

Assessment report
Limited Framework Programme Assessment

Master Life Science and Technology

Delft University of Technology

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1. Executive summary

In this executive summary, the panel presents the main considerations, which led to the assessment of the quality of the Master Life Science and Technology programme of Delft University of Technology. The programme was assessed according to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, published on 20 December 2016 (Staatscourant nr. 69458).

The programme objectives are sound. The panel appreciates the multidisciplinary and broad nature of the programme, offering students the opportunities to acquire advanced knowledge and understanding about the fundamental sciences of biochemistry, biocatalysis, microbiology and molecular biology as well as becoming familiar with applications of this knowledge in engineering of bioprocesses. The panel regards the programme profile to be well-delineated, but suggests to clarify this profile further in relation to other Dutch and foreign programmes.

The objectives of the programme are within the boundaries of the domain-specific reference framework for academic chemical sciences programmes. The panel appreciates the efforts by the joint programmes in chemical sciences in the Netherlands to draft this framework and regards this to be a sound and up-to-date description of this domain. The profile of this Delft University of Technology programme may be clearly distinguished within the framework.

Students are educated both for PhD positions and for a wide range of positions on the labour market. The programme meets the requirements of the professional field.

The panel regards the intended learning outcomes to be meet the programme objectives, to be well-articulated and to conform to the master level.

The number of incoming students in the programme is positive. The panel supports programme management's plans for gradual growth (up to 75 students maximum). The target for the proportion of international students is adequate.

The curriculum matches the intended learning outcomes of the programme. The panel appreciates the contents of the curriculum, the modules being solid and up-to-date. The curriculum is coherent, the modules and other curriculum components being balanced. The specialisations are well-chosen and have been well-integrated in the curriculum. The panel welcomes the Design project and Industrial internship, allowing students to become acquainted with the professional field. The panel suggests to give students opportunities to do more extensive internships to meet industry demands. Although soft- or transferable skills are appropriately addressed in the curriculum, the panel advises to bring them together in one teaching-learning trajectory to optimise soft- or transferable skills training.

The lecturers in the programme are very strongly research-oriented teachers. The lecturers are also very education-minded, all of them being BKO-certified. The support staff of the programme is very effective.

The entry requirements and admission procedures of the programme are appropriate. Incoming students are well-informed about the programme. The panel finds the international students to be integrated well in the programme.

The panel considers the study methods of the programme to be appropriate, promoting student-active learning processes. New, ICT-based study methods are introduced. The students-to-staff ratio and the number of hours of face-to-face education in the programme are adequate. The study guidance by the academic counsellor is welcomed by the panel. Although the programme is challenging, the panel regards the programme to be feasible and the study load to be evenly distributed. The student success rates are appropriate.

The examination and assessment regulations for the programme are appropriate. The panel approves of the examination methods adopted in the programme, noting these to be consistent with the goals and the contents of the courses. The panel is positive about measures being taken to counter free-riding in group assignments and to prevent fraud and plagiarism. The supervision and assessment processes for the Master End Projects are well-organised. Students are offered appropriate supervision. The assessment procedures are up to standard. The panel welcomes the rubrics scoring forms. Measures have been taken in the programme to ensure the validity, reliability and transparency of examinations and assessments. The panel considers these measures to be adequate and the Board of Examiners to be active in enforcing these. The contribution on the part of the programme Board of Examiners to the implementation of the measures within the Faculty is acknowledged by the panel.

The panel supports the grades awarded to the Master End Projects by the programme examiners. These projects are considered by the panel to be appropriate and to be well-elaborated.

The panel is convinced that students having completed the programme reached the intended learning outcomes. The panel is very positive about the proportion of students continuing their careers in PhD-trajectories. The panel also considers the career perspectives of the programme graduates to be very favourable.

The panel which conducted the assessment of the Master Life Science and Technology programme of Delft University of Technology assesses this programme to meet the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, judging the programme to be satisfactory. Therefore, the panel recommends NVAO to accredit this programme.

Rotterdam, 7 March 2019

Prof. dr. M.A. Cohen Stuart
(panel chair)

drs. W. Vercouteren
(panel secretary)

2. Assessment process

The evaluation agency Certiked VBI received the request by Delft University of Technology to support the limited framework programme assessment process for the joint-degree Master Life Science and Technology programme of this University. The objective of the programme assessment process was to assess whether the programme would conform to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, published on 20 December 2016 (Staatscourant nr. 69458).

Management of the programmes in the assessment cluster WO Scheikunde convened to discuss the composition of the assessment panel and to draft the list of candidates.

Having conferred with management of the Master Life Science and Technology programme of Delft University of Technology, Certiked invited candidate panel members to sit on the assessment panel. The panel members agreed to do so. The panel composition was as follows:

- Prof. dr. M.A. Cohen Stuart, professor emeritus, chair of Physical Chemistry & Colloid Chemistry, Wageningen University, professor emeritus of Physical Surface Chemistry, University of Twente, professor East China University of Science and Technology, Shanghai, China (panel chair);
- Prof. dr. A.H.T. Boyen, associate professor emeritus, Faculty of Sciences and Bio-engineering Sciences, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel (panel member);
- Prof. dr. ir. G.B. Marin, professor of Chemical Reaction Engineering, head Laboratory for Chemical Technology, Ghent University (panel member);
- Prof. dr. R.M.J. Liskamp, professor, chair Chemical Biology and Medicinal Chemistry, School of Chemistry, University of Glasgow, United Kingdom, professor of Molecular Medicinal Chemistry, Utrecht University (panel member);
- Drs. O. de Vreede, head Innovation and Human Capital, VNCI, Association of the Dutch Chemical Industry (panel member);
- A.E.M. Melcherts BSc, student Master in Nanomaterials Science, Utrecht University (student member).

On behalf of Certiked, drs. W. Vercouteren served as the process coordinator and secretary in the assessment process.

All panel members and the secretary confirmed in writing being impartial with regard to the programme to be assessed and observing the rules of confidentiality. Having obtained the authorisation by the University, Certiked requested the approval of NVAO of the proposed panel to conduct the assessment. NVAO have given their approval.

To prepare the assessment process, the process coordinator convened with management of the programme to discuss the outline of the self-assessment report, the subjects to be addressed in this report and the site visit schedule. In addition, the planning of the activities in preparation of the site visit were discussed. In the course of the process preparing for the site visit, programme management and the Certiked process coordinator regularly had contact to fine-tune the process. The activities prior to the site visit have been performed as planned. Programme management approved of the site visit schedule.

Well in advance of the site visit date, programme management sent the list of final projects of graduates of the programme of the most recent years. Acting on behalf of the assessment panel, the process coordinator selected the theses of 15 graduates from the last few years. The grade distribution in the selection was ensured to conform to the grade distribution in the list, sent by programme management.

The panel chair and the panel members were sent the self-assessment report of the programme, including appendices. In the self-assessment report, the student chapter was included. In addition, the expert panel members were forwarded a number of theses of the programme graduates, these theses being part of the selection made by the process coordinator.

Several weeks before the site visit date, the assessment panel chair and the process coordinator met to discuss the self-assessment report provided by programme management, the procedures regarding the assessment process and the site visit schedule. In this meeting, the profile of panel chairs of NVAO was discussed as well. The panel chair was informed about the competencies, listed in the profile. Documents pertaining to a number of these competencies were presented to the panel chair. The meeting between the panel chair and the process coordinator served as the briefing for panel chairs, as meant in the NVAO profile of panel chairs.

Prior to the date of the site visit, all panel members sent in their preliminary findings, based on the self-assessment report and the final projects studied, and a number of questions to be put to the programme representatives on the day of the site visit. The panel secretary summarised this information, compiling a list of questions, which served as a starting point for the discussions with the programme representatives during the site visit.

Shortly before the site visit date, the complete panel met to go over the preliminary findings concerning the quality of the programme. During this preliminary meeting, the preliminary findings of the panel members, including those about the theses were discussed. The procedures to be adopted during the site visit, including the questions to be put to the programme representatives on the basis of the list compiled, were discussed as well.

On 26 September 2018, the panel conducted the site visit on the Delft University of Technology campus. The site visit schedule was as planned. In a number of separate sessions, the panel was given the opportunity to meet with Faculty Board representatives, programme management, Board of Examiners members, lecturers and final projects examiners, and students and alumni.

In a closed session at the end of the site visit, the panel considered every one of the findings, weighed the considerations and arrived at conclusions with regard to the quality of the programme. At the end of the site visit, the panel chair presented a broad outline of the considerations and conclusions to programme representatives.

The assessment draft report was finalised by the secretary, having taken into account the findings and considerations of the panel. The draft report was sent to the panel members, who studied it and made a number of changes. Thereupon, the secretary edited the final report. This report was presented to programme management to be corrected for factual inaccuracies. Programme management were given two weeks to respond. Having been corrected for these factual inaccuracies, the Certiked bureau sent the report to the Board of Delft University of Technology, to accompany their request for re-accreditation of this programme.

3. Programme administrative information

Name programme in CROHO: M Life Science and Technology
Orientation, level programme: Academic Master
Grade: MSc
Number of credits: 120 EC
Specialisations: Biocatalysis
Biochemical Engineering
Cell Factory
Location: Delft
Mode of study: Full-time (language of instruction English)
Registration in CROHO: 21PF-66286

Name of institution: Delft University of Technology
Status of institution: Government-funded University
Institutions' quality assurance: Approved

4. Findings, considerations and assessments per standard

4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings

The Master Life Science and Technology programme is offered by the Faculty of Applied Sciences of Delft University of Technology. The dean of the Faculty has the responsibility for all bachelor, master and PDEng programmes of the Faculty. Research of the Faculty is organised in seven departments, one of which is the Department of Biotechnology. The programme is embedded in this department. Being assisted by the programme coordinator and the academic counsellor, the director of studies takes care of programme management. The Board of Studies, consisting of an equal number of lecturers and students, advises programme management on quality and organisational issues. Students views are collected by means of written surveys and quarterly evaluation lunches. The programme Board of Examiners, acting on behalf of the Faculty Board of Examiners is responsible for ensuring the quality of examinations and assessments of the programme.

The Master Life Science and Technology is a two-year, research-based, academic, multidisciplinary master programme in biotechnology. The programme is multidisciplinary in combining fundamental sciences and engineering as well as applications in this field. Students in the programme are educated broadly, being introduced at an advanced level to the fundamental sciences biochemistry, biocatalysis, microbiology and molecular biology as well as to the engineering of bioprocesses. Students may select one of the three specialisations offered, being Biocatalysis, Biochemical Engineering or Cell Factory.

The objectives of the programme are conform to the domain-specific reference framework for the chemical sciences in the Netherlands, which has been drafted by the joint programmes of this assessment cluster in the Netherlands. In this domain-specific framework, reference has been made to international frameworks and benchmark statements. This Delft University of Technology programme may be regarded as being positioned in the intersection of the molecular life sciences and the chemical engineering sub-domains of chemical sciences.

Students are trained to become modern engineers, having fundamental knowledge in biotechnology and with the knowledge on how to create technological solutions. The programme aims to prepare students both for PhD-trajectories and for industry. Students may pursue careers in environmental, medicinal or chemical biotechnology industries or in consultancy.

The programme maintains intensive contacts with industry. Lecturers in the programme have research contacts with industry and companies are involved in internships.

The programme objectives have been translated into intended learning outcomes. These specify, among others, thorough knowledge and understanding of the field of biotechnology and within this field of one or two of the specialisations offered, together with training in research skills, design skills, scientific, critical thinking, cooperation and communication skills, as well as ethical and societal awareness.

Considerations

The panel considers the programme objectives to be sound. The panel appreciates the multidisciplinary and broad nature of the programme, offering students the opportunities to acquire advanced knowledge and understanding about the fundamental sciences of biochemistry, biocatalysis, microbiology and molecular biology as well as understanding how to apply this knowledge in the engineering of bioprocesses. The panel regards the programme profile to be well-delineated, but suggests to clarify this profile further in relation to other Dutch and foreign programmes.

The objectives of the programme are within the boundaries of the domain-specific reference framework for academic chemical sciences programmes. The panel appreciates the efforts by the joint programmes in chemical sciences in the Netherlands to draft this framework and regards this to be a sound and up-to-date description of this domain. The profile of this Delft University of Technology programme may be clearly distinguished within the framework.

Students are educated both for PhD positions and for a wide range of positions on the labour market. The programme meets the requirements of the professional field.

The objectives meet the intended learning outcomes of the programme. The panel regards the intended learning outcomes to be well-articulated. The intended learning outcomes conform to the master level, as they correspond to the Meijers criteria.

Assessment of this standard

These considerations have led the assessment panel to assess standard 1, Intended learning outcomes, to be satisfactory.

4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Over the last four years, the number of incoming students in the programme fluctuated somewhat, being on average 53 students per year. About 2/3 of the incoming students come from the Delft University of Technology and Leiden University joint-degree Bachelor Life Science and Technology programme. A number of students are from abroad. Only few students come from other Dutch universities or from higher vocational education institutes. Programme management wants to achieve gradual growth of the programme (up to 75 students maximum) and strives to about 30 % international students.

The curriculum has a study load of 120 EC and takes two years to complete. Programme management presented a table, mapping the intended learning outcomes to the curriculum components. In the first year, the curriculum is composed of general modules (15 EC), specialisation modules (18 EC), electives (12 EC) and the Design Project (12 EC). The second year consists of the Industrial internship (18 EC) and the Master End Project (45 EC). The general modules are mandatory for all students, teaching them the scientific and engineering foundations and introducing them to ethical, legal and societal dimensions of biotechnology. At the end of the first year in the Design project, students in small groups of four to six students work on real-life conceptual process or product design projects, in response to industrial principals' demands. Students present their results in writing and orally. In the specialisation modules, students select courses in line with one of the three specialisations they opt for. By scheduling modules, students may do two specialisations. In addition, students select electives and do the Industrial internship, often abroad, these internships being meant to introduce students to the professional field. Instead of the Industrial internship and the electives (30 EC in total), students may choose the Annotation in Entrepreneurship/Science Based Business, Sustainability in Technology, Science Education & Science Communication or Study Abroad options. These allow students to be introduced to and prepare for business dimensions of science, sustainability or science communication or to spend part of the curriculum abroad. The final component of the curriculum is the Master End Project (45 EC), taking up the major part of the second year and requiring students to conduct an individual research project. New trends, such as renewable energy, filter via research through to the programme curriculum. In the modules, Design project, internship and Master End Project, students are taught academic skills, such as academic writing, presentation, problem-solving and collaboration skills. In the modules, these skills are woven into course contents. In the curriculum, career events are scheduled.

About 28 lecturers coming from various countries are involved in the programme. All lecturers have PhDs, are actively engaged in current, international research in their fields and work at the research groups of the Department of Biotechnology. All lecturers are BKO-certified, the director of studies being SKO-certified. In addition to the permanent staff, postdocs and PhD students act as teaching assistants in tutorials and research projects. The programme coordinator and academic counsellor comprise the support staff of the programme. Teaching days are scheduled regularly, most lecturers attending these events. The lecturers' workload is quite demanding. New staff is recruited.

Applicants who have completed the Delft-Leiden Bachelor Life Science and Technology programme are admitted unconditionally. The applications of students with other backgrounds are screened by the director of studies in his capacity of admission officer. Students with Dutch bachelor degrees in other university programmes than the one mentioned, with international bachelor degrees, or bachelor degrees from higher vocational education institutes are admitted, provided they remedy their deficiencies before entering. As the backgrounds of applicants are very diverse, no general bridging programme is offered. About 50 % of the international applications are rejected.

The educational concept of the programme may be said to be research-based learning. In the general mandatory courses and the specialisation courses (33 EC) about 250 hours of face-to-face education are scheduled, implying about 13 contact hours per week. In the Design project, the number of contact hours is about 300 hours. Study methods adopted in the courses are lectures, individual exercises, group assignments, and literature study. Lectures are recorded and lecturers adopt ICT-based study methods. The students-to-staff ratio is 17.7 : 1. New facilities are available for the programme. The programme academic counsellor interviews all students, monitors their study pace closely and advises them in case of study problems. Students may also turn to the programme coordinator or the specialisation coordinators. International students are guided in the programme by student mentors. Student groups are composed of both Dutch and international students, which is rather successful in terms of students learning from each other. The student success rates after two years are on average about 20 % and after three years are on average 74 % (figures for last three cohorts). The average study duration is 2.1 years for international students and 2.5 years for Dutch students.

Considerations

The number of incoming students in the programme is positive. The panel supports programme management's plans for gradual growth (up to 75 students maximum). The target for the proportion of international students is adequate.

The curriculum matches the intended learning outcomes of the programme. The panel appreciates the contents of the curriculum, the modules being solid and up-to-date. The curriculum is coherent, the modules and other curriculum components being balanced. The specialisations are well-chosen and have been well-integrated in the curriculum. The panel welcomes the Design project and Industrial internship, allowing students to become acquainted with the professional field. The panel suggests to give students opportunities to do more extensive internships to meet industry demands. Although soft- or transferable skills are appropriately addressed in the curriculum, the panel advises to bring them together in one teaching-learning trajectory to optimise soft- or transferable skills training.

The lecturers in the programme are very strongly research-oriented teachers. The lecturers are also very education-minded, all of them being BKO-certified. The support staff of the programme is very effective.

The entry requirements and admission procedures of the programme are appropriate. Incoming students are well-informed about the programme. The panel finds the international students to be integrated well in the programme.

The panel considers the study methods of the programme to be appropriate, promoting student-active learning processes. New, ICT-based study methods are introduced. The students-to-staff ratio and the number of hours of face-to-face education in the programme are adequate. The study guidance by the academic counsellor is welcomed by the panel. Although the programme is challenging, the panel regards the programme to be feasible and the study load to be evenly distributed. The student success rates are appropriate.

Assessment of this standard

These considerations have led the assessment panel to assess standard 2, Teaching-learning environment, to be satisfactory.

4.3 Standard 3: Student assessment

The programme has an adequate system of student assessment in place.

Findings

The examination and assessment policies of the programme meet the Assessment Policy guidelines of the Faculty of Applied Sciences. They are laid down in the Teaching and Examination Regulations for the programme and the rules and guidelines of the Board of Examiners. The Faculty Board of Examiners sets the rules, whereas on behalf of the Faculty Board the programme Board of Examiners has the authority to ensure the quality of examinations and assessments of the programme.

The examination methods in the courses are, among others, written examinations, individual and group assignments, case-studies and oral presentations. In most of the courses, multiple examinations are scheduled, both during and at the end of courses. In case of group projects, peer review among students is adopted to counter free-riding. No more than 50 % of the grades of courses may consist of group work. In design projects, internships and Master thesis projects, examination methods are performance in the projects, progress meetings, presentations, written reports and oral defence of the work. In (international) internships, examiners from the programme are involved in the assessment. Written assignments and theses are checked for plagiarism and fraud. Students are also informed about fraud and plagiarism regulations. These cases are dealt with by the Board of Examiners and few cases have been reported.

The Master End Projects are individual projects. The projects are usually done at one of the research groups of the Department of Biotechnology and, most of the time, are part of ongoing research projects. Research groups present topics to students at PhD poster presentations. The projects are supervised by supervisors of one of the research groups of this department. Day-to-day supervisors may be PhD students, acting under the responsibility of supervisors. Weekly meetings between the students and their supervisor as well as about three presentations by students are scheduled in this process. Rarely, projects are conducted in industry. These projects may only be carried out with consent of the Board of Examiners and the academic level has to be assured. At completion of the project, students submit the written report and have to present and defend their results. The projects are assessed by at least three staff members, one of whom comes from another research group. They use an extensive rubrics scoring form for their assessment, which includes knowledge and understanding of literature, application/extension of theory, experimentation skills, generation/interpretation of results, project management, communication during the project and report and presentation as assessment criteria.

In the programme, measures have been taken to ensure the validity, reliability and transparency of examinations and assessments. The director of studies discusses yearly courses' examinations and assessments with the examiners. Examiners are appointed by the Board of Examiners. Examinations of courses are peer-reviewed by fellow examiners. Test matrices are adopted to assure the correspondence of course goals and examinations. In case of deviant grade distributions, examinations may be analysed. The Board of Examiners inspects biannually examinations and assessments of each of the courses, including peer review and test matrices, and discusses these with examiners. In addition, the Board reviews yearly about 10 % of the Master theses. Students are presented with previous examinations for exercises. Students are provided with feedback on examinations they have taken.

Considerations

The panel regards the examination and assessment regulations for the programme to be appropriate.

The panel approves of the examination methods adopted by the programme and notes the methods are consistent with the goals and the contents of the courses. The panel is positive about measures being taken to counter free-riding and to prevent fraud and plagiarism.

The supervision and assessment processes for the Master End Projects are well-organised. Students are offered appropriate supervision. The assessment procedures are up to standard. The panel welcomes the rubrics scoring forms.

Measures have been taken in the programme to ensure the validity, reliability and transparency of examinations and assessments. The panel considers these measures to be adequate and the Board of Examiners to be active in enforcing these. The contribution on the part of the programme Board of Examiners to the implementation of the measures within the Faculty is acknowledged by the panel.

Assessment of this standard

The considerations have led the assessment panel to assess standard 3, Student assessment, to be satisfactory.

4.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.
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Findings

The panel reviewed the Master End Projects of fifteen graduates of the programme with different grades. Students are expected to demonstrate having reached the intended learning outcomes of the programme. The average grade of the Master End Projects of the last years is about 8.0. The proportion of cum laude awards is about 5 %.

Programme graduates find positions quite easily. More than 70 % of the programme graduates found jobs within three months after graduation, about 90 % of them in the programme domain. About 50 % of the programme graduates proceed to pursue PhD-trajectories. About 30 % of the graduates went to careers in industry. The vast majority of the programme alumni (about 95 %) consider the programme to be a good preparation for their careers.

Considerations

The panel supports the grades awarded to the Master End Projects by the programme examiners. These projects are considered by the panel to be appropriate and to be well-elaborated.

The panel is convinced that students having completed the programme reached the intended learning outcomes. The panel is very positive about the proportion of students continuing their careers in PhD-trajectories. The panel also considers the career perspectives of the programme graduates to be very favourable.

Assessment of this standard

The considerations have led the assessment panel to assess standard 4, Achieved learning outcomes, to be good.

5. Overview of assessments

Standard	Assessment
Standard 1. Intended learning outcomes	Satisfactory
Standard 2: Teaching-learning environment	Satisfactory
Standard 3: Student assessment	Satisfactory
Standard 4: Achieved learning outcomes	Good
Programme	Satisfactory

6. Recommendations

In this report, a number of recommendations by the panel have been listed. For the sake of clarity, these have been brought together below.

- To further clarify the programme profile in relation to other Dutch and foreign programmes.
- To give students opportunities to do more extensive internships to meet industry demands.
- To bring soft- or transferable skills together in one teaching-learning trajectory to optimise soft- or transferable skills training.