing industry standards. One of the Advanced Study modules includes the word 'design' among learning outcomes (design of a wastewater system for a rural area) but the module is optional.

Investigations and information retrieval: The responsible and efficient use of databases and search engines is taught through various courses such as Environmental Management Tools (6 credits) and GIS & Remote Sensing Tools (5 credits). A course in Scientific Methods exists as part of the Engineer's Working Life Skills and RDI part of the programme structure.

Regarding the design of experiments, interpretation and drawing of conclusions, the principles of scientific research and scientific methods are covered in Scientific Methods (3 credits). Supporting this aspect, the bachelor's thesis is valued at 15 credits.

The accreditation team also noted that the University has a working group on RDI and Teaching Integration, tasked with harmonising the methods used in projects, while allowing for different disciplinary requirements. Student participation in the University's externally-funded research projects is possible although awareness of these opportunities among the student body is low. The aim to further integrate RDI and teaching provides possibilities for the programme to further strengthen the learning outcomes in this area.

Multidisciplinary competences: The profession that the students will later enter involves interdisciplinary teams, interfacing the natural sciences with business. The self-evaluation report recognises the challenges whereby "*...as a branch of engineering, environmental engineering comprises a wide variety of different subjects, is constantly developing to new directions and can be said to be truly multidisciplinary.*" . To this end the programme includes courses related to topics in management, work life skills, health and safety, ethics, industrial economics and marketing. Reference is made to 'megatrends' in course updating. These major, long-term phenomena that change slowly and are often interlinked are primarily identified from the Finnish Innovation Fund 'Sitra', to highlight phenomena and the related discussions which are important for the world, especially from Finland's perspective.

Communication and team-working: The ability to communicate effectively to the profession and with the society at large, nationally and internationally, is formally taught through at least six courses. In addition to courses where databases are taught and used (see Investigations and information retrieval above), it is noted that content and language integrated learning (CLIL) practice is being used to develop reporting skills. This integration of English language courses with the reporting of, for example, soil science or mechanics courses is a good way to develop the scientific reporting skills in addition to language skills. Team-working skills are

further developed through coursework in many modules. Additionally, the international nature of each class grouping encourages development of internationally-orientated professionals. The accreditation team was impressed by the communication and team-working skills of the students interviewed but express a note of caution on the amount of joint assignments, to the detriment of individual study, especially the enduring value of self-directed enquiry in the context of preparation for continuing professional development.

In summary, tackling the weakness in engineering design is central. This inter-relates to revising the programme structure and strengthening programme-level learning outcomes in design (in the broad sense of creativity and innovation) to address current deficiencies in aspects of engineering practice set out in FINEEC reference programme learning outcomes for engineering.

Based on the team's assessment, the programme **meets standard 2 only after the following conditions are met:**

- The programme-level learning outcomes need to be expanded to better and more specifically articulate the engineering graduate attributes typically associated with an internationally-accredited engineering programme. This should reflect the FINEEC reference programme learning outcomes for engineering in respect of knowledge and understanding; engineering analysis, design and practice; investigations and information retrieval; multidisciplinary competences; and communication and team-working.
- The programme structure should be strengthened in respect of new programme-level learning outcomes in core engineering aspects, not least design (in the broad sense of creativity and innovation) to address current deficiencies in respect of engineering practice.

Standard 3: The course level learning outcomes, including thesis work and possible practical training, aggregate to the programme's learning outcomes.

The learning outcomes at course level are delivered through the following programme structure:

- Engineering tools (mathematics, computer skills, language skills; total 45 credits)
- Structure and function of natural and industrial environments (fundamental chemistry and physics, mechanics; total 45 credits)
- Engineer's working life skills and RDI (ethics, communications, scientific method, project management; total 20 credits)
- Environmental and civil engineering (water and waste, emissions, ecotoxicology, recycling and infrastructure; total 24 credits)
- Environmental management and administration (management tools, administration, economics, marketing, risk, legislation; total 20 credits)
- Environmental forensics and consulting; Energy technology and management; Logistics and Environment; Business Management and Entrepreneurship (contamination, wastewater, monitoring, remote sensing, (renewables, efficiency, power plants; select 26 credits)

- Free choice (total 15 credits)
- Practical training (total 30 credits)
- Thesis (total 15 credits)

Learning outcomes are defined for each of these sections, and for each individual course. It may be noted that there is no section of the programme dedicated to specifically develop core engineering design thinking and skills to the required level, which results in corresponding deficiencies in respect of courses in design as discussed below and also under Standards 1 and 2.

Regarding the area of *Knowledge and understanding*, the majority of courses covering knowledge and understanding are in Year 1 and Year 2. The course level learning outcomes are appropriate being typically characterised by verbs such as 'understand', 'know', 'determine' and 'solve'.

For *Engineering practice (Analysis, Problem-solving, Design, Practice),* based on the documents provided, the courses learning outcomes in respect of practice provide a satisfactory level of knowledge of the topics but the course learning outcomes are deficient in ambition in respect of skills in analysis, problem-solving and design. The lack of stated programme-level learning outcomes related to engineering design (see Standard 2) results in a general lack of courses related to technology itself. There is then a collateral failure to adequately provide for course-level learning outcomes at the level expected in respect of the design of complex processes and systems to meet established requirements and, more importantly, to use engineering specialisation in design and development of innovative processes and systems. Suitable courses will need to be included in a revised programme structure or existing courses will need to be modified to have appropriate course learning outcomes which address the abilities for engineering design. When planning such course level learning outcomes, the programme could take advantage of, for example, making specific reference to the design thinking framework that includes stages of empathy, problem definition, ideation, prototyping and testing, built on the cultivation of creative engineering design mind-sets. Put simply, the balance between training (for practical skills) and education needs to be looked at as part of a review of the inter-relationship of title, aims, programme-level learning outcomes and course-level learning outcomes.

Courses at third and fourth year have a preponderance of course learning outcomes reflecting lower order thinking skills based on verbs such as 'understand', 'know', 'identify' whereas they would be expected to represent skills higher up the learning pyramid prefixed by verbs such as 'evaluate', 'design', 'synthesise' or 'plan'. This is, to the accreditation team, further evidence of an over-concentration on breadth of knowledge rather than depth of core engineering design skill in the programme, as referred to under Standard 1.

The practical training courses cumulatively account for 30 credits, which is 12.5% of the total credits for the programme. The assessment of the student's achievement of the course learning outcomes is therefore of considerable significance. However, the course learning outcomes are very vague making it very difficult to assess both the specific intended learning outcomes and each student's attainment of the intended learning outcomes. Indeed, the instructions state that students formulate their own personal objectives for practical training. More direction to students is required.

In the area of *Investigations and information retrieval* the course learning outcomes related to methodologies for literature reviews, critically using databases, interpreting data and designing experiments are spread across a large number of courses. Typically, these aggregate to the related programme learning outcomes. However, the overall situation would be improved by more ambition in the phrasing of expectations for learning outcomes from third and fourth year modules, using verbs such as 'evaluate', 'interpret' and 'design' where appropriate.

TAMK implements different teaching and learning formats to provide the students with a toolbox of *multidisciplinary competences*. These range from knowledge of health and safety to management skills and ethical judgement. Regarding ethics, an important part of the curriculum in helping to aggregate individual course learning outcomes to programme learning outcomes, the course learning outcomes associated with the ethics course refer to "*take into account ethical issues in all their actions*" and "*has got ethical and social awareness*", which implies knowledge and understanding. It would strengthen the expectation of being able to make informed judgements if the learning outcomes were based on verbs representing higher order thinking skills such as 'evaluate', 'debate' and 'discuss'.

Regarding *Communication and team-working*, group work tasks and single assignments with different examination formats are found in the courses. The programme, as an international study programme, has a strong emphasis on language skills, team work, learning abilities and management skills in an international context. However, the descriptor for the course 'Professional Communication' only supplies a narrative of the course without setting out course learning outcomes in a way that relates to good practice.

Based on the team's assessment, the programme **meets standard 3 only after the following conditions are met:**

- Course-level learning outcomes in the later years of the programme need to be expressed in language more appropriate to higher order thinking skills so that the balance between education and training is more apparent in the aggregation of course-level learning outcomes to the attributes of an engineering professional.
- The course-level learning outcomes for practical training need to be more specific and should form part of the standard agreement with the host organisation.

Standard 4: The curriculum gives comprehensive information on all the individual courses of the programme, including thesis work and possible practical training, and is accessible to students.

The curriculum is published in the TAMK study guide and openly available online. The Panel were impressed by the clarity and comprehensiveness of information available to students through the University's online resources.

The learning outcomes are generally indicated but are not always satisfactorily phrased in respect of good practice, nor showing a sufficient level of ambition in respect of the later year courses. This issue has been referred to with recommendations for amendments under Standard 3. Regarding the situation under Standard 4, the programme may be considered acceptable, even if improvements are still possible.

Based on the team's assessment, the programme **meets standard 4 acceptably.**

Standard 5: The curriculum and the course timetable enable students to graduate in the expected time.

There has been an international trend of reductions in contact hours per module, as a reaction to both the development of online learning resources and budget cuts. Further to the introduction of a new curriculum in 2013, the timing of some courses was modified with a view to keeping the student's workload balanced at a rate of approximately 30 credits per semester. The curriculum includes provision for taking modules in other institutions. The Accreditation team were surprised at the high number of courses valued at less than 5 credits, many valued at 3 credits. Nevertheless, scheduling is possible such that each student can gain at least 55 credits per year. The graduation rates were historically very good, exceeding the University's average rate, but dipped in 2017. It will require a longitudinal study to see if changes to the curriculum and teaching methods has any enduring impact on graduating in the expected normal time for 240 credits. The majority graduate within eight to ten semesters. However, the reasons for students taking longer to achieve their degree need investigation and following corrective actions if applicable.

The scheduling system and timetable 'machine' provides a helpful system for the students to plan their individual schedules and thus enables the vast majority of students to graduate in time.

Based on the team's assessment, the programme **meets standard 5 acceptably.**

Standard 6: The criteria and process for student admission and transfer are clearly specified and published. Students should be informed of the qualifications necessary to enter the programme.

The criteria for admission and for transfer are clear and are published online.

Finnish HEI's select their own students subject to certain national stipulations. This includes the equal treatment of applicants. The programme typically admits 30-35 students per annum and is oversubscribed. The admission process, revised for 2017 entry onwards partly as a result of the introduction of fees for non-EU/EEA students, is a two-stage process involving a virtual test room. There is a combination of online tasks (pass/fail) and an interview. The online student interviews and associated pre-tasks provide applicants with realistic feedback on their suitability for this study programme.

Typically, 60 students per annum make it to interview for the final selection. The process is designed to test ability and motivation. New pre-tasks and interview questions are designed for each new intake. The interviews are conducted in a virtual test room by at least two (sometimes three) members of staff. The accreditation team is impressed by the process but recommend introduction of mandatory requirements for interview panels in respect of gender balance and training in unconscious bias to assist demonstration of every effort to ensure consistency in compliance with national stipulations in respect of equal treatment of applicants.

Students who have completed at least 45 credits of first year in another HEI may apply for admission into later stages of the programme. Those admitted have one-on-one support from a student counsellor during orientation to construct their individual study plan, taking account of the recognised credits for this programme. There is also clear public information on accreditation of prior learning through competence acquired in work experience, on-the-job training, courses, hobbies, or vocational upper secondary education.

Based on the team's assessment, the programme **meets standard 6 acceptably.**

Standard 7: Students are informed of regulations and guidelines that concern recognition of prior learning, progress of studies and graduation.

The programme aims, curriculum, regulations and guidelines are clearly stated and are readily available online. A useful and user-friendly source of information is the TAMK Study Guide. There are annual information sessions to further inform the students about regulations and guidelines. Based on the interviews, students are aware of the information sources and of the help available to them. The student support services are worthy of the accreditation team's praise.

Based on the team's assessment, the programme **meets standard 7 acceptably.**

Strengths, good practice and areas for further development regarding section 2.1: planning of the programme.

The team notes the following strengths and good practice in this section:

- The ethos of the programme is an exemplar of a university's mission to produce internationally-oriented environmentally-aware professionals to tackle engineering problems of considerable impact on society.
- The programme uses the internet in a comprehensive and coherent way to make information about the programme available to applicants and enrolled students, using well-designed web pages.
- The admission process includes screening exercises and an interview to ensure the formation of a strongly-motivated international cohort of students in each year's class.
- The student support services are excellent.

The team sees the following as areas for further development in this section:

- Clarity on the title of programme in respect of inclusion (or not) of energy engineering in the scope of the programme.
- A greater number of programme learning outcomes aims, especially those including clear articulation of core engineering design skills, that will then influence curriculum revision to have more core engineering courses.
- Revise the programme structure to strengthen learning outcomes at programme level in design, creativity and innovation to address current deficiencies, in respect of engineering practice in the context of FINEEC reference programme learning outcomes.
- Course learning outcomes in the third and fourth year should be reviewed with an objective of reducing the emphasis on verbs reflecting lower order thinking skills, such as 'understand', 'know', and 'determine', where verbs describing higher order skills such as 'evaluate', 'design', 'synthesise', 'plan', 'debate' would be more appropriate.
- Introduce mandatory requirements for interview panels in respect of gender balance and training in unconscious bias to assist demonstration of every effort to ensure consistency in compliance with national stipulations in respect of equal treatment of applicants.

2.2. Implementation of teaching and learning

Standard 8: The teaching and learning process, including the assessment of students, enables students to demonstrate that they have achieved the intended course and programme level learning outcomes. Students have an active role in co-creating the learning process and the assessment of students reflects this approach

The teaching and learning process is based on themes associated with each of the four years. These are:

- *Year 1: Create strong foundation. Development of environmental thinking in engineering.*
- *Year 2: Strengthen both the general engineering skills and gain working life skills.*
- *Year 3: Deepen the environmental engineering skills and get competences in project work and practical environmental engineering tasks.*
- *Year 4: Advance students' competences through selected study modules and prepare them for challenges in working life.*

The credits associated to foundation studies amounts to approximately 30% of the programme. The credits associated to strengthening and deepening engineering skills amounts to approximately 25%. The credits associated to core engineering attributes of analysis, design and investigation amount to at most an equivalent of 20% of the programme, with much of the learning in design and investigation coming through professional studies. Practical training amounts to 12.5% with the balance of the programme being evenly split between thesis and free choice modules (approximately 6% each).

The programme is implemented with a clear practical bias ensuring that the students are already employable as assistants by the end of first year, assisting with simple, routine environmental monitoring, LCA and EIA processes. This progresses to competence to work under supervision by the end of second year in environmental monitoring and environmental management. By the end of third year the students have competence to work as team members in environmental monitoring and environmental management projects.

Teaching methods include lectures, laboratory exercises and a considerable amount of group working, which includes verbal presentations to the class on the outcomes of the groupwork. All teachers in the programme have completed the TAMK coaching training. This results in teaching methods such that the programme is implemented in a way that is learner-centred, instilling a strong sense of co-responsibility for learning in the student from an early stage in their studies. Online learning resources are used to great effect, exploiting the power of the web as a considerable resource for an enquiring mind in a directed learning environment. Group work assignments and presentations are an integral part of each year of the students' studies. This develops articulate and confident team players in an international context, while achieving a deep sense of co-responsibility for learning on the part of the student. Stakeholders are also involved in delivering the practice parts as invited visiting lecturers.

Practical training is a significant aspect of the programme. The students accumulate 30 credits of practical training during their studies, through two training internships. Once a training place is secured and approved, a contract is made and recorded in the OIVA online system. A practical training supervisor is nominated from each of TAMK and from the host organization. Approval, by head of degree programme or practical training coordinator, is granted after assurance that the learning outcomes associated with training can be achieved. However, as noted under Standard 3, the course learning outcomes are published in vague terms, which makes it difficult to ensure that the host organisation will provide all aspects of the training environment envisaged.

Furthermore, many international students carry out the practical training in their home countries, for reasons including language. These are geographically widespread making it impossible for on-site evaluation by academic staff from TAMK. Recent locations for example have included Belarus, Czech Republic, France, Germany, India, Malta, Nepal, Netherlands, Nigeria, Russia and Vietnam. Credits are earned following submission of a practical training journal, testimonials and presentation to a practical training seminar, but it is difficult to see how assessment can be rigorous in the absence of itemised and unambiguous learning outcomes, with no real-time evaluation visit to the student during training by an academic staff member from TAMK, either on site or by Skype. Based on the evidence provided to the team, the students' written reports are very short and lack sufficient evidence of reflection on their learning from practice and defence of their right to be granted credits. This approach emphasises the importance of the presentation given at the practical training seminar, and the need for clear learning outcomes that can be used for the assessment of it.

In addition to training, topics for thesis projects are often informed by these internships with industry. However international students, who represent up to 50% of the student body, have difficulties finding such training positions. This raises a challenge for TAMK in achieving its ambition to be Finland's leading UAS in respect of internationalisation by 2020. Internationalisation is one of three themes in the University's Strategy 2015-2020. It is clear that success in internationalisation will involve engagement of companies and bodies external to the University, as well as winning the hearts and minds of the internal audience.

Taught modules are assessed by combinations of continuous assessment assignments, practical exercises in laboratories, attendance record in laboratory classes, quizzes and written examinations. The vast majority of this material is submitted online which created a problem presenting evidence to the accreditation team. The accreditation team was disappointed to find that the evidence room was devoid of easy-to-browse hardcopy examination scripts, graded essays, graded laboratory notebooks etc. Access was arranged to the TAMK intranet from which to examine course descriptors and the distribution of grades on essential courses but not all course descriptors included information on assessment method. However, the accreditation team determined that the assessment methods vary considerably from course to course. Assessment by end-of-semester examinations generally account for less than 50% of the assessment weighting. Some examinations are conducted online. The evidence

presented in respect of assessment of achievement of course-level learning outcomes for practical training comprised a very short report that did not provide sufficient information from which to assess the quality of the learning experience.

Although the replacement of some contact hours by greater use of directed learning using online resources is a positive development in getting students to take more responsibility for their learning, a longitudinal study is required to see if this suits all learners. If it is systematically found that some students suffer a significant decrease in learning experience from the reduction in contact hours consideration would need to be given to committing resources to a tutorial support system. Equally there is merit in the use of continuous assessment (eg. submitting online essays), quizzes (eg online tests) and attendance records for assessing the achievement of learning outcomes. However, eliminating the end-of-semester exam completely, or reducing its weight below 50%, may have the effect of assessing the student's mastering of individual sub-components of a course without assessing their mastery of the overarching learning outcome that led to the courses inclusion in the programme. Although continuous evaluation enables the teacher to adjust his/her teaching during the course in a more flexible way, a clear distinction needs to be maintained between teaching and assessment. Expert input should be sought on a longitudinal study to examine the combined impact of new teaching and assessment styles on deep and surface learning trends.

Based on the team's assessment, the programme **meets standard 8 only after the following condition is met:**

- The assessment of achievement of course-level learning outcomes for practical training needs to be more rigorous, by using evidence for example from a supervisor in the University, a supervisor in the host organisation and a comprehensive reflective journal from the student.

Strengths, good practice and areas for further development regarding section 2.2: implementation of teaching and learning

The team notes the following strengths and good practice in this section:

- The programme is implemented in a way that is learner-centred, which instils a strong sense of co-responsibility for learning in the student from an early stage in their studies.
- The online learning resources are used to great effect, exploiting the power of the web as a considerable resource for an enquiring mind in a directed learning environment.

The team sees the following as areas for further development in this section:

- Although the replacement of some contact hours by greater use of directed learning using online resources is a positive development in getting students to take more responsibility for their learning, a longitudinal study is required to see if this suits all learning styles. If it is systematically found that some students suffer a significant decrease in learning experience from the reduction in contact hours consideration would need to be given to committing resources to a tutorial support system.
- Expert input should be sought on a longitudinal study to examine the combined impact of new teaching and assessment styles on deep and surface learning trends.
- Progress in achieving the learning outcomes for the practical training need to be more actively monitored by staff, during the placement period, learning from best practice in other fields of study.
- Consideration could be given to enhancing the international student experience through more training place options in Finland.

2.3. Resources

Standard 9: The academic staff are sufficient in number and qualification to enable students to achieve the programme learning outcomes. There are arrangements in place to keep the pedagogical and professional competence of the academic staff up to date.

The academic staff resource dedicated to the programme consists of a principal lecturer and two senior lecturers, which in the accreditation team's opinion is very small. The principal lecturer has a PhD; the senior lecturers have Master's degrees. The principal lecturer is not currently teaching on the programme due to research commitments. The head of degree programme is one of the senior lecturers. Programme teaching involves about 30 to 35 teachers each year, drawn from a combination of TAMK's other programmes and part-time teachers from other universities and companies. Visiting lecturers are often invited to contribute to a module, through the lecturer's network of industry contacts. Based on the discussions during the site visit, the staff contributing to the programme are highly committed and enthusiastic.

In addition to teaching, lecturers influence the professional development of students in the academic staff member's role as exemplar of a professional engineer. The effectiveness of this is dependent to a large extent on the working relationship between staff and students built on the culture of the core team delivering the programme. The accreditation team were surprised to learn that, although 80% of credits are delivered by professional engineers, only three of the lecturers in the School of Construction and Environmental Technology are identified with the programme and one of these is not teaching due to research commitments. This compares unfavourably with, for example, the School's degree programmes in Construction and Civil Engineering (15 core staff); Building Services Engineering (12 core staff) and Bioproduct and Process Engineering (7 core staff). Thus, while overall staff resources (30-35 lecturers) is adequate to achieve the learning outcomes, the professional development of the students would be better nurtured by the supportive infrastructure of having a higher number of full-time professional engineering staff claiming primary allegiance and sense of ownership of the programme. The importance of this should not be underestimated at bachelor's degree level - the educational formation level on which strong engineering disciplines are based This may require decisions on strategic recruitment by the University. The position in respect of staff for 'energy engineering' is even more critical, if the revised programme aims (see Standard 1) have ambition to give parity to 'energy' and 'environmental' engineering.

Every lecturer completes compulsory vocational teacher education within three years of appointment, in order to meet the national qualification for UAS teachers. Due to the fact that TAMK is one of the vocational teacher training providers in Finland, staff have good support in respect of internal training opportunities to also further develop their digital teaching skills and pedagogy after the mandatory education. Identification of staff needs in respect of continuously improving their competences is facilitated through annual evaluations in the context of the University's annual planning and quality assurance system 'TASO'. However, the take-up of development opportunities seems to be left to the individual.

The University has a clear strategy in respect of building critical mass in selected research themes, with societal impact aligned with TAMK's strategic priorities. Nevertheless, staff workloads may be negotiated without inclusion of a minimum level of research activity.

Staff have the possibility to keep current in their professional competence through participation in research projects and visits to companies and other organisations. However, the measurement of this is not rigorous. For example, according to the self-evaluation report (underlining added by accreditation team) "…*Each teacher follows their field of teaching in their personal way that suits them best. The academic staff is encouraged to participate in different conferences, seminars, and training days*." While not wishing in any way to suggest that management needs to operate a 'command and control' system of an academic's personal development, it must be recognised that university students have a right to expect some assurance of research-led teaching. It is therefore a matter of concern that individual workloads can, on the one hand, exclude specific involvement in research or, on the other hand, exclude teaching due to research commitments. This needs to be balanced in a better way to ensure research-led teaching by the introduction of suitable indicators, for example a modest expectation in respect of regular involvement in applied research and development activity.

English language skills of the staff are benchmarked against the Cambridge Assessment English standardised test. Although the staff have sufficient English language skills to adequately deliver their courses, the students note that some brilliant and inspiring lecturers are inhibited by their English language skills when they are not working in their native language.

Based on the team's assessment, the programme **meets standard 9 acceptably.**

Standard 10: An effective team of technical and administrative staff supports the programme. There are arrangements in place to keep the competence of the support staff up to date.

The technical staff includes professional engineers with a great commitment to the student learning experience. The dedicated technical support staff to the programme is one full-time and one part-time laboratory engineer.

Administrative support is drawn from across the University and is well-organised and student-centred. School-specific contact persons maintain information flow and communication between the support services and schools in an effective manner.

Units supporting the programme include Facility Management Services, Facility Security Services and the Development Unit, who have access to a wealth of data impacting on, and reflecting, the student experience, collected through the University's impressive quality assurance system. Although the wealth of data may be overwhelming – discussed under Standard 15 – the administrative staff supporting the student experience act in a coherent manner.

Based on the team's assessment, the programme **meets standard 10 acceptably.**

Standard 11: The students are provided adequate and accessible support services to enable the achievement of the programme learning outcomes.

There is a strong service culture for students built on the concept of a 'Service Street'. This derived from the 'Ei Paha!' Project, which looked at creating a system whereby the student only has to engage with one service function even if the solution requires involvement of several University service units.

Each student group has a dedicated teacher tutor. In addition to day-to-day assistance, the tutor submits a summary of each student's development at least once a year to the student counsellor. Peer-tutoring is used to assist first year students during their early study period. Programmes conducted in the English language are also assigned a Degree Tutor. TAMK offers student tutor support for the selection and organisation of free choice studies, the mandatory practical training courses, and selecting the Bachelor thesis project. Personal tutoring is scheduled at least once a year. Thus, students are well-supported through counselling to support both academic studies and their physical, psychological and social wellbeing.

The special needs of international students, especially those at undergraduate level, are recognised and supported. TAMK makes clear in the documentation that the university is aware of cultural and national impacts on international students. Tutoring is underpinned by comprehensive online resources. For the application there are step-by-step instruction for future students. For the practical training courses there are lists and information for the practical trainings that need to be approved and for the contract that needs to be signed by all parties. This is especially helpful for international applicants and current international students.

All students are entitled to health care services of their study municipality regardless of their home municipality, in accordance with the Finnish Primary Health Care Act.

Excellent sports services are available to students on three campuses (TAMK, TUT, and UTA in the city centre) by paying one sports fee.

A student club "GLOBE" acts as a strong and effective peer support group. In keeping with the short transition to expectations that an answer to every question is somewhere on the TAMK web presence, there is a blog written by current students where other students can get current information about the study programme.

Regarding appropriate support for those in the final stages of their studies, TAMKrekry (Student Employment Services) supports students' employment and career planning.

Based on the team's assessment, the programme **meets standard 11 acceptably.**

Standard 12: The classrooms, computing facilities, software, laboratories, workshops, libraries and associated equipment and services are sufficient and accessible to enable students to achieve the programme learning outcomes.

The programme is supported by high quality and well-managed facilities. These include well-equipped classrooms with data projectors; shared laboratory facilities; designated special software classrooms (for example CAD, GIS, air and noise pollution monitoring) and the 'OPENLAB' workshop. The shared facilities include excellent chemistry laboratories and the physics laboratory has a range of instruments in stock that students can use in measurements of environmental parameters. The library is modern with excellent working spaces and it is designed to function effectively as a creative working space for both individuals and groups. Based on the site visit, it is achieving its intent.

In addition to shared facilities the programme has its own Environmental Laboratory equipped with basic equipment to carry out the course work and a collection of field equipment used in nearby forests and waterways. The programme has its own trailer-mounted rowing boat and a University transport pool provides access to minibuses. The Environmental Laboratory also includes a well-equipped conservatory space providing working space for setting up experiments in a controlled location where work-in-progress is secure.

The facilities support the current curriculum's emphasis on 'environmental' but would need to be enhanced on the 'energy' side if there was ever an intent to give parity to these two areas, as implied in the programme title 'energy and environmental engineering'. However, the University indicated in the Self-Evaluation Report that "*the role of energy in the curriculum needs to be reconsidered*". Given that statement as an indication of the University's direction of travel, the accreditation team do not attach conditions in its assessment of the programme in respect of Standard 12.

Based on the team's assessment, the programme **meets standard 12 acceptably.**

Standard 13: The HEI and the programme have external partnerships that are adequate to the achievement of the programme learning outcomes.

Strong partnerships exist with many companies who host training places for the students and from whom visiting lecturers contribute to the programme. During the site visit, evidence was tabled of no less than 173 such companies, involved in specialisations including air quality, asbestos removal, biomass, brewing, concrete recycling, energy efficiency, food production, life cycle assessment, oil fractionation, oil spill response, paper recycling, smart metering, soil remediation, solar power, waste management, well water and wastewater services. There is also partnership with NGO's, notably the Global Dry Toilet Association of Finland. However international students on the programme still find it difficult to secure training places with companies in Finland and revert to their home countries for training opportunities. While this is not necessarily an impediment to completing the learning outcomes, it is a lost opportunity for a truly international learning experience among highly-motivated international students.

Research collaborations are also conducted with organisations, allowing further choice of training opportunities.

Further deepening of the local collaborations with Tampere University of Technology and the University of Tampere, through cross-institutional studies, is envisaged through the 'Tampere3' process, currently in train.

The programme has two partner universities in Germany with whom a double degree programme agreement exists - Ostfalia UAS and Hannover UAS. Outgoing mobility from TAMK is generally a feature of the former (8 students recently) whereas inward mobility to TAMK is more common for the latter.

Exchange agreements are in place with 31 universities across ten EU countries, Argentina, Japan, Korea, Mexico, Palestine, Russia, Switzerland and Turkey. Detailed evidence presented during the site visit indicated the exchanges agreements are active with a typical flow of 10 to 15 students per annum.

Based on the team's assessment, the programme **meets standard 13 acceptably.**

Standard 14: The financial resources are sufficient to implement the learning process as planned and to further develop it.

The board of TAMK Ltd oversees the distribution of financial resources in an annual planning exercise. A seven-member Executive Board, led by the president makes decisions on the cost-effective completion of TAMK's commitments under four-year performance agreements with the Ministry of Education and Culture. The annual cycle commences at the May meeting of the Executive, following a review of the preceding year's results by schools and support services. A seminar of line managers is then held in June to discuss the following year's joint strategic objectives. Schools and support units then complete preparation of action plans, finance plans and investment proposals by autumn. The Executive Board and board of TAMK Ltd agree the action plans, finance plans and investments in December, with the Director of the School having negotiated the final budget, investments and targets with the Executive Board.

The accreditation team were furnished with the budget for the programme during the site visit. The financial resources dedicated to the programme are essentially staff costs only. Laboratories staff and other costs are from a different budget. There is essentially no discretionary funding for use by the Programme Director. The accreditation team were informed that additional financial resources may be applied for through various support schemes if thought necessary, but the programme is in competition with many others and funding cannot always be expected, even for the most worthy of requests. The accreditation team suggests that the budget of the programme be reviewed with an objective of increasing it to a level commensurate with other programmes in engineering of similar scale in respect of student numbers and needs.

Essentially the programme is reliant on access to the staff resources, infrastructure resources and a consumables budget that are not in the direct control of the head of the degree programme. This greatly lengthens the distance between ideas to enhance the quality of the programme and their likely implementation, thus stifling ambition for the programme's development.

The programme has established a lengthy track record of attracting international students and under new rules non-EU/EEA students now pay fees to the University. Consideration should be given to re-investing some of this income in the programme through an appropriate financial model for use of non-exchequer income in the University.

Based on the team's assessment, the programme **meets standard 14 only after the following condition is met:**

- The discretionary and development budget of the programme should be reviewed with an objective of increasing it to a level commensurate with other programmes in engineering of similar scale in respect of student numbers and needs.

Strengths, good practice and areas for further development regarding section 2.3: resources

The team notes the following strengths and good practice in this section:

- The staff are highly committed and enthusiastic.
- Staff have good support in respect of training opportunities to develop their digital skills and pedagogy.
- The technical staff includes professional engineers with a great commitment to the student learning experience.
- The support services are highly visible and work in a coherent manner through the concept of a 'service street' and co-operation between administrative units, leading to a high-quality student experience.
- The library is designed to function effectively as a creative working space for both individuals and groups. It is achieving its intent.
- The classrooms and the laboratories are of high quality and are very well maintained, leading to an excellent working environment and work ethic culture for the students.
- Maintenance of good physical and mental health is encouraged through easy access to high quality sports facilities in all three Tampere universities through a single registration process.

The team sees the following as areas for further development in this section:

- The formation of the students' engineering design and judgement skills needs to be nurtured by greater interaction with full-time professional engineering staff of the university, especially in the latter stages of the programme. The number of staff members allocated to the programme could be increased to a typical average for engineering programmes in the School, with particular emphasis on growing the proportion of professional engineers identified as having a strong sense of identity with the programme working in close contact with the students, especially in later years. This may require decisions on strategic recruitment by the University. The position in respect of staff for 'energy engineering' is even more critical, if the revised programme aims (see Standard 1) have ambition to give parity to 'energy' and 'environmental' engineering.
- It is a matter of concern that individual workloads can, on the one hand, exclude specific involvement in research or, on the other hand, exclude teaching due to research commitments. To better assure maintenance of a high-quality student experience based on research-led teaching there should be a modest expectation in respect of the ongoing applied research and development activity portfolio of each academic staff member.
- The programme is marketed to international students yet there is a systematic difficulty in offering practical training opportunities in Finland for many of them. Given that the practical training is mandatory and represents a significant 12.5% of the credits, greater efforts should be made to secure an adequate number of guaranteed positions in companies.
- The financial resources dedicated to the programme are just about adequate for running it but do not provide scope for development other than through competitive in-house funding schemes. Consideration should be given to re-investing some of the non-exchequer income from international student fees through an appropriate financial model in the University that rewards quality enhancement of international programmes.

2.4. Quality management

Standard 15: The quality management procedures of the programme are consistent with the quality policy of the higher education institution.

The quality management system at TAMK is commendable.

The system 'TASO' is based on the PDSA principle (Plan, Do, Study, Act). A quality manual 'Compass' sets out responsibilities at each management level. The University intranet is used as an interactive real-time quality tool. The system is student-centred with inclusion of students in all relevant groups. External stakeholders are included via the Advisory Board. There is staff 'buy-in'. Based on the evidence provided to the team in advance, and on the interviews, the programme follows TAMK's common quality procedures.

In assessing the quality management of the programme the accreditation team were fortunate in having available to it a very recent (2016) FINEEC audit of the quality system at Tampere University of Applied Sciences. The report, prepared by a five-member international audit team, included an audit of three sample degree programmes. One of these was the degree programme in 'Energy and Environmental Engineering'. This was a significant piece of evidence for the accreditation team and was made available to the team before the site visit. The audit by FINEEC in 2016 found that the quality system of the University fulfils both national criteria and the European quality assurance principles and recommendations for HEI's. FINEEC awarded TAMK a quality label valid to 2022.

The audit found that quality management at the level of the degree programme in Energy and Environmental Engineering was at 'developing' stage, as it is for TAMK as a whole (on a four-point scale of development: 'absent, emerging, developing and advanced').

Based on the team's assessment, the programme **meets standard 15 acceptably.**

Standard 16: The organisation and decision-making processes of the programme are fit for effective management.

The University is organised into five schools, two related to engineering and one each in the business, humanities and health sector. The two engineering schools are School of Construction and Environmental Engineering and the School of Industrial Engineering. The programme is one of seven in the School of Construction and Environmental Engineering. At University senior management level, oversight and support of the programme involves both the Vice-President for Education & RDI (*inter alia*: education, research) and the Vice-President for Development (*inter alia*: quality management, operations management). Each school is led by a Director of Education, who reports to the Vice-President for Education

and RDI. Within the School there are Heads of Degree Programmes. Responsibilities are clearly defined on different managerial and operational level, thus encouraging inclusiveness. Students are included in various positions and boards.

The planning and implementation of the programme is supported by target-orientated, degree programme specific objectives together with follow-up through annual evaluation and planning in accordance with the University's yearly cycle of the performance planning process. This process includes objective setting, monitoring of operation, analysis of results, and budgeting.

Owing to the relatively small size of the programme, the organizational structure is, using the description of the self-evaluation "*flat and its management system and decision-making processes are kept light*." Degree programme meetings are held formally on a monthly basis, were the most significant decisions are made. The invited participants include all staff working in the administrative unit of the programme, teacher tutors, study counsellor and study affairs coordinator. The accreditation team explored their views on empowerment and although many were in practice distant from key decision-making bodies that influenced the programme (effectively observer status, even at degree programme meetings) none expressed dissatisfaction with the arrangements as they felt that they had a voice and thereby an acceptable degree of influence. Decisions regarding the operation of the programme are arrived at in a collegiate manner.

The accreditation team were made aware of possible management restructuring during the 'Tampere3' project implementation phase and are confident that such a major initiative will involve management restructuring reflecting current best international practice.

Based on the team's assessment, the programme **meets standard 16 acceptably.**

Standard 17: The programme reviews and develops the programme aims, curriculum, teaching and learning process, resources and partnerships and quality management in a systematic and regular manner, taking into account analysis of results of student admissions, students' study progress, achieved learning levels, student, graduate and employer feedback and graduate's employment data.

TAMK has a specific Curriculum Working Group that oversees curriculum revision in a systematic way. An implementation plan is devised for each course in advance. Development of the programme is then based on the annual internal performance planning process which utilizes and analyses the feedback gathered through TAMK's quality system and collected into TAMK's joint report portal. Feedback is collected at different time points in the study programme from course feedback, employer's feedback, new students' feedback, annual student feedback survey, graduation phase feedback (AVOP), alumni feedback, summary reports from counsellors, and informal feedback through GLOBE student club. There are also annual feedback meetings of staff and students.

The accreditation team noted that an overwhelming amount of data was collected, in the sense that the amount of data collected exceeds the capacity of the system to process it fully. The accreditation team believe that the only data that needs to be collected is that which can be evaluated such that it leads to a corrective action or statement of satisfaction used in trend monitoring. Thus caution should be exercised against the negative effect of multiple surveys (survey fatigue) on the collection of valuable data. The feedback loop is also sometimes incomplete – students provide a lot of feedback but do not necessarily learn of changes implemented on foot of their feedback.

The programme has a small number of students and assigned staff compared to many other programmes of the University. On the one hand, this allows operational issues to be discussed and handled in a somewhat informal way, as they arise. On the other hand, it discourages systematic evaluation of programme issues on a longitudinal study basis through full engagement with the University's TASO quality system. Additionally, the 'institutional memory' regarding the programme is not fully captured. Nevertheless, there is some degree of complexity about the TASO system which may blur the boundaries between personal responsibility (*quality work is an everyday task for everybody*) and the over-powering effect of a data-rich intranet portal being perceived as an automated gate-keeper of quality (*everyone responsible so no-one responsible*). Thus, the value of daily informal quality management by professionals in this degree programme is recognised.

On balance the accreditation team found the blend of a comprehensive formal quality management system and the informal daily undocumented ad-hoc quality management is serving the students of the programme satisfactorily.

Based on the team's assessment, the programme **meets standard 17 acceptably.**

Standard 18: The programme provides public, up to date information about its objectives, teaching and learning process, resources, quality management procedures and results.

The websites of TAMK, the Ministry of Education and Culture and the Finnish National Board of Education are very informative and provide a wealth of information and data from programme level to national comparative statistics, indicators and analysis of HEI's. The TAMK website is user-friendly with an emphasis on the '*what can we do for you?*' style, rather than the '*this is our organisation!*' approach to information dissemination. Also, the TAMK Study Guide, which gives programme, module and course-level information about the teaching and learning process, is publicly available through the internet.

Based on the team's assessment, the programme **meets standard 18 acceptably.**

Strengths, good practice and areas for further development regarding section 2.4: quality management

The team notes the following strengths and good practice in this section:

- The quality management system at TAMK is commendable, gaining stakeholder 'buy-in' by students and staff together with awareness by external stakeholders.
- The quality management system is student-centred.
- Decisions regarding the operation of the programme are arrived at in a collegiate manner.
- The TAMK website is user-friendly with an emphasis on the 'what can we do for you?' style rather than the 'this is our organisation!' approach to information dissemination.

The team sees the following as areas for further development in this section:

- The amount of data collected through surveys exceeds the capacity of the system to process it in a timely manner so caution should be exercised against the negative effects of survey fatigue in pursuit of valuable data.
- The feedback loop is sometimes incomplete – students provide a lot of feedback but do not necessarily learn of changes implemented on foot of their feedback. This should be addressed, as academic staff can gain much from such feedback but it will not be valued if the level of engagement is small, leading to bias in the data.

3
Overall evaluation of the programme

Upon reviewing the programme, the team highlights the following **key strengths and good practice**:

- The programme is implemented in a way that is learner-centred, which instils a strong sense of co-responsibility for learning in the student from an early stage in their studies.
- The physical and virtual learning infrastructure is of high quality and well maintained, leading to an excellent working environment and work ethic culture for the students. The power of the web as a learning resource for an enquiring mind is used effectively in a directed learning environment.
- The staff are highly committed and enthusiastic, supported by good training opportunities to develop their digital teaching skills and pedagogy.
- The technical staff includes professional engineers with a great commitment to the student learning experience.
- The support services are highly visible and work in a coherent manner through the concept of a 'service street' and co-operation between administrative units, leading to a high-quality student experience.
- Maintenance of students' physical and mental health is encouraged through easy access to high quality sports facilities in all three Tampere universities through a single registration process.
- The student-centred quality management system at TAMK is commendable, gaining stakeholder 'buy-in' from students and staff together with awareness by external stakeholders.

The team sees the following as **areas for further development** of the programme:

- The inter-relationship between programme aims, programme learning outcomes and course-level learning outcomes could be made more coherent, following a clearer articulation of the aims and outcomes at programme level.

- The emphasis in the four programme-level learning outcomes is solely in the general sphere of 'environmental' to the total exclusion of aims in respect of 'energy' with no mention either of 'engineering'. It would be valuable to address this anomaly as part of a review to better and specifically articulate the engineering graduate attributes typically associated with an internationally-accredited engineering programme.
- The number of programme-level learning outcomes listed seem too few as it precludes detailed reference to expected general attributes of an engineering graduate.
- The students' critical thinking skills, judgement and capacity to tackle as-yet-unforeseeable complex design challenges could helpfully be built on more ambitious course level learning outcomes in the later years of the programme, allied to more 'open problem' assignments.
- The students' communication and team-working skills are excellent due to the very high proportion of joint assignments but consideration should be given to examining if the number of individual study assignments needs to be higher as an effective foundation for independent lifelong learning.
- The balance between training and education could usefully form part of a review of the inter-relationship between title, aims, programme-level learning outcomes and course-level learning outcomes. Course-level learning outcomes in the later years of the programme would then be expected to be expressed in language appropriate to higher order thinking skills, more so than at present.
- Regarding practical training, consideration should be given to enhancing the current course descriptor to better describe the expectations of the University in respect of the course learning outcomes for practical training and the defence by students of their claim for recognition of achievement of these outcomes.
- Regarding admissions, the University could consider introducing mandatory requirements for interview panels in respect of gender balance and the training of panel members in unconscious bias, to further assist compliance with national stipulations in respect of equal treatment of applicants to the programme.
- It would be useful to undertake a longitudinal study to ascertain the impact of a trend to replace some of the contact hours by greater use of directed learning using online resources in the case of different learning styles. Consideration could be given to committing resources to a tutorial support system if warranted.
- Proactive monitoring of each student's progress in achieving the learning outcomes from practical training could be enhanced by learning from best practice in other fields of study.
- Consideration could be given to enhancing the international student experience through more training place options in Finland.
- It would be helpful if the there was a greater proportion of professional engineers, engaged as full-time staff of the university, working in close contact with the students, especially in later years.
- Greater assurance of research-led teaching should be assured by a modest requirement in respect of staff engagement in applied research and development activity.
- Regarding quality assurance, consideration should be given to strengthening the feedback loop with the students to enable greater engagement in using this resource for identifying aspects for improvement.

The team recommends that the programme **is *accredited with the following conditions:***

- There needs to be greater clarity on the relationship between the title of the programme and the programme aims in respect of energy engineering. (Standard 1).
- The programme aims need to be stronger in respect of the ambition of the programme to produce professional engineers with the combination of knowledge, skills and attitudes expected of engineering graduates, guided by the expectations outlined in the FINEEC programme outcomes (Standard 1).
- The programme-level learning outcomes need to be expanded to better and more specifically articulate the engineering graduate attributes typically associated with an internationally-accredited engineering programme. This should reflect the FINEEC reference programme learning outcomes for engineering in respect of knowledge and understanding; engineering analysis, design and practice; investigations and information retrieval; multidisciplinary competences; and communication and team-working. (Standard 2).
- The programme structure should be strengthened in respect of new programme-level learning outcomes in core engineering aspects, not least design (in the broad sense of creativity and innovation) to address current deficiencies in respect of engineering practice (Standard 2).
- Course-level learning outcomes in the later years of the programme need to be expressed in language more appropriate to higher order thinking skills so that the balance between education and training is more apparent in the aggregation of course-level learning outcomes to the attributes of an engineering professional. (Standard 3)
- The course-level learning outcomes for practical training need to be more specific and should form part of the standard agreement with the host organisation. (Standard 3).
- The assessment of achievement of course-level learning outcomes for practical training needs to be more rigorous, by using evidence for example from a supervisor in the University, a supervisor in the host organisation and a comprehensive reflective journal from the student. (Standard 8).
- The discretionary and development budget of the programme should be reviewed with an objective of increasing it to a level commensurate with other programmes in engineering of similar scale in respect of student numbers and needs. (Standard 14).

4
FINEEC Committee for Engineering Education's decision

In its meeting on 14 June 2018 the FINEEC Committee for Engineering Education decided, based on the proposal and report of the accreditation team, that the Degree Programme in Energy and Environmental Engineering (from 2019 onwards the Degree Programme in Environmental Engineering) at Tampere University of Applied Sciences is accredited conditionally.

The set conditions are those listed in section 3, except for the first condition regarding the title of the programme which had been satisfied already before the Committee meeting by TAMK's decision to change the title of the programme from *Energy and Environmental Engineering* to *Environmental Engineering*.

The accreditation is valid until 14 June 20202 by which Tampere University of Applied Sciences should report to the Finnish Education Evaluation Centre on how they have met the set conditions. If the FINEEC Committee for Engineering Education then finds that the conditions have been successfully met, the validity of the accreditation will be extended until 14 June 2024.

The Finnish Education Evaluation Centre (FINEEC) is an independent, national evaluation agency responsible for the external evaluations of education from early childhood education to higher education in Finland. It implements system and thematic evaluations, learning outcome evaluations and field-specific evaluations. Moreover, FINEEC supports providers of education and training and higher education institutions in matters related to evaluation and quality assurance, as well as advances the evaluation of education.

Engineering programme accreditation is a degree programme specific evaluation that can lead to the European EUR-ACE® Label. The accreditation aims to support the enhancement of quality in engineering degree programmes and increase the international comparability and recognition of engineering degrees within Europe. The accreditation is voluntary for Finnish higher education institutions and degree programmes. This report presents the process and results of the accreditation of the Degree Programme in Energy and Environmental Engineering at Tampere University of Applied Sciences, Finland.

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