

ADDITIONAL ASSESSMENT

**BACHELOR'S PROGRAMME**

**INDUSTRIAL ENGINEERING**

DEPARTMENT OF INDUSTRIAL ENGINEERING &  
INNOVATION SCIENCES

**EINDHOVEN UNIVERSITY**

**OF TECHNOLOGY**

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This report was finalized on 28 February 2019



# REPORT ON THE ADDITIONAL ASSESSMENT OF THE BACHELOR'S PROGRAMME INDUSTRIAL ENGINEERING OF EINDHOVEN UNIVERSITY OF TECHNOLOGY

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (September 2016).

## ADMINISTRATIVE DATA REGARDING THE PROGRAMME

### **Bachelor's programme Industrial Engineering**

Name of the programme:	Industrial Engineering
CROHO number:	56994
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	-
Location:	Eindhoven
Mode of study:	full time
Language of instruction:	English
Expiration of accreditation:	30/10/2019

The meeting of the assessment panel took place on January 28, 2019 in Utrecht.

## ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Eindhoven University of Technology
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

## COMPOSITION OF THE ASSESSMENT PANEL

The NVAO has approved the composition of the panel on January 14, 2019. The panel that assessed the bachelor's programme Industrial Engineering consisted of:

- Prof. dr. ir. R.E.C.M. (Rob) van der Heijden, professor Innovative planning methods at the Nijmegen School of Management of Radboud University [chair];
- Prof. dr. E. (Erik) Demeulemeester, professor in Operations Management at the Faculty of Economics and Business and head of the Research Center for Operations Management of KU Leuven (Belgium);
- Nathan Clercx BSc, master's student Industrial Engineering & Management at the University of Twente.

The panel was supported by drs. L.C. (Linda) te Marvelde, who acted as secretary.

## WORKING METHOD OF THE ASSESSMENT PANEL

### *Preparation*

The panel that was asked to assess the improvement of the programme included two of the members of the original panel: professor Rob van der Heijden (chair) and professor Erik Demeulemeester. New



member Nathan Clerkx BSc (student member) was added to the panel. In accordance with the NVAO guideline, the panel was asked to focus on the standard that was originally assessed as unsatisfactory, standard 4. In accordance with NVAO's *Uitgangspunten bij de beoordeling van een opleiding in een herstelperiode* (november 2014) the panel chose a proportional approach in assessing the improvements made to the programme. With the approval of the programme and panel, the reassessment was based on written evidence which was discussed during a panel meeting at QANU's office in Utrecht.

In preparation for the reassessment, the programme drew up a brief status report (*Report Recovery Period, Bachelor's Program Industrial Engineering, December 2018*), which was made available to the panel members. In addition to the status report, the panel selected and studied a sample of 15 Bachelor End Projects (BEPs) that were completed in 2018, together with the evaluation and grading reports (assessment forms) for these projects. The student member of the panel had access to the theses as a second reader. All panel members sent their feedback on the status report and sample BEPs to the panel and secretary in preparation for the panel meeting.

#### *Panel meeting and report*

The panel met on January 28, 2019 to discuss its findings. After the panel reached a conclusion on the improvement that was achieved, the secretary drafted an assessment report. The report was submitted to the panel for feedback approval and afterwards sent to the programme for a check on factual inaccuracies. The panel finalised its report after discussing the programme's comments.

#### *Decision rules*

In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

#### **Generic quality**

The quality that can reasonably be expected from a higher education bachelor's programme.

#### **Unsatisfactory**

The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

#### **Satisfactory**

The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

#### **Good**

The programme systematically surpasses the current generic quality standards across its entire spectrum.

#### **Excellent**

The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

## SUMMARY JUDGEMENT

The bachelor's programme Industrial Engineering has made suitable changes to its Bachelor's End Project (BEP) which focused on prerequisites, clarification of the set-up and structure, improving communication with students and supervisors, and developing a transparent and fair assessment process. The programme has written a new study guide, optimised the online learning environment (CANVAS), and developed a detailed rubric (and assessment form) and assessment procedure to aid the implementation of the redesigned BEP. The panel compliments the programme with the improvements it has made.

The panel studied fifteen BEPs prior to its meeting on January 28, 2019 to assess their overall quality. It found that all but one BEP showed vast improvements compared to the BEPs it reviewed in 2017. Students are evidently made aware of performing research in the regulative cycle or 'problem solving cycle'. The panel sees the current quality of the BEPs as evidence that students are much better prepared for conducting research and reporting on it. The panel asks, however, for continuous attentiveness concerning the use of literature as it has seen differences between students in the extent to which literature is explored and used. A second issue concerns the quality of Dutch language use. The panel has encountered BEPs that contained (too) many spelling mistakes, and punctuation and grammatical errors. All in all, the panel found that their assessments of the BEPs corresponded with the evaluations/grading of the programme's assessors.

The panel is positive about the great care with which a new rubric and accompanying assessment form for the BEP were developed by involving many different stakeholders and benchmarking several rubrics from similar programmes. The panel also applauds the manner in which all stakeholders were informed on the new rubric/assessment form and the programme's expectations on its use. The panel encourages assessors to consistently use the option on the assessment form to provide qualitative feedback, as it has seen several filled-out forms in which assessors had declined the option to provide qualitative feedback to the student. Especially grades that are given around the pass-mark (6) need written additional clarification and elaboration of the assessors' final conclusion.

The panel makes two additional recommendations concerning the BEP assessment process. Firstly, the panel strongly advises the programme to make the presence of the 2<sup>nd</sup> assessor at the final BEP presentation mandatory. Being present during the final presentation gives the second assessor an opportunity to have an overview of all efforts and achievements of the student, and to discuss any questions or observations the second assessor may have. Secondly, the panel suggests that the two-week improvement period (presently only for students to achieve a pass-mark after initial assessment) could also be used by all students to correct linguistic errors in the BEP.

In conclusion, the panel finds that the programme has used the recovery period wisely and has made improvements to go beyond the recommendations of the panel. The panel compliments the programme on their achievements and supports the future plans it presented for the BEP and the curriculum as a whole. The enhanced quality of the programme is already evident from the improved quality of the most recent BEPs.

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

*Bachelor's programme Industrial Engineering*

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Student assessment	satisfactory
<i>Standard 4: Achieved learning outcomes</i>	<i>satisfactory</i>

*General conclusion* *satisfactory*

The chair, prof. dr. ir. R.E.C.M. (Rob) van der Heijden, and the secretary of the panel, drs. L.C. (Linda) te Marvelde, hereby declare that all panel members have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 28 February 2019



# DESCRIPTION OF STANDARD 4 FROM THE ASSESSMENT FRAMEWORK FOR LIMITED FRAMEWORK ASSESSMENTS

## Introduction

De NVAO heeft de Technische Universiteit Eindhoven (TU/e) bij brief van 18 juli 2017 gemeld dat zij op grond van de negatief beoordeelde kwaliteit van de opleiding niet kon overgaan tot accreditatie van de opleiding, waar de instelling bij brief van 2 mei 2017 om had verzocht. Zij heeft de instelling in de gelegenheid gesteld om een herstelplan in te dienen waarin deze aangeeft welke verbetermaatregelen zij zou nemen om tegemoet te komen aan alle kritiepunten en/of aanbevelingen van het panel met betrekking tot standaard 4 (Gerealiseerde eindkwalificaties).

De NVAO ontving per brief van 11 september 2017 een door het panel beoordeeld herstelplan. In het herstelplan werd een overzicht gepresenteerd van maatregelen die naar het oordeel van het panel, bij juiste implementatie, het gewenste effect zullen bewerkstelligen op stroomlijning van de beoordelingsprocedure en het bereiken van het gewenste kwaliteitsniveau. Het pakket voorzag onder meer in nadere uitwerking en communicatie van het beoordelingsformat, inclusief regels voor weging en compensatie, onafhankelijke beoordeling door twee beoordelaars met voldoende ervaring, training van nieuwe beoordelaars en communicatie met reeds actieve beoordelaars, een actieve toezichhoudende rol van de Examencommissie en tenslotte een duidelijk communicatietraject richting studenten. Het herstelplan voorziet tevens in een realistische tijdslijn voor implementatie. Het panel achtte het opgestelde herstelplan een adequaat antwoord op zijn kritiepunten en kwam tot een positief advies over het herstelplan. Als het herstelplan zou worden uitgevoerd zoals omschreven en als de opleiding daarbij ook aandacht zou besteden aan het op het BEP voorbereidende traject, dan lag het in de ogen van het panel voor de hand dat de opleiding na ruim een jaar aan de eisen voor heraccreditatie zou voldoen.

### **Standard 4: Achieved learning outcomes**

The programme demonstrates that the intended learning outcomes are achieved.

## Findings and considerations 2017

Students of the bachelor's programme Industrial Engineering (IE) finish their studies with the Bachelor End Project (BEP, 10 EC), consisting of a thesis that commonly takes form as a research assignment directed towards solving an existing problem or answering a research question with the use of relevant academic literature and qualitative and/or quantitative data analyses. The BEP usually explores field behaviour and the performance of business processes in industrial and service organisations within a suitable company. The panel studied fifteen BEPs prior to the site visit, two of which (according to the panel) did not meet the pass grade. The research questions posed were not of an adequate level, they were badly presented and failed to reflect certain academic skills. References to and the use of literature were inadequate and all but critical. As over 10% of the theses was considered unsatisfactory, the selection was enlarged with ten extra theses that were randomly selected, representing various examiners, tracks and a range of marks. Again, the panel deemed two theses unsatisfactory.

Additionally, the panel noted that no clear marking criteria seemed to exist regarding what 'sufficient' and 'poor' entailed. It also wondered whether a BEP, assessed with five out of nine aspects as 'poor', should still be considered passable. The panel strongly advised the programme to ensure that all staff members align their practice regarding the management's directives: the BEP is a project in which all learning outcomes come together. All staff members, in particular those heavily involved in BEP supervision, should endorse the course requirements and marking criteria and BEPs should meet the requirements regarding academic presentation and level in the future.

In conclusion, as the panel assessed more than 10% of the evaluated BEPs as unsatisfactory, Standard 4 was assessed as unsatisfactory. The panel recommended the programme to redesign the



BEP preparation trajectory and the BEP itself, to continuously align its staff regarding scoring criteria and to ensure that the staff recognises the BEP as the final project that encompasses all intended learning outcomes.

The panel expressed confidence in the strong curriculum, committed and qualified staff members and in the solid learning environment. The panel found that the programme should be able to address the identified shortcomings in a timely and satisfactory manner.

## **Findings and considerations 2019**

### *1. Quality of Bachelor End Projects (BEPs)*

The panel studied fifteen BEPs prior to its meeting on January 28, 2019 to assess their overall quality. It found that all but one Bachelor's End Project showed vast improvements compared to the BEPs it reviewed in 2017. Students are clearly made aware of performing research in the regulative cycle or 'problem solving cycle'. The BEPs showed that students now seem to follow the same steps, starting with an adequate formulation of a business problem and research question, followed by a description of the research approach. Students then proceed to analysing the problem (data collection, data analysis, problem diagnosis), to reporting the causes and consequences of the problem, and the formulation of possible directions for additional research as well as possible management implications.

The panel sees the improvement of the BEPs as evidence that students are better prepared for conducting research and reporting on it. The panel made two additional remarks concerning the quality of the BEPs. It asks for continuous attentiveness concerning the use of literature as it has seen differences between students in the extent to which scientific literature is explored and used. A second remark concerns the quality of Dutch language use. The panel has encountered BEPs that contained (too) many spelling mistakes, and punctuation and grammatical errors. The panel did not report the same findings in the BEPs written in English. The panel stresses that the correct use of Dutch and/or English is important and deserves continued attention from assessors.

The findings on the improved quality of the BEPs strengthens the panel in its conviction that the original problems it identified did not concern a major structural problem with the curriculum, organisation, or staff, but was rather a matter of the programme's alertness in the final stages of the bachelor.

### *2. Redesigning BEP*

The programme has made some changes to the BEP which focused on prerequisites, clarification of the set-up and structure, improving communication with students and supervisors, and developing a transparent and fair assessment process. The programme has written a new study guide, optimised the online learning environment (CANVAS), and developed a detailed rubric and assessment procedure to aid the implementation of the redesigned BEP.

As per the recommendation of the panel (2017), the BEP preparation trajectory and the BEP itself were reconsidered. The minimum requirements to start the BEP have been tightened to improve the quality of the project. Students are now required to have acquired 115 out of 120 EC at the moment of BEP registration. Moreover, the course *Research methods* is now part of the prerequisites, which the panel deems a vast improvement as students will find themselves better prepared for the BEP. A uniform structure which includes a timeline, clear and strict mandatory deadlines for deliverables and assessments have been installed and are incorporated in CANVAS. CANVAS, according to the panel, is appropriately used as a communication and support system during the entire BEP process.

The former set-up of the BEP contained a detailed explanation of the research cycle, and a scheme on how to implement this in the BEP, which was meant to support students in planning and executing their research. However, the interpretation of the research cycle differed per supervisor/research

group and the schedule was not applicable to all types of projects. The programme now provides a general explanation on doing research by shortly introducing the research cycle. This should stimulate students to determine the set-up of their research, design the different phases, and to start discussions with their supervisors on their plans, thus making this set-up applicable to different types of research. The programme now also offers the option for a 15 EC BEP for in-company projects (including 5 EC from the elective space), which the panel perceives as a very attractive option for students.

The purpose and importance of the BEP as the final project that reflects the learning outcomes of the BSc IE program is explicitly communicated with the lecturers and students. The panel appreciates the efforts the programme made with regards to their communication strategy, which includes information meetings with students and staff, training sessions with assessors, and assistance through CANVAS which was set up to facilitate the new BEP process and assessment procedure. The panel appreciates that students are informed in week 1 of their third year of what is expected of them in the BEP at the end of the academic year.

### *3. BEP assessments*

#### *3.1 BEP rubric/assessment form*

A rubric and accompanying assessment form has been developed for the BEP to ensure alignment between assessors on assessment criteria and levels of accomplishment, leading to consistent and reliable assessments.

A benchmark study was performed of thesis rubrics from other TU/e bachelor's and master's programmes and similar national and international IE bachelor's programmes, including rubrics on professional skills for engineering bachelor's programmes. Educational experts, the Curriculum Committee, the Programme Committee, and the Examination Committee provided feedback on a draft version. The final version of the BEP rubric was approved by the Examination Committee and introduced in the academic year 2017/2018. The BEP rubric was introduced to BEP supervisors, assessors, and students by means of instructional meetings.

All users of the rubric (students, BEP supervisors, assessors, Programme Committee, Examination Committee, and the subcommittee of the Examination Committee concerned with quality of the theses) are encouraged to continuously provide feedback on the rubric, possibly leading to further adjustments in the upcoming BEP cycles. An annual review process aims to safeguard the validity and reliability of the rubric, followed by clear communication towards all stakeholders for optimal transparency. Currently, efforts are made to further digitalise and streamline the BEP rubric and assessment form, to further optimise the assessment procedure and to promote transparency.

The panel finds that the BEP rubric and assessment form specify in great detail what the main learning goals are with regard to the quality of the problem identification and the theoretical framework, the quality of the research strategy, the quality of the research execution, the quality of the conclusion and discussion, the quality of the research report, and the quality of the professional skills. The rubric is useful in all stages of the BEP process. It specifies the requirements for assessors and students, serves as a detailed framework for consistent judgements, and after the assessment it can provide information about the quality of the performance of students against the specified criteria.

The panel is positive about the great care with which the rubric was developed by involving many different stakeholders and benchmarking several rubrics from similar programmes. The panel also applauds the manner in which all stakeholders were informed on the new rubric/assessment form and the programme's expectations on its use. The panel finds that the rubric/assessment form is clear and provides assessors with plenty of opportunity to provide qualitative feedback as well. The use of the assessment form will be discussed below.

#### *3.2 BEP assessment process*



The BEP assessment process is described in detail in the BEP study guide. Submission deadlines of the deliverables (students) and assessment deadlines (assessors) are listed in the timelines on CANVAS per quartile/ semester. The TU/e supervisor hands in the final assessment at the Education Administration IE/IS, which consists of:

1. Assessment form TU/e supervisor filled in and signed by TU/e supervisor/1<sup>st</sup> assessor (including scores for the final presentation and all professional skills (PRVs), with the exception of PRV6: dealing with scientific information);
2. Assessment form 2<sup>nd</sup> assessor filled in and signed by the 2<sup>nd</sup> assessor (only partly covering the report);
3. Final assessment form BEP filled in and signed by both TU/e supervisor/1<sup>st</sup> assessor and the 2<sup>nd</sup> assessor.

The TU/e supervisor (1<sup>st</sup> assessor) coaches students on content and process. The TU/e supervisor assesses the BEP assignment, plan of work, final presentation, final report and the professional skills (with exemption of PRV6). If the TU/e supervisor is a PhD student, assessment will be performed by an examiner who is advised by the PhD student, in which case the student has three supervisors. The 2<sup>nd</sup> assessor (arranged by the TU/e supervisor) has to approve the plan of work and independently assesses the final report. The 2<sup>nd</sup> assessor currently does not have to be present at the final presentation. The panel strongly advises the programme to make the presence of the 2<sup>nd</sup> assessor at the final presentation mandatory. The final presentation is an important part of the assessment. Being present during the final presentation gives the second assessor an opportunity to have an overview of all efforts and achievements of the student, and to discuss any questions or observations the second assessor may have. Also, the panel considers it a courtesy towards students when the second assessor is present. The final presentation is an important occasion since it represents the conclusion of their bachelor's programme; an important achievement.

The panel deems the overall assessment process as satisfactory and applauds students' two-week opportunity to improve elements in the BEP to obtain a pass grade. The panel suggests that this two-week period could also be used by other students to correct linguistic errors in the BEP that surpass minimum requirements that have yet to be established (cf. §1).

The Education Administration IE&IS is tasked with enforcing the requirements regarding timeliness and completeness of the BEP assessment forms as a prerequisite of finalisation of the BEP grade. The panel has seen that the assessors systematically use the rubric/assessment form. The panel encourages assessors, however, to consistently use the option on the assessment form to provide qualitative feedback, as it has seen several filled-out forms in which assessors had declined the option to provide qualitative feedback to the student and/or did not score the subcriteria.

According to the assessment procedure final assessments are discussed between students and their TU/e supervisor in an assessment meeting. The panel has been unable to determine what the quality of the feedback is or whether it is written down. The panel recommends that the Education Administration pays extra attention to the use of the qualitative part of the assessment form. Having completed assessment forms that include qualitative feedback underpinning final grades is crucial, for instance when students want to challenge their grade, or for the Examination Committee (EC) to perform their legal task. Especially grades that are given around the pass-mark (6) need written additional clarification and elaboration of the assessors' final conclusion.

The *BSc thesis assessment committee* performs annual stratified spot checks of BEPs to safeguard the quality of assessment. The Examination Committee acts when the assessments of the subcommittee differ from that of the assessors, in which case the EC requires additional information from the assessors. Such instances are to be reported in the EC's annual report. The panel found that its assessments of the BEPs corresponded with the evaluations/grading of the programme's assessors.

#### 4. *Redesigning the IE curriculum*



The status report shows that the BSc IE is committed to continually improve its programme and working practices. Based on student evaluations and the outcomes of a BEP project group, the programme has defined a number of plans for the new future such as the start of a BEP buddy programme (tutor programme) and information sessions organised by Industria (IE study association). The panel has taken note of all proposed plans and finds that they are sensible.

The programme has also revised its curriculum which will be rolled out in phases starting in the academic year 2019-2020. The panel is not tasked with assessing the new curriculum, but notes that it has seen that several elements of the revised curriculum directly correspond to recommendations that the panel made in 2017, most notably in preparing students for the BEP by introducing integration courses that allow students to practice their research skills throughout the bachelor's programme, and by strengthening the disciplinary profile students will be able to build by shifting disciplinary knowledge from the second and third year to earlier in the programme, thus creating possibilities for more in-depth disciplinary learning in later years of the programme.

In conclusion, the panel finds that the programme has used the recovery period wisely and has made improvements, even beyond the recommendations of the panel. The panel compliments the programme on their achievements. The improved quality of the programme is already evident from the quality of the most recent BEPs.

### **Conclusion**

*Bachelor's programme Industrial Engineering: the panel assesses Standard 4 as 'satisfactory'.*

## **GENERAL CONCLUSION**

Based on the information provided in the documents, the panel established that the programme has fully implemented the measures proposed in the improvement plan. Furthermore, the panel finds that the programme satisfies the criteria for Standard 4 and that the (consistency in the) assessment of the BSc End Project has significantly improved. The panel expresses its full confidence in the programme's future.

The panel upholds its initial assessments of Standard 1, 2, and 3 and judges the overall quality of the programme as satisfactory.

### **Conclusion**

The panel assesses the *bachelor's programme Industrial Engineering* as 'satisfactory'.



# APPENDIX



## APPENDIX 1: THESES AND DOCUMENTS STUDIED BY THE PANEL

Prior to the site visit, the panel studied 15 theses of the bachelor's programme Industrial Engineering. Information on the selected theses is available from QANU upon request.

The panel studied the following documents:

1. Report Recovery Period, Bachelor's Program Industrial Engineering December 2018
2. 2017 QANU report on the TU/E Bachelor's Programme IE
3. BEP Rubric
4. BEP Rubric Training
5. BEP CANVAS
6. BEP Study Guide
7. BEP Teacher Manual
8. List of BEP projects 2017/2018
9. Overview actions based on recommendations
10. Besluit strekkende tot het verlengen van de geldigheidsduur van het accreditatiebesluit van 11 mei 2011 [...] van de opleiding wo-bachelor Technische Bedrijfskunde van de Technische Universiteit Eindhoven tot en met 30 oktober 2019 (NVAO)