Advanced Technology

Faculty of Science and Technology,
University of Twente

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Report on the bachelor's programme Advanced Technology of University of Twente

This report considers the NVAO's Assessment Framework for Limited Programme Assessments as reference.

Administrative data regarding the programme

Bachelor's programme Advanced Technology

Name of the programme:	Advanced Technology
CROHO number:	50002
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	Multi-disciplinary bachelor
Location(s):	University of Twente, Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

The visit of the assessment committee Advanced Technology to the Faculty of Science and Technology of University of Twente took place on 23rd and 24th of October 2013.

Administrative data regarding the institution

Name of the institution:	University of Twente
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	applied (pending)

Quantitative data regarding the programme

The required quantitative data regarding the programme are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the bachelor's programme Advanced Technology consisted of:

- Prof. dr. R. P. (Ronald) Griessen (chair), Emeritus Professor at VU University Amsterdam and lecturer at Amsterdam University College;
- Prof. dr. ir. F. (Fred) van Keulen, Professor at the Department of Precision and Microsystems Engineering at Delft University of Technology;
- Dr. ir. J. H. (Johan) Klootwijk, Senior Scientist and Project Leader at Philips Research and secretary of the daily committee of the Nederlandse Natuurkunde Vereniging;
- Dr. F. (Cis) van den Bogaert (education expert), Head of the Department of Education in the central administration (rectorate) of the University of Antwerp;

- L. (Lieke) van Son (student member), BSc, master student of Innovation Sciences, Eindhoven University of Technology.

The committee was supported by Mrs. J. J. (Jasne) Krooneman, MSc, who acted as secretary.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

Preparation
The management of the bachelor's programme Advanced Technology provided a critical reflection as part of its preparation. The project manager checked the quality and completeness of the information. After receiving approval by the project manager, it was forwarded to the members of the committee, who formulated questions based on its content. Each committee member also had to review three bachelor theses and, if available, the corresponding assessment forms prior to the site visit. Taking a variation in grading into account, the theses were carefully selected by the project manager, in consultation with the chair of the committee (see Appendix 7 for a list of theses and documents studied by the committee).

The project manager designed a visiting timetable, which was discussed with the programme director and the chair of the committee. Preparations for the site visit continued only after an agreement on the visiting timetable was reached. The preparations were somewhat delayed as a result of the retirement of the former director and the appointment of the new director.

Site visit
During the preparatory meeting held at the start of the site visit, the committee was officially installed. It discussed its working method, the findings from the evaluation of the critical reflection and theses, and its perception of the domain-specific framework of reference. It also studied additional information on the content of several courses, such as reference books and other learning material, and read reports on consultations in relevant committees/bodies. It analysed important management information and documentation regarding teacher and student satisfaction. Its members did not find it necessary to request any additional theses.

Immediately after the preparatory meeting, interviews were held with representatives of the management, students, lecturers, alumni, Programme Committee, Board of Examiners, study advisor/coordinator, and finally with the dean and, again, the management team. Nobody made use of the open office hour, when people involved in the programme had the opportunity to speak freely to the committee.

The site visit concluded with an oral presentation of the preliminary findings by the chair of the committee, consisting of a general assessment and several specific observations and impressions of the programme.

Report
After the site visit, the secretary wrote a draft report based on the committee's findings. This draft was sent to the committee members. After processing their comments, the report was delivered to the programme management to check for factual irregularities. Any suggestions made by the programme management were discussed with the chair of the committee, and a

general notice was circulated to the other committee members. After that, the report was finalised.

Decision rules
In accordance with NVAO's Assessment Framework for Limited Programme Assessments (as of 22 November 2011), the committee 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 in an international perspective from a higher education bachelor's or master'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

This report provides an overview of the committee's findings and considerations regarding the bachelor's programme Advanced Technology at the University of Twente. The committee based its judgement on information acquired from the critical reflection, a number of selected theses, the interviews during the site visit, additional reading material which was available during the site visit, and the digital learning environment. The committee found positive aspects as well as points for improvement. After careful consideration, it concluded that the bachelor's programme Advanced Technology satisfies the requirements for accreditation.

Standard 1
The profile of the programme is rather unique, so that it overlaps essentially its framework of reference. In other words: as a consequence of this unique position, the domain-specific framework of reference is predominantly formulated along the lines of the programme itself. It matches international academic standards and is very clearly defined. The committee is enthusiastic about the profile of the programme and its implementation, although the communication of this profile should be improved. It believes that especially the management needs a clearer description of the profile. In the interview during the site visit, the management had some difficulties explaining the word 'advanced', and was hardly able to provide a clear, coherent profile of the programme. The committee appreciates the multidisciplinary breadth of the first two years of the programme and argues that this aspect should be included more explicitly in recruitment material, together with the emphasis on fulfilling a societal need for creative, future scientists. It studied the intended learning outcomes and is convinced that they target the right academic level, fit into the profile and domain-specific reference framework and are well defined.

Standard 2
The curriculum extends over three years. In the first and second year, students follow a great variety of courses that as a whole provide a broad yet solid scientific background. A remarkable component in the curriculum is the project work, which is organised in each semester of the first two years. In the third year there is room for specialisation. There are two areas of specialisation: science and engineering. The narrowing down of knowledge in the third year predominantly functions as a preparation for the student's preferred master's programme. In this year, students also work on their bachelor's assignment (bachelor thesis). Each year is worth 60 EC.

The committee is enthusiastic about the first and second year, which offer a very broad and coherent combination of courses. Although it understands the need for specialisation in the third year on the one hand, it regrets the narrowing down of subjects and perspectives on the other. Nevertheless, it believes that the curriculum consists of a good mix of courses and is convinced that students are able to see the connections between courses – possibly in a later period during their studies. Theory and practice are already nicely intertwined in the curriculum, but it is likely that this will be further enhanced by TOM (*Twents Onderwijsmodel*): the new educational model which aims to provide attractive education for the student population in the coming years. According to the committee, TOM offers an opportunity to strengthen the connection of the curriculum with society and business. It is therefore in favour of the new model and looks forward to its related future developments.

The learning outcomes are adequately embedded in the curriculum, although the committee thinks that the design and multidisciplinary components need more attention. It recognises that design tools are present, but courses on methodology are missing.

Although the didactic vision is not always clear in the documentation, the projects, which are constructed parallel to the courses, are an interesting didactic choice and can be considered as the 'glue' of the curriculum. The committee considers the practicals a somewhat classical didactic method, but thinks they are very suitable teaching tools for the programme.

The committee feels the intake numbers are adequate, and it praises the increase in international students. Shortcomings are the absence of an English translation of the Programme and Assessment Rules and Regulations (OER) and the incomplete set of well worked out course descriptions. It strongly advises the management to get those documents in order as soon as possible. In addition, the committee believes that the programme should optimise its linkages with foreign universities and partners in industry.

The programme is feasible, students receive excellent support from the study advisors in their academic trajectory, and the workload currently amounts to 35 hours per week. Students chose a unique and broad programme and therefore can be expected to think more out of the box than monodisciplinary students. Although the dropout rate before 2010 used to be on the high side, the committee has faith in the improved communication towards freshmen.

The committee believes that the programme houses excellent staff members, in sufficient number. However, it would like to see an increase in the synergic value of the staff members of the different faculties involved. It therefore recommends meetings of lecturers involved with a subset of related courses to strengthen the coherence of their courses, to develop cross-links and improve the general appreciation for the Advanced Technology programme. The Programme Committee could play a role in organising those meetings, as it is clearly a very proactive board of lecturers and highly motivated students. The committee is of the opinion that the Programme Committee functions very well.

Standard 3

With regard to the assessment system, the committee believes that the Board of Examiners currently functions adequately but should implement a clear, explicit assessment system to improve the transparency while also reflecting on and developing its duties. It particularly recommends the explicit implementation of the checklist with criteria for the bachelor thesis, which is published in the study guide.

The committee is impressed by the high level of the bachelor's theses and would like to praise the programme for the extremely solid, well conducted and supervised research processes. Although many theses nearly match a master's thesis level, the committee regrets the absence of a multidisciplinary approach. A discussion of the societal relevance or entrepreneurial context is clearly missing in the thesis procedure. The committee is astonished however, that although multidisciplinarity is considered an essential prerequisite for the bachelor assignment, it does not seem to play any role in the acceptance of a thesis research project and the assessment of the thesis. Since the learning outcomes are all covered in the courses, they are nevertheless achieved.

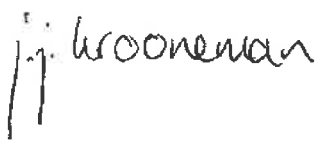
The relationships with industry and the job market are not exploited well enough, according to the committee. However, since a clear fit with the job market is not really relevant for this programme as most students continue with a master's degree, the committee assigns more importance to the fit with further studies. This does not mean however, that the connection with industry should not be optimised. Those who continue on to a master's level achieve good results, and some even continue with a PhD.

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

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 06-01-2014



Prof. dr. R. P. Griessen

Mrs. J.J. Krooneman, MSc

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

This standard first provides an insight into the committee's findings regarding the domain-specific framework of reference (1.1). Subsequently, attention is paid to the profile and orientation (1.2) and the intended learning outcomes and their level (1.3).

1.1 Domain-specific framework of reference

As stated in the domain-specific framework of reference and evident in the presented figure (see Appendix 2), the bachelor's programme Advanced Technology is positioned in a multi-disciplinary field, ranging from the science and technology domain to the socio-economic science domain. It is an academic programme where science, entrepreneurship and technical innovation are combined. There are a few other broad programmes in the Netherlands, such as the University College (ATLAS) for example, but they differ from Advanced Technology. ATLAS has a similar breadth of covering science and technology disciplines as well as socio-economic disciplines, as can be distilled from the figure. However, ATLAS has its centre of gravity somewhere in the middle of those disciplines, whereas Advanced Technology is predominantly rooted in the science and technology domain. Hence, the accents of the Advanced Technology programme lie on the technical disciplines.

The committee has studied the domain-specific framework of reference and is convinced that it fits within international academic standards. According to the committee, the programme is rather unique, and it is therefore difficult to make a comparison with other educational programmes. It believes that, as a consequence of this unique position, the domain-specific framework of reference is predominantly formulated along the lines of the programme itself. It is also very clearly defined.

1.2 Profile and orientation

According to the critical reflection, the main ambition for the bachelor's programme Advanced Technology is to realise an excellent, multi-disciplinary academic programme with an outstanding (international) reputation. The combination of science, technology and engineering in a socio-economical context is characteristic for the programme. The programme aspires to teach students to find creative solutions for tomorrow's problems while considering the broader economical, societal and socio-cultural context.

The committee has studied the programme and agrees that it has a wonderful profile that targets the right academic level. However, it believes that not everybody involved in the programme is aware of this profile. It found it remarkable that in the interviews during the site visit, students were better at describing the profile of the programme than the

management. According to the committee, the communication regarding the profile of the programme has to be improved, and it needs to be formulated more explicitly. All people involved should be able to explain what it stands for. The programme management should use a clear description of the profile for benchmarking. At the time of application, not many students seemed to be aware of its strong academic character, with a clear link to research. The broad multidisciplinary educational basis which is offered in this programme is something to celebrate, the committee affirms. The fact that this programme provides a fruitful opportunity to freshmen to postpone the moment of choosing an academic specialisation is something to be proud of. The committee believes that the programme serves as a 'springboard' towards really advanced technology, and fulfils the needs of many to start their career with a broad academic basis. At the same time, the programme meets the wishes of society to train future creative scientists and engineers. According to the committee, these are the characteristics of the programme that should be communicated in recruitment material.

1.3 Intended learning outcomes and academic level

According to the critical reflection, the aim of the bachelor's programme Advanced Technology is 'to offer students a broad academic orientation and thorough domain knowledge and skills in mathematics, physics, chemistry as well as electrical/mechanical engineering in relation to society'.

As can also be seen in the table in Appendix 3, the programme has formulated several learning outcomes. Graduates of the bachelor's programme:

1. Have knowledge of and insight into the basic theoretical concepts of important methods and techniques in the field of the essential technical sciences – mathematics, physics, chemistry and electrical engineering.
2. Have knowledge of and insight into the most important scientific methods and design methods of the technical sciences.
3. Have knowledge of and insight into a number of fundamental socio-economic aspects of the technical sciences.
4. Are capable of analysing, modelling, interpreting and solving simple technical-scientific problems, both independently and in a team, with the aid of concepts, methods and techniques from the essential technical sciences.
5. Are capable of formulating a simple problem definition, selecting information and processing it, conducting research and critically evaluating the subsequent results, and formulating conclusions within a broad multidisciplinary (sub)area, both independently and in a team, with the aid of known concepts, methods and techniques.
6. Are capable of designing and evaluating solutions for simple technical-scientific problems, within a broad and multidisciplinary (sub-)area of the technical sciences, working with an integrative and creative approach, with consideration for the correlation between different aspects and perspectives to the problem, the broader (technical) scientific and social context, the different interests of those involved and ethical aspects.
7. Are capable of analysing technological solutions and ideas from an economic point of view and of using the results to formulate a general professional concept or business plan.
8. Are capable of working professionally and product-oriented within a team. Can communicate within the team in an appropriate manner and reflect on the group process, working process and results and their own role in and contribution to the team.
9. Are capable of communicating in writing and orally in a clear and professional manner, using technical-scientific terminology.

10. Are capable of linking technical-scientific questions and personal professional actions to the dynamics of scientific, technological and social developments and contributing to discussions concerning the social implications and value of these developments.
11. Are capable of recognising their personal strengths and weaknesses as well as their personal interests.
12. Have the learning skills that are necessary to opt for follow-on studies, in particular an academic master's programme, which requires a high level of autonomy.

The committee has studied the intended learning outcomes and concludes that they are well-defined, target the correct academic level, and perfectly fit the profile and domain-specific framework of reference.

Considerations

The committee studied the domain-specific framework of reference, the profile and orientation, and the intended learning outcomes of the bachelor's programme Advanced Technology. It is convinced that all elements are targeted at the correct academic level although the programme cannot easily be compared with other educational programmes. Its uniqueness is embedded in the domain-specific framework of reference, which nicely links up with the intended learning outcomes. However, the committee believes that the definition and communication of the profile need some improvement. The broad multidisciplinary educational basis and strong academic character require more emphasis and are worth celebrating, according to the committee. A well-defined profile can be used for future benchmarking.

Conclusion

Bachelor's programme Advanced Technology: the committee assesses Standard 1 as 'satisfactory'.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

This standard provides an insight into the curriculum (2.1) of the bachelor's programme Advanced Technology. Special attention is paid to the relation between the learning outcomes and the curriculum in section 2.2. Then, the teaching concept, formats and programme-specific services (2.3) and the feasibility (2.4) of the bachelor's programme are analysed. In section 2.5 the quality and quantity of the teaching staff are discussed. This standard concludes with an analysis of the programme-specific quality control (2.6).

2.1 Curriculum

The committee studied the curriculum (see Appendix 4) of the bachelor's programme Advanced Technology. To begin with, the curriculum is constructed in such a way that the first year comprises a broad basic programme (60 EC). The second year continues with a broad programme but with an emphasis on specialisation through electives (60 EC, of which 20 EC are electives). The third year includes individual specialisation in order to prepare students for their preferred bachelor assignment and admission to a master's programme (60 EC).

Year 1
The first year of the bachelor's programme consists solely of mandatory courses. These courses include *Introduction to Engineering I* (6 EC), *II* (6EC) and *III* (5 EC), *Project I - New Energy Technologies* and *II - Accelerometers* (5 EC each), *Materials Engineering I* and *II* (5 EC each), *Laboratory Practice I* and *II* (5 EC each), *Analysis of Technology in Society* (3 EC), *Fundamentals of Mathematical Methods* (5 EC) and *Innovation and Entrepreneurship* (5 EC).

The *Introduction to Engineering* courses are organised around a number of mathematical subjects. *Introduction to Engineering I*, for example, provides an integrative approach towards dynamics, mechanics of materials, network analysis and the underlying mathematics. In *Project I - New Energy Technologies* the theme of the project is "Energy conversion for our century", and in *Project II - Accelerometers* an accelerometer is used to study a mass-spring-damper system. In both *Project* courses, the students work in groups. In *Materials Engineering I*, attention is paid to the relationships between crystal structure, microstructure and macroscopic properties. *Materials Engineering II* provides an introduction to thermodynamics. *Laboratory Practice I* and *II* include the opportunity to conduct experiments in science and technology. Setting up and executing experiments, processing the measured data and performing error analysis are all part of the courses. The *Analysis of Technology in Society* course aims to increase the student's understanding of technology as a social phenomenon. Students critically examine the social context in which technologies emerge and the social consequences of new technologies. The *Fundamentals of Mathematical Methods* course aims to teach students basic skills in two areas: analysis (in particular functions of more than one variable) and linear algebra. The *Innovation and Entrepreneurship* course is an introduction to the strategic, commercial, organisational and

financial jargon that engineers need in order to convince experts and decision makers about the value of their technical ideas.

Year 2
In the second year of the bachelor's programme, students follow mandatory courses and restricted optional specialised courses. The latter gives students the opportunity to start their first specialisation, while fulfilling all the requirements of the second year.

The mandatory courses include: *Engineering of Complex Systems I* and *II* (5 EC each), *Mathematical Modelling* (5 EC), *Project III – Lab on a Chip* (5 EC), *Modelling of Physical Systems* (5 EC), *Differential Equations* (5 EC), *Project IV – Startrix* (5 EC), *Long Term Development of Science and Technology in Society* (5 EC).

In *Engineering of Complex Systems I* and *II*, students focus on vibrations in mechanics and electrostatics. The *Mathematical Modelling* course aims at developing the students' mathematical skills in the field of functions of one complex variable and functions with more than one variable. In addition, the basics of partial differential equations with analytic methods as well as numerical methods are discussed. In *Project III – Lab on a Chip* students work on the design and realisation of a 'lab-on-chip' device and utilise it for experiments. The principles of modelling dynamic systems are taught in the *Modelling of Physical Systems* course. Unsurprisingly, students study ordinary differential equations and partial differential equations in *Differential Equations*. The central theme in *Project IV – Startrix* is the 'commercialisation of a technology'. The objective of the project is to provide an introduction into the field of high-tech entrepreneurship and all the different elements that play a part in it. *Long Term Development of Science and Technology in Society* is a course developed to understand how science, technology and society interact over time.

In the first semester of the second year, students can choose two of the following three optional courses: *Electronics Basic Functions* (5 EC), *Production Technology* (5 EC), *Interfaces and Catalysis* (5 EC). In the second semester of the second year, students can choose two of the following three optional courses: *Vibrations and Waves* (5 EC), *Molecular and Cellular Biophysics* (5 EC) and *Basic Chemistry* (5 EC).

The course *Electronics Basic Functions* comprises a short recap of semiconductor physics, modelling of non-linear components, analogue and digital basic circuits, an introduction to oscillators, EM-waves and transmitter systems. *Production Technology* aims at acquiring basic knowledge of and elementary insight into the technologies necessary to conduct a chemical conversion safely, efficiently (energy), and economically viable. In the *Interfaces and Catalysis* course students obtain insight and understanding of the fundamental aspects of interfaces, colloidal systems and catalytic reactions. In *Vibrations and Waves* students focus on free and forced vibrations of discrete systems with one or more degrees of freedom. *Molecular and Cellular Biophysics* looks at how physical forces govern the behaviour of molecules, cellular macromolecules and even whole cells. If students choose to follow *Basic Chemistry*, they acquire knowledge, understanding and practical skills in the basic principles of atomic and molecular structure, reactivity in organic and inorganic chemistry, and theory and techniques of analytical chemistry.

Year 3
In the final year, students follow one mandatory course (15 EC) and several electives (total 30 EC) and work on their bachelor's assignment (15 EC).

In the third year, the programme offers two types of specialisations: the science specialisation and the engineering specialisation. Students from the science specialisation follow the mandatory *Module Science* course (15 EC), students from the engineering specialisation follow several mandatory courses: *Systems and Control for Mechatronics* (5 EC), *Introduction to the Finite Element Method for AT* (5 EC), *Manufacturing Systems and Technical Drawing* (5 EC).

The selected electives depend on the specialisation students wish to follow. For their bachelor's assignment, students have to write a report (the thesis) and present their findings orally in front of an academic committee. In this presentation, they focus on the scientific reasoning, the experimental methods utilised and the results of the work performed.

The committee believes that the curriculum consists of a good mix of courses. From the interviews it became clear that many students initially did not see the connection between courses, but did discover them along the way. The committee was impressed by the students' clear identification of connections between courses, and is convinced that they are capable of 'seeing the bigger picture'. It is particularly approving of the first and second years, which offer a very broad and coherent combination of courses. The third year is heavily focussed on the preparation of students for their master's programme. On the one hand, the committee understands the need for specialisation in the third year, on the other hand it regrets the narrowing down of subjects and perspectives to essentially monodisciplinary topics.

According to the committee, theory and practice are already nicely intertwined in the curriculum, but this will be further enhanced by TOM (*Twents Onderwijsmodel*): the new educational model which aims to provide attractive education for the student population in the coming years. The introduction of TOM offers an opportunity to strengthen the connection of the curriculum with society and business, according to the committee. It approves the new model and its related future developments.

2.2 Relation between learning outcomes and the curriculum

The committee analysed the relation between the learning outcomes and the curriculum. It also focussed on the cohesion and composition within the curriculum.

The programme provided a schematic overview to indicate the relation between the learning outcomes and the curriculum. The committee agrees with the programme that there is a clear relation between the learning outcomes and the curriculum, and is of the opinion that the provided schematic overview indicates those linkages adequately. It is pleased to learn that courses from several departments are specially designed for the Advanced Technology programme. Nevertheless, it has three recommendations.

To begin with, the design element, which is included in the learning outcomes, needs more explicit attention. Designs are already embedded in the programme, but solely as a translation of the acquired knowledge. The design tools are clearly present, but a course on design methodology is missing.

Secondly, the multidisciplinarity, which is also included in the learning outcomes, seems to fade slowly but surely in the third year. Due to the fact that many master's programmes are monodisciplinary, the third year requires students to specialise in order to create a perfect fit with a certain master's degree. The committee argues, however, that in order to strengthen the multidisciplinary character of the programme, more multidisciplinary courses are needed in the third year. *Project 1 - Future Energy Technology*, for example, contains nearly all intended learning outcomes and would therefore be a perfect multidisciplinary course to exploit further

in the third year. Another important element which can contribute to an increased multidisciplinarity in the third year is the bachelor's assignment (the thesis). In the assignment, a multidisciplinary approach should be encouraged.

Thirdly, the specialisation in the third year should be less focussed on the local master opportunities. Collaboration with other universities on an international level should be intensified.

2.3 Teaching concept, formats and programme-specific services

The committee examined which teaching concept and formats form the basis of the offered education, and which programme-specific services enable this.

As stated in the critical reflection, the didactic concept is based on the belief that at the end of the programme and with an appropriate follow-up master's programme, students should be able to solve urgent and challenging questions of the present day and near-future society by using the integrated knowledge from disciplines such as physics, chemistry, electronics and mechanics. In order to do so, students need academic, professional and general knowledge, the right technical, societal and communication skills, and a firm attitude. In short, the didactic concept has the following elements: focus on integration and application, knowledge and skills in a broad context, education in small groups, team work and an active working attitude, personal development and independent behaviour, and a modern educational environment.

In the committee's view, this didactic concept is not automatically evident in all the documents it received. However, during the interviews the concept became clearer. The committee thinks that it is an interesting didactic choice to initiate projects from the start of the curriculum. The projects are constructed parallel to the theories discussed in the courses, and therefore can be considered the 'glue' of the curriculum. The committee truly appreciates the project work. Although it considers the practicals as a somewhat classical didactic method, it nevertheless thinks they are very suitable teaching tools for the programme.

The students of the bachelor's programme Advanced Technology spend most of their time at two locations: the Horsttoren and Carré. Carré houses the laboratories where students conduct their practical work. The committee visited one of the available laboratories and thinks that the programme-specific services are adequate in general. It confirmed that students have access to nice locations with a good atmosphere. The equipment is of sufficient quality to conduct experiments. It welcomes the use of Labview, a programme which enables students to carry the necessary data with them, so they can work on it at home. However, it challenges the programme to think out of the box and provide a greater variety of experiments. For example, in one of the buildings a windtunnel is present. The committee argues that an experiment with a windtunnel is of added value for the programme (for example, for sustainable energy sciences) and addresses the desired multidisciplinarity. It advises the management to make use of the existing equipment, laboratories and skills, and exploit them for their own Advanced Technology programme.

2.4 Feasibility

The quantitative data regarding intake numbers, transfers and graduates, the achieved teacher-student ratio and the average amount of face-to-face instruction per stage of the study programme can be found in Appendix 5.

Intake numbers
According to the critical reflection, Dutch students with a VWO (pre-university education) profile 'Nature & Techniques' or 'Nature & Health with Physics and Mathematics B' meet the requirements for admission. The programme director, programme coordinator and the study advisors work in close cooperation with the university's admission office in order to determine whether the international applicant meets the requirements for admission.

As can be seen in Appendix 5, the intake numbers have increased over the past few years. While the total intake of students was 53 in 2006, it was 74 in 2012. According to the programme management, the increase is a result of the switch to English as the language of instruction. The number of German students has increased significantly, and since 2010 students from many different countries have entered the programme.

The committee thinks the intake numbers are adequate, and praises the increase of international student numbers. It would appreciate efforts of the programme management to attract more female students.

Course load
Although there is no information about the study load in the critical reflection, from the interview with students it became clear that they generally spend 35 hours per week on their studies. This was confirmed by the study advisors. The committee believes the course load is adequate. It is a unique and broad programme, so one can expect these students to think a little more out of the box than monodisciplinary students.

Feasibility
According to the table provided in Appendix 5, the average number of dropouts after one year is 28% for the period 2006-2011. After three years, this increases up to 34%. The management of the programme believes that this dropout rate is caused by students who underestimated the level of the bachelor's programme.

The committee discussed the dropout issue during the interviews and is convinced that the programme management is currently trying to improve the situation. In the past few years, a majority of the dropout happened in the first two weeks, partly due to the students' ignorance of the factual content of the programme, and partly as a result of an unexpectedly high workload in the first period of the curriculum. The committee advises the programme management to provide students with extra support during the first two weeks of the programme, so they can develop their study skills. The improved communication regarding the content of the programme and study load has already had a positive effect on the dropout rate. The committee would like to express its faith in the way in which the problem of the dropout rate is being tackled.

The committee truly appreciates the efforts of the study advisors, who personally know each student enrolled in the programme. It believes that the presence of the study advisors therefore contributes significantly to the feasibility of the programme. There do not seem to be any real stumbling blocks in the curriculum, and a delay in study completion is generally due to individual circumstances. There is room for improvement in the relationship between supervisors from the study association and study advisors from the programme. At the moment, study advisors train the supervisors at the beginning of each new academic calendar. This training could be elaborated further in the curriculum.

Internationalisation
As stated in the critical reflection, the number of students has almost doubled as a consequence of switching from Dutch to English in 2010. The number of international students has consequently grown, too. The committee argues that the increase of foreign students is a positive development. However, it noted that the programme management has some difficulty assessing the qualities of foreign students prior to enrolment. Therefore, it advises the programme management to make use of Skype interviews in the application process. In addition, the committee thinks that foreign students need extra support in their acclimatisation process. One option to support this process would be the introduction of a so-called 'buddy system', in which students support each other during the first period of their academic year. The attention paid to foreign students should be more explicit than is currently the case.

Important issues are the availability of the Programme and Assessment Rules and Regulations (OER) in English and of course descriptions that are worked out well. The committee strongly advises the management to get those documents in order as soon as possible.

According to the committee, the programme should optimise its linkages with foreign universities and partners in industry. This would contribute to the content of the curriculum in the third year.

2.5 Teaching staff

The committee focussed on the quality and quantity of the teaching staff at the bachelor's programme Advanced Technology.

Quality
According to the critical reflection, 17% of the teaching staff possesses a University Teaching Qualification (UTQ). Another 17% is currently involved in the UTQ courses, and 20% are following a short course (or are about to). The remaining staff members have at least 20 years of teaching experience and are exempted from the UTQ courses.

The committee thinks the programme houses excellent teaching staff. There were no complaints from students or alumni regarding the capabilities and teaching methods of staff members. However, in some cases they believed that the lecturer's proficiency of English could be improved.

When it comes to the involvement of lecturers from different departments in the Advanced Technology programme, the committee thinks the management should opt for improvement. It encourages the management to organise more meetings between staff members from different departments. Gatherings of lecturers who together form a certain intellectual group are particularly desirable. Those lecturers could, for example, give a presentation about what they teach and how they are connected to the programme. In that way, lecturers would at least have a feeling for what is being taught in related courses. The committee also noted that the physics department is presently taking the lead. The active participation of other departments is necessary to increase the synergic value. It argues that if those meetings cannot be forced, they should be introduced spontaneously.

Quantity
Approximately 50 lecturers are involved in the first and second years. With a total of 15.1 teaching FTEs and 212 registered students, the number of students per teaching FTE was

14.0 in May 2013. The committee believes the number of lecturers available for the programme is adequate. This is confirmed by the students and alumni.

2.6 Programme-specific quality control

The quality assurance has been implemented according to the PDCA cycles: Plan, Do, Check, Act. Evaluations are conducted at three levels:

- Institutional level
- Programme level
- Course level

The evaluation at the institutional level is included in an institutional audit, which will take place in the second half of 2013. The evaluation at the programme level is conducted by the programme director, who may ask the advice of the Programme Committee. When it comes to the evaluation at the course level, the Programme Committee plays an important role. It consists of four students, four lecturers, the programme coordinator and the quality manager. Together, they discuss student evaluations with the lecturers, the programme and faculty management.

From the interview with the Programme Committee, it became clear that the members are strongly involved in the programme. The committee is impressed by their active attitude, in particular that of the student members. During the interview, all members were open to discussion, interacted among each other and rethought their own perceptions critically. The committee argues that this is clearly a proactive Programme Committee which functions very well.

Considerations

The committee studied the teaching-learning environment to analyse whether the curriculum, teaching concepts, formats, programme-specific services, feasibility, staff, and programme-specific quality control enable the student to ultimately achieve the learning outcomes.

According to the committee, the first and second years of the curriculum provide a nicely broad and solid academic foundation. It is less pleased with the third year as it forces students to drastically narrow their focus. However, it understands the need for specialisation to prepare for further studies. The committee argues that the curriculum consists of a good mix of courses, which are very clearly built around the intended learning outcomes. The only elements that could be strengthened are the design aspect, which currently lacks design methodology, and the multidisciplinarity, which fades away in the third year.

Although the didactic vision is not automatically evident in all available documents, the committee is enthusiastic about the project work and thinks the practicals suit the programme well.

With regard to the building and programme-specific services, the committee thinks they are adequate. Students have access to nice locations with a good atmosphere, and the equipment is of adequate quality. However, the committee feels that the existing equipment, laboratories and skills can be exploited more efficiently.

The committee thinks the intake numbers are adequate and praises the increase in international students. However, extra care should be taken of foreign students, and the OER

and well developed course descriptions should be available in English as soon as possible. Linkages with foreign universities and partners in industry have to be strengthened.

The programme seems feasible; students have an average workload of 35 hours per week, and the high dropout rate is being tackled by improved communication. The committee appreciates the efforts of the study advisors to guide students during their studies. It advises the programme management, however, to provide students with extra support during the first two weeks of the programme.

According to the committee, there is excellent teaching staff, and the numbers of lecturers available are adequate. It is particularly enthusiastic about the Programme Committee, which consists of very active student members and functions in a proactive manner.

Conclusion

Bachelor's programme Advanced Technology: the committee assesses Standard 2 as 'satisfactory'.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This standard considers the findings regarding the assessment system (3.1) and subsequently deals with the question of whether the graduates have achieved the learning outcomes (3.2).

3.1 Assessment system

The committee analysed the assessment system of the bachelor's programme Advanced Technology and focussed on the assessment policy, including the functioning of the Board of Examiners, the examinations and the thesis procedure.

Assessment policy
The University of Twente has formulated an assessment policy framework for educational programmes which defines the following requirements:

- The subjects of assessment should cover the learning objectives of a course;
- The form of the assessment should be in agreement with the learning objectives and didactical concept of the course;
- The scheduling of all assessments should promote a balanced study load as much as possible;
- The examiners should be qualified;
- The requirements for passing and the cut-off score should be clear and published in advance;
- The quality, execution and evaluation of the assessments have to be monitored, and required improvements should be implemented.

In 2012, the bachelor's programme Advanced Technology started implementing this framework.

According to the committee, the assessments are executed appropriately, but for an outsider the procedures are not transparent. Last year's introduction of the assessment framework and the recent introduction of standardised assessment forms for the thesis indicate that the assessment system has not been optimal in the past few years. In the study guide there is a valuable and adequate assessment checklist for the bachelor's assignment, but it is not mentioned in any of the other available documents or assessment procedures. It seems as if this checklist is used by staff members, but not in an explicit manner. The committee regrets this lack of transparency.

The committee believes that the requirements presented above are all delivered, although in a non-transparent manner. However, the requirement that the passing and cut-off scores for a certain course should be published in advance, was not sufficiently confirmed during the site visit. Although lecturers argued that they do upload the requirements of a course to Blackboard and explain the assessment procedure of the course during the first lecture,

students complained that they do not always receive the right information on time. The committee thinks it is important for students to know what they can expect from a course before the start of the lectures. It believes that an explanation of the assessment in the first lecture – as is currently the case – is necessary, but not timely enough to be the only source of information. The communication between non-students, such as the programme coordinator and the lecturers, has to be improved as well.

Despite the fact that the committee is critical about the absence of transparency during the assessment in the past years, it has faith in TOM, in which the rules and regulations are recorded in a more detailed manner. The first improvements are already visible.

Examinations
As stated in the critical reflection, all courses in the bachelor's programme Advanced Technology have an assessment procedure to test whether students have indeed achieved the learning outcomes. A variety of assessment methods is used: written and oral examinations, practical training with individual and group assignments, project deliverables (usually reports), oral presentations and poster presentations.

From the study guide it appears as if the courses are only assessed by written exams. According to the OER, an exam can have the design of multiple forms of assessment such as oral or written exams. In reality, the assessment procedure in place is indeed rather differentiated. The breadth of assessment types was confirmed in the critical reflection and several interviews. In the projects, for example, there are presentations, reports and group assignments. Nevertheless, the committee advises making the examinations more explicit in different types of paperwork. As mentioned earlier in this report, it also thinks that the assessment procedures should be clarified to students before the courses start.

Regarding the content of the programme, the committee states that there is a nice fit with the examinations. However, from the interview with students it became clear that the content is assessed, not their proficiency of English. Although the committee understands the decision to prioritise the content of an exam, it would like to stress that correct academic writing in English should not be forgotten.

Thesis procedure
The final bachelor's assignment consists of a thesis and a presentation. The thesis, in which the integration and application of acquired knowledge are central, is decisive in testing to what extent the student satisfies the learning outcomes. The Board of Examiners has to approve the content of the assignment. It also appoints an Assignment Committee, consisting of at least three members. This Assignment Committee will fill in the assessment protocol.

From the interview with students, it became clear that the first step in deciding on a research topic is to search on the university website for a research group. If the student finds a suitable assignment, he or she pays a visit to the thesis supervisor. The student fills in several forms and makes a global planning for the research project. The project starts with a literature study. During the research, the students meet the head of their research group approximately every two weeks, and their supervisor every week. The committee applauds this intensive coaching during the thesis procedure.

Due to the fact that students select a topic related to a local research group, and as a consequence of the preparations for the fit with a master's degree, the majority of the students end up working on a strictly monodisciplinary subject for their bachelor's thesis. The

committee regrets the absence of a multidisciplinary approach in the thesis work. Even more as multidisciplinarity is mentioned in the study guide as an essential prerequisite.

3.2 Achieved learning outcomes

By reading fifteen theses, the committee analysed the achieved learning outcomes of graduates. The theses were carefully selected, taking into account a proportional distribution of low, average and high grades.

The committee is impressed by the high level of the bachelor's theses. Looking at the limited time available for the thesis procedure, the committee thinks the achieved level nearly matches that of a master's thesis. It would like to praise the programme for the extremely solid, well conducted and supervised research processes. It is disappointed, however, to note that the multidisciplinary approach is missing in nearly all theses. Considering the fact that the programme has a strong multidisciplinary character, which is also embedded in the learning outcomes, the committee regrets the absence of a wider perspective on the research subject. Also, the lack of a consideration of the societal relevance or entrepreneurial context is a shortcoming in the thesis procedure. Due to the fact that the learning outcomes with respect to multidisciplinarity are intertwined in the curriculum, the learning outcomes are achieved. Nevertheless, the committee advises the programme management to provide opportunities for those students who wish to utilise a multidisciplinary approach and to encourage them.

A clear fit with the job market is not really relevant for this programme, as most students continue with a master's degree. The committee thinks that the entrepreneurial characteristic which the programme claims to have is thus hardly used. The relationships with industry and the job market do exist, but are not exploited well enough. According to the committee, the programme management should improve those relationships. The alumni, however, seem very satisfied with their bachelor's background. Those who continued on a master's level achieve good results, and some have even been accepted for a PhD position.

Overall, the committee argues that the excellent theses and perfect fit with master and PhD degrees proves that the learning outcomes of the programme are achieved and that it delivers well trained, broadly oriented scientists and engineers.

Considerations

The committee studied whether the bachelor's programme Advanced Technology has an adequate assessment system in place, and analysed whether the learning outcomes are actually achieved.

The committee initially had some doubts about the assessment system but is now convinced that the programme is already taking action, especially with TOM, to raise the quality of the system. It believes that if several steps are taken, the assessment system will be further formalised and hence will be transparent. It stresses the importance of informing students about the assessment procedures on time.

Different types of assessment are applied, and the committee thinks they nicely fit the content of the programme. It warns that correct academic writing should not disappear entirely from the assessments.

The committee is particularly satisfied with the excellent guidance provided throughout the bachelor assignment (thesis). However, it regrets the absence of a multidisciplinary approach,

and advises the programme management to fully support those who wish to conduct their research from a multidisciplinary perspective. The achieved level of the theses is outstanding, however, and it believes that the bachelor's programme prepares students very well for a continuation of their studies in the academic world.

Conclusion

Bachelor's programme Advanced Technology: the committee assesses Standard 3 as 'satisfactory'.

General conclusion

Prior to the site visit, the committee had some doubts about the quality of some aspects of the bachelor's programme Advanced Technology. This worry was a result of the critical reflection and available documents, which did not provide clear answers to some important questions. However, during the interviews, many issues were resolved, and the committee was impressed by the enthusiasm of the students and lecturers involved. It truly enjoyed the site visit and along the way discovered many facets of the programme that were leaning more towards 'good' than the overall assessed 'satisfactory'. A vivid example is the overall quality of the theses, which were often almost at a master's level. The committee also appreciates the academically broad first two years and the fact that many of the courses especially cater for the needs of the Advanced Technology programme. It has high expectations of the just started implementation of TOM, and is excited to see the involvement of the Programme Committee in the developments. It hopes the Board of Examiners will mirror the Programme Committee's enthusiasm and adopt a proactive attitude. The committee therefore has the feeling that what was observed at the location itself was far better than expected. It formulated this discovery as follows: "the food is really good, better than the menu". The product is of a good quality, but the communication has to be improved. Nevertheless, the committee believes that the future is bright. It is convinced that there is a spirit present which will provide reasons for a higher score than 'sufficient' in the next accreditation. It advises the programme management to be consistent, define the goals and stick to them, and improve the communication towards current and potential students.

After the draft report was sent to the bachelor programme for feedback, the committee was pleased to notice that the programme management had already picked up some of the recommendations. The design aspect receives more attention in the new curriculum as it will be defined as a learning path and as such implemented at various points throughout the curriculum. In addition, the programme management announced that it will use tools like Skype interviews in the application process to clarify the profile of the programme and discuss the match of the potential foreign student with this profile. According to the committee, this positive attitude of the programme management towards the committee's recommendations is promising.

Conclusion

The committee assesses the *bachelor's programme Advanced Technology* as 'satisfactory'.

Appendices

Appendix 1: Curricula Vitae of the members of the assessment committee

Prof. dr. R. P. (Ronald) Griessen (1945) studied Physics at the ETH (Eidgenössische Technische Hochschule) in Zurich. After having completed his PhD in 1974 at the same university on quantum oscillatory effects in metals, he went as a Research Associate to the McLennan Laboratory of the University of Toronto. In 1976, he joined the VU university in Amsterdam, where he was full Professor and Head of the Condensed Matter Physics department until 2010. His research activities include high temperature superconductivity, switchable mirrors, energy storage in hydrides, optic fiber hydrogen sensors and smart plastic solar thermal collectors. He published more than 300 scientific articles and has 11 patents. From 2005 till 2010 he was Chairman of the Board of Governors of FOM and Chairman of the Physics Division of NWO.

Prof. dr. ir. F. (Fred) van Keulen (1962) received his MSc. degree in Mechanical Engineering (cum laude, 1987) and his doctorate (cum laude, 1993) both from Delft University of Technology. In 1999 he was rewarded an 'Antoni van Leeuwenhoek' chair. From 2005 to 2010 he was the first chairman of the new Department PME (±100fte) at Delft University of Technology and was scientific director of the Delft Centre for Mechatronics and Microsystems. He is vice chair of the NanoNextNL programme on Micro- and Nanotechnology (budget 250 million euro's from which 123 million euro's funding, more than 100 industry partners). Present research activities focus on micro/nano devices and systems and the high performance tools to manufacture them.

Dr. ir. J. H. (Johan) Klootwijk (1969) received his MSc. (1993) and PhD (1997) degrees in Electrical Engineering from the University of Twente. He then joined Philips Research Laboratories, Eindhoven, where his work covers a wide range of applications, such as wideband RF applications, nanowire sensors, EUV spectral purity filters and new materials for direct conversion CT scanners. He received the Best Paper Award on the ESSDERC Conference in 2001 and a Bronze Award for the 'NXP Invention of the Year 2007'. He served as a tutorial chairman of the International Conference on Measurement and Teststructures, ICMTS, 2002, 2008 and 2011.

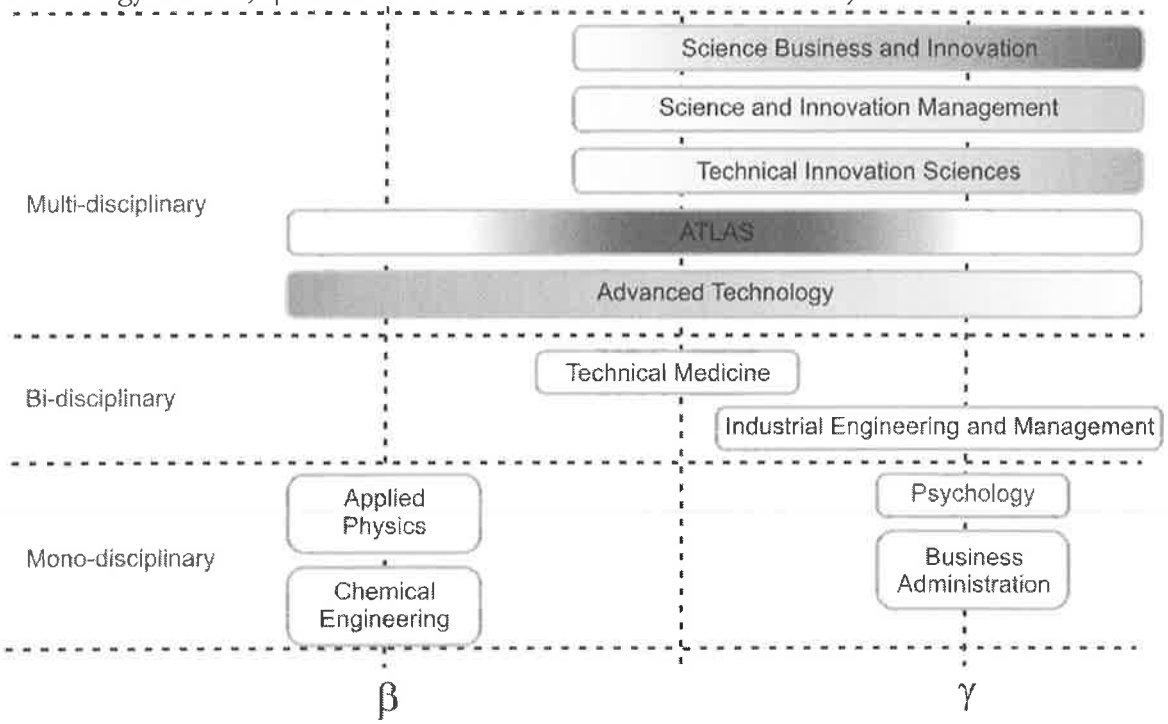
Dr. F. (Cis) van den Bogaert (1952) received a PhD in Elementary Particle Physics from the University of Antwerp. He worked at the Belgian Consumer Association as project leader for comparative quality assessment and at the Flemish Interuniversity Council as project leader for educational professionalisation. He coordinated bridging courses and tutoring activities for freshmen at the University of Antwerp. He is secretary to the university's Education Council and heads the Department of Education in the university's central administration. He was the chairman of Flemish working groups on blended learning and the challenges for higher education in the 21st century.

L. (Lieke) van Son, BSc (1991) specialised in Energytechnology and graduated in Innovation Sciences at Eindhoven University of Technology. During her bachelor's degree she was a full-time member of the Study Association Board, where she fulfilled the role of supervising director of education. In this position, she secured and improved the quality of education. During her bachelor's degree she was a member of the Faculty Board, the Programme Committee and the Student Advisory Board. In her first year of studies she participated in visitation of her own programme at the other side of the table. Currently, she follows a master's degree in Innovation Sciences at Eindhoven University of Technology.

Appendix 2: Domain-specific framework of reference

The domain in which the bachelor programme Advanced Technology is positioned is that of interdisciplinary scientific education. The place of Advanced Technology in the broad domain is presented in figure 1.1. The horizontal scale depicts the relation with the relation with science & technology (β) to socio-economic sciences (γ) and on the vertical axis the level of interdisciplinary is indicated. A number of mono- and multidisciplinary programmes have also been included in the figure to illustrate the distinctive character of AT. The darker shades in the figure show that the dominant accents of AT are at the technical disciplines, but there is also a substantial component of the socio-economic domain present. This is a clear distinction with the mono-disciplines.

Figure 1.1 The place of Advanced Technology in the domain (β refers to the science & technology domain, γ refers to the socio-economic science domain)



Appendix 3: Intended learning outcomes

Graduates with a Bachelor's in Advanced Technology:	
1	Have knowledge of and insight into the basic theoretical concepts of important methods and techniques in the field of the essential technical sciences - mathematics, physics, chemistry and electrical engineering.
2	Have knowledge of and insight into the most important scientific methods and design methods of the technical sciences.
3	Have knowledge of and insight into a number of fundamental socio-economic aspects of the technical sciences.
4	Are capable of analysing, modelling, interpreting and solving simple technical-scientific problems, both independently and in a team, with the aid of concepts, methods and techniques from the essential technical sciences.
5	Are capable of formulating a simple problem definition, selecting information and processing it, conducting research and critically evaluating the subsequent results, and of formulating conclusions within a broad multidisciplinary (sub-)area, both independently and in a team, with the aid of known concepts, methods and techniques.
6	Are capable of designing and evaluating solutions for simple technical-scientific problems, within a broad and multidisciplinary (sub-)area of the technical sciences, working with an integrative and creative approach, with consideration for the correlation between different aspects and perspectives to the problem, the broader (technical) scientific and social context, the different interests of those involved and ethical aspects.
7	Are capable of analysing technological solutions and ideas from an economic point of view and of using the results to formulate a general professional concept or business plan.
8	Are capable of working professionally and product-oriented within a team. Can communicate within the team in an appropriate manner and reflect on the group-process, working-process and results and their own role in and contribution to the team.
9	Are capable of communicating in writing and orally in a clear and professional manner, using technical-scientific terminology.
10	Are capable of linking technical-scientific questions and personal professional actions to the dynamics of scientific, technological and social developments and contributing to discussions concerning the social implications and value of these developments.
11	Are capable of recognising their personal strengths and weaknesses as well as their personal interests.
12	Have the learning skills that are necessary to opt for follow-on studies, in particular an academic master's programme, which requires a high-level of autonomy.

Appendix 4: Overview of the curriculum

B1

Block 1A	Block 1B		Block 2A	Block 2B
Introduction to Engineering I 6EC	Project I 5 EC	Introduction to Engineering II 6EC	Proejct II - Accelerometers 5 EC	
	Materials Engineering I 5 EC		Materials Engineering II 5 EC	
			Fundamentals of Mathematical Methods 5 EC	Introduction to Engineering III 5 EC
	Laboratory Practice 1 5 EC		193901410 Laboratory Practice 2 5 EC	
	Analysis of Technology in Society 3EC		Innovation and Entrepreneurship 5 EC	

B2

Block 1A	Block 1B	Block 2A	Block 2B
Engineering of Complex systems I 5 EC		Engineering of Complex systems II 5 EC	
Mathematical Modeling 5 EC		Differential Equations 5 EC	Optional courses (2 out of 3) Vibrations and Waves 5EC Molecular and Cellular Biophysics 5EC Basic Chemistry 5EC
Project III - Lab on a Chip 5 EC	Optional Courses (2 out of 3) Electronics Basic Functions 5EC Production Technology 5EC Interfaces and Catalysis 5EC	Project IV - Startrix 5EC	
Modeling of Physical Systems 5 EC		Long Term Development of Science and Technology in Society 5EC	

B3

Block 1A	Block 1B	Block 2A	Block 2B
Mandatory Courses (1 out of 2) **Science specialization:** Module Science 15 EC **Engineering specialization:*** Systems and Control for Mechatronics 5 EC Introduction to the Finite Element Method for AT 5EC Manufacturing Systems and Technical Drawing 5EC	*Elective courses, depending on master of choice (15 EC total)*** **Science specializations** Module Materials Science and Engineering 15EC **Engineering specialization** Optional courses depending on master of choice	*Elective courses, depending on master of choice (15 EC total)*** *Mandatory course: Bachelor Assignment (15 EC)*	

* In the future the Engineering module will be organised as one 15 EC course. In 2012 this was not yet possible.
** For an overview of the elective courses required for admission to the master programmes, see the document "AT to master.pdf".

Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Bachelor intake 2006 – 2012

	2006	2007	2008	2009	2010	2011	2012
Total intake per October 1	53	42	62	45	48	81	74
Female	2	3	6	4	7	17	10
	4%	7%	10%	9%	15%	21%	14%
German	2	3	3	3	2	20	8
Other countries	-	-	-	-	3	11	11
					6%	14%	15%
From other WO	-	3	2	8	2	1	1
From HBO	-	-	-	1	-	3	1
Criterion group	53%	42%	46%	43%	72%	67%	58%

Dropouts per cohort (with respect to the total intake)

Cumulative dropout	2006	2007	2008	2009	2010	2011	Mean 2006-2011	Mean 2004-2011
after 1 year	28%	10%	21%	31%	25%	36%	28%	29%
after 2 years	28%	17%	27%	38%	31%		31%	33%
after 3 years	30%	26%	31%	38%			34%	37%
until now	34%	31%	31%				33%	39%
with P-diploma	0%	0%	0%	0%	0%		0%	0%

Average P- and B-performance over the period 2006-2011

Performance	Regular students[1] 2006-2011	Criterion group 2006-2011	Total intake 2006-2011
P diploma ≤ 1 year	29%	49%	27%
P diploma ≤ 2 years	38%	57%	36%
P-diploma ≤ 3 years	48%	66%	46%
P diploma final	66%	82%	66%
BSc diploma ≤ 3 years of re-registrants	3%	3%	4%
BSc diploma ≤ 4 years of re-registrants	28%	38%	26%
BSc diploma ≤ 5 years of re-registrants	50%	62%	47%
BSc diploma final of re-registrants	64%	81%	61%

[1] Regular means all new students that started before 1 December of the academic year with a VWO- or equivalent diploma.

Teacher-student ratio achieved

Student-staff ratio for the AT programme (B1-B3)

Year	Number of Teaching FTE's	Number of registered students	Number of graduates in 2012	Number of students per Teaching FTE	Number of graduates per Teaching FTE
May 2013	15.1	212	36	14.0	2.4

Average amount of face-to-face instruction per stage of the study programme

Number of average contact hours for the various years

Year	Lectures/Tutorials	Lab Work	Projects / Assignments	Self-study unscheduled	Other unscheduled
B1	400 (24%)	160 (10%)	160 (10%)	680 (40%)	280 (17%)
B2	550 (33%)	50 (3%)	270 (16%)	760 (45%)	50 (3%)
B3	400 (24%)			860 (51%)	420 (25%)

Appendix 6: Programme of the site visit

Visitation Advanced Technology on Wednesday and Thursday, October 23-24th 2013

Wednesday 23	**Location: Horstring Z-203**
11.30-14.30	Preparation meeting (self-assessment + theses), reading additional documentation + lunch
14.30-15.30	Interview with management *Dr. ir. J. (Jaap) Flokstra (programme director until October 2013)* *Dr. H.K. (Herman) Hemmes (programme coordinator)* *Dr. ir. H. (Herbert) Wormeester (programme director as of October 2013)*
15.30-16.15	Interview with students *Ruben van Aalst (fifth year, just finished B-assignment)* *Abla Al-Kiyumi (second year)* *Niko Bienia (third year)* *Shirley Fedder (second year)* *Eric Smeets (fourth year, working on B-assignment)* *Mateo Snoeijenbos (fourth year)*
16.15-16.30	Break
16.30-17.15	Interview with lecturers *Dr. ir. R.G.K.M. (Ronald) Aarts* *Dr. R.M.J. (Ruud) van Damme* *Dr. M.M.J. (Marc) Dhallé* *Prof. Dr. ir. G.J.M. (Gijs) Krijnen* *Prof. Dr. N.E.J. (Nelly) Oudshoorn* *Dr. ir. H. (Herbert) Wormeester*
17.15-18.00	Interview with alumni *J.M. (Jelmer) Boter, BSc* *(graduated 2012, currently Applied Physics master student at Twente University)* *B.B. (Brigitte) Bruijns, MSc* *(graduated 2007, MSc Science Education [Chemistry] 2008, MSc Forensic Science 2010, MSc Analytical Sciences 2011, currently works at Saxion university of Applied Sciences, Enschede)* *B. (Bram) Burkink, MSc* *(graduated 2009, MSc Mechatronics 2012, currently works at VDL Enabling Technologies Group, Almelo)* *G.A. (Geert) Folkertsma, MSc* *(graduated 2010, MSc Mechatronics 2012, currently a PhD student in the Robotics and Mechatronics group at Twente University)* *G.M.B. (Guus) Remmerswaal, BSc* *(graduated 2012, currently Mechanical Engineering master student at Twente University)* *M.G.C. (Michel) Zoontjes, MSc* *(graduated 2009, MSc Nanotechnology 2010, currently a PhD student in the Photocatalytic Synthesis group at Twente University)*

Thursday 24	**Location: Horstring Z-203**
9.00-9.45	Interview with the Programme Committee *K.J.H. (Koen) van Alphen (third-year student)* *T. (Tom) Bokhove (third-year student)* *Prof. dr. ir. H.J.M. (Marcel) ter Brake (lecturer)* *Dr. R.M.J. (Ruud) van Damme (lecturer)* *Dr. R. (Regina) Lüttge (lecturer)* *Dr. A.H. (Rik) van Reekum (lecturer)* *C. (Cees)Trouwborst (fourth-year student)*
9.45-10.15	Open consultations + internal meeting committee
10.15-11.15	Interview with the Board of Examiners and study advisors *Prof. dr. ir. A. (André) de Boer (chairman)* *Dr. D. (Dejana) Djokovic (study advisor)* *Dr. H.K. (Herman) Hemmes (secretary)* *Dr. ir. G. (Gertjan) Koster* *M.A. (Marijke) Stehouwer, MA (study advisor)* *Dr. ir. N.R. (Niels)Tas*
11.15-12.45	Lunch and internal meeting committee + guided tour (30 minutes)
12.45-13.45	Interview with Management, including rector and dean *Prof. dr. H. (Ed) Brinksma (rector) – not available in connection with site accreditation* *Dr. ir. J. (Jaap) Flokstra (programme director until October 2013)* *Dr. H.K. (Herman) Hemmes (programme coordinator)* *Prof. Dr. G. (Gerard) van der Steenhoven (Dean of the Faculty of Science and Technology)* *Dr. ir. H. (Herbert) Wormeester (programme director as of October 2013)*
13.45-15.00	Internal meeting committee
15.00-15.30	Presentation of preliminary findings in Zuidhorst 286 *All*

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

0208019	0193175	0150754	0203157	0176117
1001817	0212008	1098749	0190594	1007718
0198722	1007696	0194344	0199230	0191140

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Subject-specific reference framework and the learning outcomes of the programme;
- Overview of the curriculum;
- Outline description of the curriculum components;
- Teaching and examination regulations;
- Overview of allocated staff;
- List of the last 25 final projects or the final projects of the past two years;
- Overview of the contacts maintained with the professional field;
- Report on the institutional quality assurance assessment;
- Reports on consultations in relevant committees/bodies;
- Test questions with corresponding assessment criteria and requirements and a selection of actual administered tests and assessments;
- Selection of final projects with corresponding assessment criteria and requirements;
- Reference books and other learning materials;
- Summary and analysis of recent evaluation results and relevant management information;
- Documentation regarding teacher and student satisfaction.

Appendix 8: Declarations of independence

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: R GRIESSEN

PRIVÉ ADRES: EMMAWEG 29 B
1241 LG KORTENHOEF

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

ADVANCED TECHNOLOGY

AANGEVRAAGD DOOR DE INSTELLING:

UT

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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nvao
nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: ENSCHEDE

DATUM: 23/10/2013

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: A. van Kuik

PRIVÉ ADRES: J.L. Hofmanlaan 11
2104 TT Heemstede

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Adv. Technologies UT

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 23-10-'13

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Johan Vlootwyk

PRIVÉ ADRES: Grasboom 29

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Advanced Technology

AANGEVRAAGD DOOR DE INSTELLING:

~~QANU~~ University of Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Eindhoven DATUM: 23/10/2013

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Cis Van Den Bogaert

PRIVÉ ADRES: Laaplandlaan 45
B-2170 Merksem
België

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Advanced Technology (Bachelor)

AANGEVRAAGD DOOR DE INSTELLING:

Universiteit Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Antwerpen DATUM: 22/10/2013

HANDTEKENING:

nvao
nederlands-vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Lieke van Son

PRIVÉ ADRES:

prinsenhof 3
5616 TE Eindhoven

IS ALS DESKUNDIGE / ~~SECRETARIS~~ GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Advanced Technology

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Eindhoven DATUM: 22-10-2013

HANDTEKENING:

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nvao
nederlands-vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Jasne Kroeneman

PRIVÉ ADRES:

Kazernestraat 8N
Amsterdam

IS ALS ~~DESKUNDIGE~~ / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Advanced Technology

AANGEVRAAGD DOOR DE INSTELLING:

University of Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Enschede DATUM: 23-10-2013

HANDTEKENING: j.j. kroonenan