Research Master in Fluid Dynamics

Von Karman Institute for Fluid Dynamics

30 june 2010

Initial accreditation

NVAO Panel report

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1 Executive summary

The Accreditation Organization of the Netherlands and Flanders (NVAO) has received a request for an initial accreditation procedure, including programme documents, regarding a proposed *Research Master in Fluid Dynamics* ("master after master") offered at the Von Karman Institute for Fluid Dynamics (VKI).

The VKI has been established in 1956 as an international centre for the study of fluid dynamics. More specifically its core business nowadays is:

- training scientists and engineers in the field of fluid dynamics with application to aeronautics and astronautics, turbomachinery and propulsion as well as environmental and applied fluid dynamics;
- stimulating research in fluid dynamics and
- disseminating knowledge in the domains mentioned.

Since the VKI has been established 1367 students participated in the 9 month post graduate degree course. VKI's staff consists of 96 permanent employees, among them 11 full time professors and 7 part time professors. The yearly intake for the degree course is about 35 to 40 students.

The main aim of the programme is training engineers and scientists for research and/or advanced product development and design in fluid dynamics. The intentions of the more specific objectives are clear. They comply with the descriptions of a master programme. They show a combination of insight, in-depth knowledge and research which will guarantee adequate further careers in fluid dynamics for the alumni.

The pivot of the programme is the research project (30 EC) that students become involved in right from the beginning. This project is the point of reference for choosing a specialisation and courses (30.5 or 35.5 EC). The educational concept of teaching research through doing research is a very good one given the ambitions of the Research Master Programme on Fluid Dynamics. It is also a good idea to have a diversified course programme in three main fields supporting the research projects: Aeronautics and Aerospace (AR); Environmental and Applied Fluid Dynamics (EA) and Turbomachinery and Propulsion (TU). The close relation between the research project and the courses guarantees the development of knowledge, techniques and skills.

The panel found an adequate attention by VKI staff to handle the variation and fragmentation in assessments of courses that are currently being offered. This is challenging in view of demands in a master after master programme. The relation between criteria for grading and the intended learning outcomes is quite implicit. In the assessment of projects this is counterbalanced by the definition of the criteria for grading. Consistency in the use of these criteria is achieved by cross validation with other projects via the advisory members of other departments in the project evaluation teams (PET).

Students indicated that they have to work hard but can manage, even can take some extra courses if they like. The panel found the formal rules for admission clear and adequate, although in some respects (e.g. proficiency in English) not specific enough. On the whole the panel found the selection committee coping in good conscience with the admission of students.

The panel assesses the twelve master theses seen as thorough work contributing to the field. Initially the panel wondered to which extent master theses indeed report on 'independent research projects' due to the close supervision during the completion of the report and the associated research. Guidance of the research project is well structured with several moments of evaluation and feedback by the project evaluation team (PET). Also the supervision by the research engineers might be a rather intense one. Research projects sometimes are part of a continuing research line of the department. The panel was convinced that students are assessed on the extent to which they are capable of independent and creative research. This is explicitly formulated in the criteria used for grading.

According to the panel a staff student ratio of 1:3 is very fortunate. The panel is convinced of the organisational qualities of staff. The quality of staff regarding the content of the programme is adequate to train young researchers. The panel noticed growing awareness of the necessity to further develop didactic qualities among staff. The programme actually started to invest in this.

According to the panel numerical, theoretical and modelling facilities are adequate. The experimental facilities of VKI are unique and for that reason well known among colleagues. It became clear to the panel that tutoring is very intense due to the educational concept.

The institution formulated concrete qualitative objectives to be achieved within the next years regarding the internal quality assurance system. Some of these objectives in the first place aim at the enhancement of research quality and hence indirectly contribute to the quality of teaching. The panel however was convinced that the priorities are realistic and appropriate for this programme which is so tightly linked with research. The institution presented convincing plans for systematic quality assurance. Instruments for periodical evaluations of the programme are developed and tested. First results are available. Responsibilities and tasks are clearly divided. First evaluation results are discussed. The panel noticed active involvement of staff, students, alumni and the professional field. The panel appreciated the willingness to get an appropriate system of internal quality assurance in place in which for example the educational committee and the ombudsperson are important actors.

Given the fact that the programme actually has been running for fifty years, the panel is convinced that the conditions for continuity are guaranteed. It recommends investing in staff development regarding educational qualities and further development of the system of internal quality assurance suitable for the relatively small size of the VKI. Once VKI manages to set up the suggested improvements, the panel expects that a well-organised and strong master after master course can be offered; doing justice to the good scientific reputation of the VKI in the field of fluid mechanics.

Given these considerations the panel advises the NVAO to take a positive decision regarding the current quality of the proposed programme Research Master in Fluid Dynamics of the Von Karman Institute for Fluid Dynamics.

The Hague, 30th June 2010

On behalf of the panel convened to assess the Research Master in Fluid Dynamics of the Von Karman Institute for Fluid Dynamics in Sint-Genesius-Rode, Belgium,

Prof. dr. Ir. B.J. Geurts (Chair)	Drs. J. Braaksma (Secretary)

2 Introduction

2.1 The procedure

On 16 June 2009 NVAO received a request for an initial accreditation procedure including programme documents regarding a new masters programme, the Research Master in Fluid Dynamics from the Von Karman Institute of Fluid dynamics.

To a certain extent, initial accreditation demands a different approach from the accreditation procedure for programmes already being offered. Initial accreditation is in fact an *ex ante* assessment of a programme, and a programme becomes subject to the normal accreditation procedures once initial accreditation has been granted. In this case the panel had the chance to also consider previous results as the programme has already been offered quite some time as a degree course.

NVAO convened a panel of experts. This panel consisted of:
- Prof. dr. ir. B.J. Geurts, chair, University of Twente and Eindhoven University of Technology
- Prof. dr. ir. G. Ooms, Technical University Delft
- Prof. dr. ir. M. Baelmans, Catholic University Leuven
- Ms G. Wijnen, student member Technical University Eindhoven

On behalf of the NVAO dr. M.Woutersen (until January 2010) and drs. F. Wamelink (since January 2010) have been responsible for the process-coordination. Drs. J.Braaksma drafted the panel's report.

This composition reflects the expertise deemed necessary by NVAO. (Annex 1: Composition of the panel). All panel members signed a statement of independence and confidentiality, which is available at the NVAO upon request.

The panel has based its assessment on the standards and criteria described in the NVAO Initial Accreditation Framework.

The following procedure was undertaken. The panel studied the documents regarding the proposed programme. (Annex 2: Documents studied) The NVAO organised a preparatory meeting of the panel on 16 September 2009 in which the panel members expressed their first findings. After this meeting the panel asked for additional information which was discussed by the panel on the day before the site visit. The site visit took place on 13 October 2009 at the Von Karman Institute. (Annex 3: Programme of the site visit).

The panel formulated its preliminary assessments per theme and standard immediately after the site visit. These were based on the findings of the site visit, and building on the assessment of the programme documents.

After the site visit the Von Karman Institute sent a letter to NVAO clarifying some points raised during the site visit. The draft version of this report was circulated among the members of the panel for comments.

This version took into account the available information and relevant findings of the assessment and the information put forward in the letter.

In the process of drafting this report the committee encountered several aspects that needed further clarification. The panel decided to ask for additional information to clarify the questions and to provide convincing evidence of the programme meeting the accreditation standards.

The additional information was received by the NVAO on the 12th of March 2010. Based on the additional information the panel decided to have an additional meeting. This meeting was scheduled for the 2nd of June 2010 in the afternoon. After a discussion on the questions of the panel, the panel interviewed Prof. R. Van den Braembussche and Prof. H. Deconinck to clarify some questions raised by the additional material.

The additional information and the interview convinced the panel on the aspects in need of further substantiation. The panel also wants to stress that the additional information confirmed a positive evolution of the programme towards a more systematic quality assurance which clearly strengthened the reflection of the programme on its strengths and weaknesses. Additionally a realistic programme for improvements was developed.

After the meeting the panel decided on the adjustments to be made in the initial draft and came to a final decision on the scores. After the meeting the report was redrafted and again circulated among panel members for comments.
The panel finalized the report on 30 June 2010.

2.2 Panel report

This report is made up of several chapters in which the panel outlines its findings regarding the advanced master's programme Research Master in Fluid Dynamics offered at the Von Karman Institute for Fluid Dynamics.

The previous chapter provides an executive summary of the conclusions of the panel. The current chapter functions as an introduction, which means that it outlines the followed procedure and the panel composition.

The third chapter gives a description of the programme as a whole, including its position within the higher education system of Flanders (Belgium), and the international context into which it can be placed.

In the fourth chapter the panel will present its assessment. The programme is assessed by examining the themes and standards in the Initial Accreditation Framework. For each standard and theme the panel presents an outline of its findings, considerations and the conclusion.

The outline of the findings are the objective facts as found by the panel in the programme documents, in the additional documents and during the site visit. The panel's considerations are made up of the panel's subjective evaluations regarding these findings and the importance of each. The considerations presented by the panel logically lead to a concluding assessment. The panel has to assess each facet as either satisfactory or unsatisfactory. The consequence is that satisfactory sometimes means good.

The report will be concluded with a summarizing table containing an overview of its assessment per theme and per standard.
The annexes contain the programme of the site visit on 13 October 2009, a short outline of the panel, and a list of documents reviewed.

3 Description of the programme

3.1 Overview

Country	Belgium
Institution	Von Karman Institute for Fluid Dynamics
Programme	Research Master in Fluid Dynamics
Level	Master after Master
Orientation	Academic
Degree	Master
Title	Research Master in Fluid Dynamics
Location(s)	Sint-Genesius-Rode
Mode of study	Full time
Field of study	Turbomachines and Propulsion, Environmental and Applied Fluid Dynamics, Aeronautics and Aerospace

3.2 Profile of the institution

The Von Karman Institute for Fluid Dynamics (VKI) started in 1956 as an international centre for the study of fluid dynamics. More specifically its core business nowadays is: training scientists and engineers in the field of fluid dynamics with application to aeronautics and astronautics, turbomachinery and propulsion as well as environmental and applied fluid dynamics; stimulating research in fluid dynamics and disseminating knowledge in the domains mentioned.

Since the VKI started it has had 1367 participants in its 9 month post graduate degree course, provided research opportunities for 177 PhD candidates, supported 2211 master students in preparing their theses and offered 380 one-week courses in which 19422 persons participated. VKI is very well known among researchers in the area of fluid dynamics for especially the one-week courses (lecture series) in which experts from a variety of institutes and backgrounds participate.

VKI receives only partial funding from the Belgian government. For nearly 40% of its budget VKI depends on funds from NATO countries. The additional budget comes from contract research, consultancy and fees of some students.

The VKI offers several educational programmes:

- a final-year project programme in which students enrolled in an undergraduate programme elsewhere can carry out their final-year project in VKI laboratories under the supervision of a VKI faculty member,
- a short training programme in which qualified undergraduates can get acquainted with the practices of modern fluid dynamics,

- an applied research orientation programme in which graduates of the research master may be further instructed in the methodology of applied fluid dynamics and the practice of independent research,
- a multi-year doctoral programme of basic research in fluid dynamics carried out with a national university and
- the research master in fluid dynamics which is subject of this assessment for initial accreditation by the NVAO.

VKI's staff consists of 96 permanent employees, among them 11 full time professors and 7 part time professors. The yearly intake for the degree course is about 35 to 40 students.

The VKI would like to have its degree course accredited by NVAO because this provides a legally recognised diploma. This makes it easier to collaborate with other universities, to integrate in Europe and to participate in the international exchange of students.

3.3 Profile of the programme

New programme in the Netherlands
The Research Master in Fluid Dynamics is a new programme for Flanders.

New programme for the institution

The Research Master in Fluid Dynamics has been offered by the VKI since 1956.

4 Assessment per theme and per standard

This chapter presents the evaluation by the assessment panel of the six themes and nineteen standards. The panel has reproduced the criteria for each standard. For each standard the panel presents (i) a brief outline of its findings based on the programme documents provided by the institution and the site visit, (ii) the considerations the panel has taken into account and (iii) the conclusions of the panel.

4.1 Aims and objectives

4.1.1 Level and Orientation

The intended learning outcomes of the program correspond with the following descriptions of a Master's degree:

- *general competences at an advanced level such as the ability to reason and act in an academic manner, the ability to handle complex problems, the ability to reflect on one's own thoughts and work, and the ability to convert this reflection into the development of more effective solutions, the ability to communicate one's own research and solutions to professional colleagues and laymen, and the ability to develop an opinion in an uncertain context*
- *general academic competences at an advanced level such as the ability to apply research methods and techniques, the ability to design research, the ability to apply paradigms in the domain of the sciences or the arts and the ability to indicate the limits of paradigms, originality and creativity regarding the continuously expanding body of knowledge and insight, and the ability to collaborate in a multi-disciplinary environment*
- *advanced understanding and insight in scientific, discipline- specific knowledge inherent to a certain domain of the sciences or the arts, insight in the most recent knowledge in the subject/discipline or parts of it, the ability to follow and interpret the direction in which theory formation is developing, the ability to make an original contribution towards the body of knowledge of one or several parts of the subject/discipline, and display specific competences characteristic for the subject/discipline such as designing, researching, analysing and diagnosing*
- *the competences needed for either independent research or the independent practice of the arts at the level of a newly-qualified researcher (in the arts), or the general and specific professional competences needed for independent applicationof academic or artistic knowledge at the level of a newly-qualified professional*

Outline of findings

The main aim of the degree programme is: “the training of engineers and scientists capable of performing independent research and/or doing advanced product development and design on an autonomous basis in all fields where fluid dynamics are important”. The more specific objectives are:

- to provide the student with an advanced theoretical knowledge of fluid dynamics i.e. in depth understanding of physical and mathematical models,
- to provide the student with a profound knowledge of numerical and/or experimental techniques, including an estimation of their advantages and limitations in terms of accuracy,
- to train the student in the managerial skills required for the autonomous execution of large research projects and
- to prepare students for the integration of their research in the worldwide community by providing them with an insight into the structure and customs of the international scientific world with special attention for networking.

These objectives are further specified in terms of learning contents for the three main fields of application: aeronautics and aerospace, environmental and applied fluid dynamics and turbomachinery and propulsion (application p12/13).

The panel discussed with the management of the programme the level of independent research that can be expected from a master student. It did so especially in relation to the aims of the programme in this respect. After the site visit the panel received a letter from VKI in which it is stated that the training for independent research is an aim of the degree course but not an objective as this is a more proper objective for the doctoral programme.

Considerations
The intentions of the aims and objectives of the programme are clear. On the whole they also comply with what should be expected of a master programme. The objectives concerning theoretical knowledge for example do comply with the requirement of ‘advanced understanding and insight in scientific, discipline-specific knowledge’. This also holds for the objective about numerical and/or experimental techniques and its further specification for the three fields, which complies with the requirement of ‘attention for general academic competences at an advanced level regarding the ability to apply methods and techniques for designing research’. The ‘competences needed for independent research or independent practice’ are integrated in the objectives regarding managerial skills and the integration of research in the worldwide community.

The panel recommends making a more systematic analysis of how the aims and objectives of the degree course comply with the definition of the master level in the accreditation framework. The formulation of the aims and objectives in terms of learning outcomes could also be improved. In some cases the objectives are formulated in terms of inputs and less in terms of concrete learning outcomes that can be evaluated.

Conclusion
The panel assesses the standard 1.1 *‘Level and Orientation’* as satisfactory.

4.1.2 Subject Specific Requirements

The intended learning outcomes of the program correspond with the requirements set by professional colleagues, both nationally and internationally, and the relevant domain concerned (subject/discipline and/or professional practice or practice of the arts). In case of regulated professions, the requirements correspond with the regulation or legislation concerned. The learning outcomes stem from requirements set by the academic and/or artistic discipline, international academic practice and, for study programmes to which this applies, practice in the relevant professional field.

Outline of findings
A comparison is presented with other European and American institutions offering master courses or master degrees in the three fields of specialisation in the program. VKI concludes that its program, compared to these programs, is more oriented to research, more specialised and more systematic within its specialised research orientation. VKI explains its distinction from other educational centres by the combination of: a multinational en multicultural environment, unique facilities, intensive contacts with the outside world through e.g. the VKI lecture series, a strong industrial dimension of research topics and intensive training in research methodology, presenting and reporting. VKI further illustrates its qualities by mentioning that their alumni over the last 50 years have found positions in the academic world (44%, half of them at the level of professor), at national research centres (21%), in R&D offices of large companies (12%) and in government agencies (7,5%).

Considerations
To the perception of the panel the intended learning outcomes of the program are in line with the international academic practice and meet the subject-specific requirements. The intended learning outcomes are comparable to similar, in some aspects probably less specialised, Dutch and Belgian master programs. They show a combination of insight, in depth knowledge and research which will guarantee adequate further careers for the alumni in fluid dynamics. The figures about alumni presented by VKI illustrate this. The claim of VKI that its learning outcomes are relatively advanced needs further substantiation according to the panel.

Conclusion
The panel assesses standard 1.2 *'Subject-discipline-specific requirements'* as satisfactory.

4.1.3 Concluding Assesment of Theme 1 'Aims and Objectives'

The panel has assessed the two standards of the theme 'Aims and objectives' as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics regarding the theme 'Aims and objectives' as satisfactory.

4.2 Curriculum

For a description of the programme, see above, chapter 3.3.

4.2.1 Requirements for academic orientation (standard 2.1)

The proposed curriculum meets the following criteria for an academic orientation:

- *Students develop their knowledge through the interaction between education and research (including research in the arts) within relevant disciplines.*
- *The curriculum corresponds with current developments in the relevant discipline (s) by the verifiable links with current scientific theories.*
- *The programme ensures the development of competences in the field of research and/or the development and practice of the arts.*
- *Where appropriate, the curriculum has verifiable links with the current relevant professional practice***.**

Outline of findings
The curriculum of this master after master programme consists of a research project and a number of courses. The pivot of the individual programme of the student is the research project of 30 EC. The student is allocated to a project within the first month of being at VKI. The research project is leading in making choices for experimental or numerical courses as well as for the main field of interest: i) aeronautics and aerospace, ii) environmental and applied fluid dynamics or iii) turbomachinery and propulsion.

There are common courses on basic knowledge which have to be followed by every student (8,5 EC for the experimental option or 10 EC for the numerical option). In line with their specialisation they further follow specialised courses in one of the three main fields (21,75 EC in the experimental option as well as in the numerical option). It is possible to choose optional courses (5 EC max) from all courses offered when necessary for the research project. Thus in total the curriculum to be followed by students consists of a minimum of 60.5 and a maximum of 65.5 EC.

Considerations
The panel has considered the content of the curriculum and found that generally the courses are adequate. They do guarantee the development of the knowledge and skills necessary for realising the research project. Courses also cover the topics of the domain adequately. The course Introduction to Numerical Fluid Dynamics is taken from the VKI's lecture series, thereby offering all students a concentrated exposition of current numerical methods. This is essential for students interested in the numerical option, but is also an important basis for students in the experimental option as it provides a common language to communicate research and design steps.

The panel wonders, however, whether there is a mismatch between the 5 EC PRM course on Presenting, Reporting and research Management as a separate course and the research project. The current PRM course appears to be only an extension of the research project, e.g. via the literature study that is included.

VKI's additional explanation that specific tutorials regarding for example critical reviews and resource management are included in PRM and that they intend to further improve this course counterbalanced the panels' doubts.

In the discussions with faculty and students it became clear that the relation between research and the development of knowledge is not only intense due to the formal structure of the programme but also in practice. The pivotal role of the research project and the small groups facilitating intensive contact between professors and students are mentioned regularly in this respect.

Conclusion
The panel assesses standard 2.1 '*Requirements for academic orientation'* as satisfactory.

4.2.2 Correspondence between the aims and objectives and the curriculum (standard 2.2)

The intended curriculum, the educational concept, the study methods and the learning assessments reflect the intended learning outcomes. *The intended learning outcomes have been adequately transferred into the educational goals of (parts of) the intended curriculum*

Outline of findings
The educational concept of VKI is: teaching research through doing research. For that reason the research project runs during the whole programme and counts for 30 EC. Learning via the research project requires certain knowledge, techniques and skills already mastered via courses. In the application document a table is presented in which it is demonstrated how the attention for the development of knowledge, techniques and skills is spread over the courses. In the appendix of the application, the courses are described in detail. Thus for most courses it is clear how many EC are involved, what the intended learning outcomes of the course are, who lectures the course, which literature will be used and how the learning results of students are assessed.

In the additional information received on the request of the panel, the logical order of the courses is described for two trajectories: the experimental option of environmental and applied fluid dynamics and in the numerical option of turbomachinery. Both show a sequence from basics via more specialised courses for certain aspects (knowledge or techniques) to finally an integrated application via either research or design exercises.

Remarkable is that a number of the courses are included in the VKI's lectures series. These courses appear to be rather introductory; many courses are small (about 1 to 3 EC). VKI's rationale for the introductory and small courses is that, in order to remediate deficits in the background of students due to their cultural as well as disciplinary diverse background (see also 4.2.5), these courses function either to broaden the student's view or to get multidisciplinary input for their research projects. The number of introductory courses followed by a student is limited. The panel was convinced by this explanation.

The panel had the impression that a wide variety of study methods is being used. At least this applies to the forms of learning assessments: written and oral exams, open and closed book exams, exercises, design assessments, problem solution, reports, software development and homework. It often happens that several forms of assessment are used for one (small) course.

VKI stresses the appropriateness of this variety in relation to the learning objectives at course level. Furthermore the variation in assessments and their grading depends on the lecturers involved.

In order to let the students get acquainted to VKI's assessment methods, VKI has the practice of test assessments in the first trimester. These test assessments consider only one part of a course. If the student gets good results in the test, he/she is allowed to transfer the results to the final grade. If not, he/she has a second opportunity at the end of the course when doing the complete assessment of the course.

The criteria for grading appear to be mainly implicit. Some lecturers told the panel that they do work with a list of criteria when assessing students but these criteria are not communicated directly to the students. Students are generally informed about the course's objectives at the beginning of the course. Students reported that they experience the grading as more or less fair.

Research projects have their own assessment procedure. The project evaluation team (PET) consists of three to five professors: one supervisor and at least from each other department a member. The PET supervises the project from the start to the end. The student has regular contact with the supervisor; day to day supervision is partly realised by research engineers who can advise the PET. The student meets the other PET members three times for the presentation of the project in its distinctive phases. The advisory members have mainly an advisory role and participate in assessing the project work. Because staff members have an advisory role in several PET's it is possible to compare between projects and safeguard consistency in the assessments. Thus the PET members contribute to consistent assessments among projects. The final grade for a project consists of two parts. First there is an assessment of the report, a presentation and cross questioning of the student of about one hour by the PET (23 EC). Second there is a final presentation and answering questions of about half an hour which is graded by all faculty present (7 EC).

Table 3 in the application document presents the criteria for the scores VKI uses in the assessment of the research project. In this scale 'words' about competences and products are related to numerical grades. A numerical grade between 60 and 64 represents, for example: needs constant supervision, honest worker, mediocre results. A grade between 75 and 79 represents: good project, but needs some guidance; might eventually be capable of doctoral research; possible lower class journal article. A grade between 90 and 94 represents: fully capable of independent research at highest doctoral level, DC report of journal quality – high level, project of exceptional breadth and depth. In the additional information a revised grading scale was presented. In this scale a numerical grade between 60 and 64 represents: satisfies only minimum project requirements, minimum interpretation and validation of results and shows no creativity or innovation. A grade between 75 and 79 now represents: good overall achievements, might eventually be capable of doctoral research, possible international conference paper and capable of selecting appropriate

techniques and/or test methods. The panel acknowledges the improvement of the revised grading scale.

In order to get a 'sufficient' diploma the student needs to have numerical grades of 60 or more in both course work and the project. Given the revised definitions of the grades this is now fully in line with the intended learning outcomes of the degree course.

According to the also recently revised 'Regulations of Master after master program at VKI', version February 2010, students getting grades of 80 or more for the courses as well as for the project get an honours diploma from VKI. In motivated cases the jury may deviate from this rule, e.g. when a small shortcoming on the course part is compensated by a high grade for the project and 2/3 of the jury agrees.

Considerations
Given the findings described above, the panel sees strengths and weaknesses in the correspondence between the aims and objectives and the curriculum. The educational concept of teaching research through doing research is a very good one given the ambitions of the research master programme on fluid dynamics. Having a diversified course programme in three main fields supporting the research projects and guaranteeing the development of knowledge, techniques and skills is also well conceived in the programme.

The panel accepts the explanation given by VKI, for the variation and fragmentation in assessments of courses. The panel notices some challenges, as the relation between criteria for grading and the intended learning outcomes at course level remains implicit. For the programme as a whole this aspect appears to be changing for the better as shown in the recent improvements in the grading scale and the regulations. In the additional meeting of the panel with representatives from VKI it became clear that in the assessment and grading of projects some cross departmental validation of consistency is guaranteed via the advisory members of the PET team.

The panel was ultimately not convinced that there is good ground to exclude the height of the grade from the right of the student to make a complaint about examinations. The panel however does appreciate that the VKI introduced an ombudsperson nominated by the educational committee and an external expert in the recently revised procedure for complaints against decisions of the examiner as described in the new 'Regulations of the "Master after Master" program at VKI', version February 2010. In general the procedure was fair and appeared to be conducted with care.

Conclusion
The panel assesses the standard 2.2 '*Correspondence between the aims and objectives and the curriculum"* as *satisfactory.*

4.2.3 Consistency of the curriculum (standard 2.3)

The contents of the curriculum are internally consistent.

Outline of findings

The documentation presents the programme as a set of courses and a research project. In the discussions with staff and students it became clear that the programme can better be interpreted, and is experienced, as a research project and courses. Since the emphasis of the programme is on the research project, the assignment to this project is crucial and therefore done carefully (see standard 2.5 admission requirements).

Related to the research project a student chooses the main field of specialisation, the courses within his or her specialisation and, when necessary, also from other specialisations. Thus each student composes his or her individual study programme. Nevertheless, the programme of each student follows a sequence from basic and common courses to specialisation and application. Application is achieved sometimes in courses but almost always in the research project. In the first two trimesters students have relatively much course work and less work on their research project whereas in the third trimester it is the other way round. The panel has been told by alumni that variations in this general pattern occur due to the character and planning of the research project involved.

Considerations

The panel very much appreciates the possibilities for students to reach the intended learning outcomes via almost individual programmes. The flexible programmes give room for the remediation of deficiencies, acquisition of the basics of the field and specialisation in one of the three designated areas of specialisation. The individual programmes still appear to be consistent and to have a focus in a certain field of specialisation. Contrary to many other programmes consistency in this programme is not primarily to be found via the courses offered but via the research project on the basis of which the relevant courses are chosen. The panel considers this as an interesting and acceptable way of working.

Conclusion

The panel assesses the standard 2.3 *'Consistency of the curriculum'* as satisfactory.

4.2.4 Workload (standard 2.4)

The program meets the legal requirements

Outline of findings

The research Master in Fluid Dynamics "master after master" programme consists of 60,5 or 65,5 EC (European credit points). These credits are divided over the programme as follows:

- a research project (30 EC)
- a selection of mandatory courses in a specified field (30,5 EC)
- optional courses if appropriate for the project (5 EC)

The allocation of ECs to courses is remarkable. Many courses have very few ECs, sometimes even calculated in decimal numbers. No formal monitoring of the study load has been found. Students told the panel that in the programme it is hard work at VKI, but they can manage and it is worth doing so. Some of them even follow some extra courses without claiming ECs for them. Alumni estimated the division between their time spent on project work and courses as 60% versus 40%.

Considerations
The panel has some worries regarding the workload. First of all many courses of the degree programme have few ECs, frequently also calculated in decimal numbers like 1.25 EC. This practice matches with the concept of the programme that research and courses are integrated (and geared towards specialised knowledge), but causes a fragmented curriculum. The panel recommends integrating very small courses into more substantial parts of the programme. Second, the proportion in the programme of the research project and the courses deserves some more in-depth analysis too, because alumni gave another perceived proportion than intended. Especially in the case of project work it is clear that the workload is hard to constraint. Therefore, it is recommended that workload for project work in general is monitored within the framework of quality assurance (see also 4.5.1). Nevertheless students indicated that they have to work hard but can manage, even can take some extra courses if they like, often in the form of participating in some of the lectures series that are also offered at VKI, but outside this master after master programme. The informal intensive coaching of students seems to make the workload manageable. The panel supports the initiative of evaluating courses more regularly. It has seen the questionnaire developed for this aim. It includes a question about the course load in relation to the ECs attributed to it.

Conclusion
The panel assesses the standard 2.4 '*Workload*' as satisfactory.

4.2.5 Admission requirements (standard 2.5)

The structure and contents of the intended curriculum are in line with the qualifications of the incoming students for an advanced master's programme:
A master's degree, with a qualification or qualifications specified in more detail by the management of the institution, possibly supplemented with an assessment concerning the fitness or capability, or with a preparatory programme.

Outline of findings
The application presents the following admission requirements:

- a five year engineering or science degree (3 year BSc + 2 year MSc) from a European University or a MSc from an American, Canadian or Turkish University,
- a working knowledge of the English language. Students that did not obtain their degree from a university with lectures in English have to deliver a proof of having studied in English or an English language test result from an international organisation,
- endorsement of the applicant by an RTO National delegate. Citizenship of one of the NATO countries is required in view of the financing organisation. Non NATO nationals residing in NATO countries will be considered for admission if they are recommended by the RTO National delegate of their country of residence on the ground that their attendance at VKI would be beneficial to that country,
- recommendations by three professors from a university where the candidate has studied previously,
- there is no tuition fee for students from countries financing VKI.

The application form on VKI's website makes it clear that proficiency in either French or English is required. If the applicant needs to prove his or her knowledge of English, this will be tested via a TOEFL test. No more explicit criteria are mentioned as far as proficiency in English is concerned.

The application form also inquires extensively into motivation and future plans of the applicant and how he or she thinks following the Research Master in Fluid Dynamics will serve their career. In this perspective applicants are asked to describe their area of interest. According to their specific interest they also have to choose and rank five research projects from a list of VKI projects.

During the site visit it has been explained to the panel that professors of VKI departments review the application forms and make a proposal to the selection committee. The selection committee consisting of the heads of department discusses the proposed applications, taking into account the quality of the candidates, a balanced intake among countries and the NATO quota of 40 students for the degree course. Normally about 50% of the applicants can be admitted. Recent additional information shows that students do have a variety of MSc diploma's when entering the programme; for example in thermo fluids, physics engineering, chemical engineering, biomechanics, metallurgy, mathematics, electromechanics, energy conversion, civil engineering, nuclear engineering, etc.

The assessment of the quality of candidates is mainly based on long experience and consequently conventional wisdom. Furthermore the selection committee preliminary looks at the projects applicants would like to commit themselves to. The selection committee also looks at the possibilities for assigning the students in preferred projects as proposed by the departments.

Upon arrival at the VKI the applicant gets an intake interview in which the assignment of a project is finalised. Accordingly the individual study programme for this particular student is fixed.

Considerations
The panel found the formal rules for admission clear and adequate, although in some respects not specific enough. This applies especially for the proficiency in English. Therefore it recommends including a formal test with a specific score for all applicants. On the whole the panel found that the selection committee deals with the admission of students in good conscience. The students met by the panel appeared to be eligible for this research master as they had followed a degree in fluid mechanics before they entered this master after master programme.

Conclusion
The panel assesses the standard 2.5 '*Admission Requirements'* as satisfactory.

4.2.6 Credits (standard 2.6)

The programme meets the legal requirements regarding the range of credits.
- Advanced master's programme: 60 ECTS.

Outline of findings
The programme of the *Research Master in Fluid Dynamics* comprises 60,5 or 65,5 ECTS credit points for a nine months programme.

Considerations
The panel has reviewed the curriculum and programme documents, and concludes that the programme meets the legal requirement of a minimum of 60 ECTS for an advanced master's programme. It also noticed the arbitrary number of 60.5 or 65.5 EC allocated to the programme followed by the student.

Conclusion
The panel assesses the standard 2.6 '*Credits'* as satisfactory.

4.2.7 Master's Thesis

The master's programme is concluded with the master's thesis. The master's thesis corresponds to at least a fifth of the total number of credits with a minimum of 15 and a maximum of 30 credits.

Outline of the findings
In the application VKI describes the criteria and procedures regarding the master's thesis. The project for the master thesis should be an independent research project starting with a problem definition. It also must exhibit originality in the sense that it contributes to the field. Computational projects are mostly related to software development; experimental projects often study a phenomenon in view of the development or validation of a numerical model or the development of a new experimental technique. Projects are often part of the larger industrial research projects performed at VKI but can also be more fundamental VKI funded exploratory research. A limitation in the choice of projects for students preparing their master's thesis is that these projects cannot have a confidential nature since it should be possible to publish the research findings.

While realising the research project, students are supervised and assessed by a project evaluation team (PET) which consists of professors: one supervisor and a staff member from each other department. The PET supervises the project from the start to the end; day-to-day supervision is partly realised by research engineers who may advise the PET (see also standard 2.2). At the end of the first trimester the student has to present a summary of the work accomplished until then to the PET; this should at least include results of the literature search and future plans. At the end of the second trimester the presentation has to include a report on the literature survey which is assessed as part of the course on presenting, reporting and research management. In the third trimester there are two presentations; one as an exercise and one for the final presentation of the project which is the basis for the final assessment. Members of the PET may propose changes to the report which have to be realised before graduation day.

The main purpose of these changes is to make sure that all information needed for the follow up of the project, either as a project or as a publication, is available. They do not influence the grade. For more details on the assessment of the master's thesis see standard 2.2.

As the Research Master in Fluid Dynamics already has a long tradition the panel had the opportunity to look at 12 master theses. Generally they represent thorough work.

Considerations
The panel assesses a selection of twelve master theses as thorough work contributing to the field. Initially the panel wondered to what extent master theses indeed report on 'independent research projects'. Guidance of the research project is well structured with several moments of evaluation and feed back by the project evaluation team (PET). Also the supervision by the research engineers might be a rather intense one. Research projects sometimes are part of a continuing research line of the department. The panel was convinced that students are assessed on the extent to which they are capable of independent and creative research. This is explicitly formulated in the assessment criteria used.

Conclusion
The panel assesses the standard 2.7 '*Master's thesis'* as satisfactory.

4.2.8 Concluding Assessment of Theme 2 'Curriculum'

The panel has assessed the seven standards of the theme 'Curriculum' as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics regarding the theme 'Curriculum' as satisfactory.

4.3 Staff

4.3.1 Requirements for academic orientation (standard 3.1)

The programme meets the following criteria for the deployment of staff for a programme with an academic orientation:

- *teaching is principally provided by researchers who contribute to the development of the subject/discipline;*
- *in addition, and where appropriate, the sufficient staff will be deployed with knowledge of and insight in the professional field.*

Outline of findings

The core staff of VKI consists of 11 full time professors and 7 part time professors, among whom 4 honorary professors. In each department there are at least 3 full time professors, one of them being head of the department. Several of the 40 research engineers also contribute to the degree course by assisting and supervising students participating in their research projects.

The curricula vitae included in appendix 7 of the application show a rather wide range of scientific track records among the members of staff with some individuals known internationally for their contributions to the field while others have a more modest scientific reputation. This is visible in the differences in research output that can be observed among the different staff members. VKI puts high priority on the improvement of the scientific visibility and reputation of the institute, e.g. by more publications in international high ranking journals.

The teaching staff has in many cases strong ties with VKI over almost their entire career. In a letter sent after the site visit VKI argues against the impression of the panel, expressed during the site visit, that most teaching staff are recruited internally in VKI. VKI argues that 7 out of 16 members of the core staff appointed in the last 25 years did their doctorate in another institute, that 3 out of the other 9 have some years of experience elsewhere before returning to VKI and that 6 of them so far have a complete career at VKI.

Considerations

Having seen the curricula vitae, including the lists of publications and the research topics of staff members, the panel had a good impression of the research qualities of the staff. The panel came to the conclusion that international contacts and visibility are adequate. The institute has a good scientific reputation partly because of very specialized equipment and related research projects. The panel feels that there is good reason to reflect seriously on the position and future prospects of VKI in this respect. There seems no reason to assume a leading position. Both because of the quantity of high quality publications realised and because of a shift in the focus of the research in this field, which might endanger the relevance of some of the research conducted at VKI. The VKI recently formulated promising aspirations in this respect (see 4.5.1).

The panel judges the academic quality of the staff as sufficient to carry out this master after master programme as the staff members are for a considerable amount of time involved in contract research and consultancy.

Conclusion
The panel assesses the standard 3.1 '*Requirements for academic orientation'* as satisfactory.

4.3.2 Quantity of staff (standard 3.2)

- Sufficient staff is deployed to be able to start the proposed programme. *- Sufficient staff is deployed to be able to continue the proposed programme.*

Outline of findings
There are 11 full time professors at VKI. With an intake of 35 students on average, the staff: student ratio is about 1:9. According to the application all professors have about 50% of their time devoted to research and the other 50% to educational activities. When meeting staff members they estimated the proportion of their time devoted to contract work including research and educational activities as 60% versus 40%. Educational activities include the degree course among other activities like supervising PhD students, giving lecture series and lecturing in universities.

In terms of FTE (full time equivalents) there is about 4 FTE (full time professors) available for the degree programme. In addition research engineers are involved. The panel was told that they are supposed to spend about 30% of their time on working with students if students participate in their projects (according to new rules since October 2009 they can only for 10% of their time be requested to contribute to activities not related to their PhD project; supervising students on a project related to their PhD is not included in this). In practice the involvement of research engineers in the degree programme varies depending on other VKI work. During the interview students were very positive about the quantity of staff.

Considerations
According to the panel a staff student ratio of 1:3 is fortunate. The same holds for the 4 FTE available for the degree programme at the level of full time professors. As there is also the contribution of research engineers to the realisation of the programme in the research projects, it can be concluded that the quantity of staff is good.

Conclusion
The panel assesses the standard 3.2 '*Quantity of staff*' as satisfactory.

4.3.3 Quality of staff (standard 3.3)

The staff to be deployed is sufficiently qualified to ensure that the aims and objectives regarding content, didactics and organization of the programme can be achieved.

Outline of findings
The tenured faculty is composed of 4 full professors, 3 associate professors and 4 assistant professors. They all spend a substantial part of their time on research activities including publishing; conferences etc. (see also standard 3.1 and 3.2). Thus their expertise regarding the content of the programme is guaranteed.

In the application it is said that due to the almost individual teaching of students didactic competences have traditionally received little attention.

When discussing this with management and the (staff) assessment committee (see also standard 5.1), it became clear that the policy is: attract or train didactic qualities elsewhere and gradually transform staff in this respect. Minutes seen during the site visit show that the main criteria for assessing educational performance of staff are: quality of lectures, availability and quality of course notes and didactic material and the relevance of the course content. These aspects will be evaluated by the educational committee and reported to the assessment committee (see also standard 5.2). Other educational performance criteria are: the number of lecture series organised and invitations to teach in external organisations.

Considerations
The panel is convinced of the organisational qualities of staff as the degree programme runs already and no severe problems about its organisation are noticed during the meetings with staff, students and alumni. The quality of staff regarding the content of the programme is adequate to train young researchers (see standard 3.1). The panel also noticed growing awareness of the necessity to develop didactic qualities systematically among staff although it thinks this could be done more professionally. For example by looking for a tailor made external training course. The panel is positive about the installation of the assessment committee by VKI.

Conclusion
The panel assesses the standard 3.3 '*Quality of staff*' as satisfactory.

4.3.4 Concluding assessment of Theme 3 'Staff'

The panel has assessed the three standards of the theme *'Staff'* as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics as satisfactory regarding the theme 'Staff'.

4.4 Facilities

4.4.1 Material Facilities (standard 4.1)

Intended housing and facilities are adequate to achieve the learning outcomes.

Outline of findings
VKI presents a variety of facilities in the application. There are a large number of specialised test facilities equipped with advanced instrumentation and a powerful computer centre. The design and drawing office facilitates the technical drawings for the wind tunnel models, experimental set ups, facility modifications and figures and charts for reports and presentations. Most of the electronic instrumentation for the measurement in fluid mechanics can be found in the electronic laboratory. New instruments and electronic devices are also developed here. VKI has a specialised library and publishing office with a substantial number of specialised reports of aeronautical /aerospace organisations. The metal and woodworking shops are equipped with a range of machining tools and welding equipment, including the recently developed 'high precision mechanics' section for constructing dedicated instrumentation. Finally there are study and conference rooms, a catering service, secretaries and an administrative and purchasing service.
During the site visit some panel members had a tour through the laboratories. They noticed several unique experimental facilities. It also became clear that students are never allowed to use the laboratory facilities alone; there has to be a supervisor with them.

Considerations
According to the panel numerical, theoretical and modelling facilities are adequate. The experimental facilities of VKI are unique and for that reason well known among colleagues. The panel judges the facilities to be sufficient to achieve the intended learning outcomes.

Conclusion
The panel assesses the standard 4.1 '*Material Facilities'* as satisfactory.

4.4.2 Study Counseling (standard 4.2)

There is adequate staff capacity to provide counselling as well as information provision for students, and these are adequate with a view to study progress.

Outline of findings
Appendix 6 of the application document shows the information booklet for students. This information booklet about the diploma course concentrates on matters regarding grading, the project report and the role of the supervisor and the technical advisor.

In the application document the programme describes that the supervisor of the project also supervises students in their course work, in cooperation with the individual professors. The technical advisor of the project supervises and assists the student as far as laboratory and technical aspects are concerned.

Individual results during the study are communicated to the whole faculty and discussed in faculty meetings if necessary. Results of exams will be communicated and eventually discussed with the student before being archived. The dean is available to discuss any problem that might occur.

In meetings with students and alumni it became clear that they felt well taken care of. They feel stimulated in choosing and executing their project right from the beginning of the degree course. Due to the small scale of the institute, bilateral contacts between students and staff are experienced as easy and frequent. The class representative reported it is also easy to contact staff if more general topics like laboratory planning deserve attention.

Considerations
The panel found the student booklet minimal and not very clear. It supports the plans of VKI to include the document regarding regulations in the next information booklet. Interviews confirmed that tutoring is very intensive, in line with the educational concept.

The panel however sees the danger of this tutoring turning into an obedient model, hampering critical reflection and creative independent thought.

Students do not complain about the absence of a study advisor as staff can easily be approached. The impression of the panel is that there is a strong feeling of family-like cohesion in VKI.

Conclusion
The panel assesses the standard 4.2 '*Study counselling'* as satisfactory.

4.4.3 Concluding assessment of Theme 4 'Facilities'

The panel has assessed the two standards of the theme 'Facilities' as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics as satisfactory regarding the theme 'Facilities'

4.5 Internal quality assurance system

4.5.1 Internal Quality Assurance System

A system of internal quality assurance is in place, which uses verifiable objectives and periodical evaluations in order to take measures for improvement.

Outline of findings
In the application several elements of an internal quality assurance system have been presented. Some existing instruments for monitoring parts of the programme were improved and extended. There are revised questionnaires to be used for all courses instead of only for two of them. Additionally VKI explained that in order to get adequate numbers for statistically analysing results sometimes questionnaires from several year groups of the same course have to be combined. In some cases the response could be raised. It also has been mentioned that when course evaluations show three or more negative comments on a lecturer, measures for improvement are taken by the educational committee. Instruments or procedures for monitoring the project part of the curriculum systematically are to be developed and made available.
No verifiable objectives are found in the initial application documentation.

When the panel asked the management about quality assurance of the programme and objectives set in this respect, it got a twofold answer. There are two objectives: an intake of 40 students and getting accredited. The content of the programme is discussed with all faculty members and in the separate teams of each department. The panel has also been told that the assessment and evaluation of courses, not the programme as a whole, is realised by the educational committee. The additional information includes promising minutes of the educational committee meetings and mentions a variety of qualitative objectives for improvement. In the near future the focus will be especially on: the system of internal quality assurance, the intake of students, the number of publications by staff members, strengthening the links with alumni and more stable financing of the institute. When asking professors about procedures for discussing potential innovations of the programme, the answer indicated that in such a case there will be discussion among group members. The panel did not get the impression this would happen in the context of a process in which systematic evaluations and verifiable objectives give a sound basis for measures for improvement.

Considerations
The panel did not come across a convincing set of explicit verifiable objectives in the initial documentation. The additional information provided qualitative objectives. Some of these objectives in the first place aim at the enhancement of research quality and only indirectly contribute to the quality of teaching. The panel however was convinced that the priorities are realistic and appropriate for this programme which is so tightly linked with research. The institution presented convincing plans for systematic quality assurance. Instruments for periodical evaluations of the programme are developed and tested. First results are available. Responsibilities and tasks are clearly divided. First evaluation results are discussed.

There are plans to intensify periodical evaluations of the programme. However, these evaluations appear to mainly cope with courses. Projects are taken care of by the PET, but the descriptions presented indicate that monitoring focuses on the quality of the project and how the students realise them rather than on the quality of projects as part of the programme. The additional information mentions the intention to increase monitoring the workload of projects. Although changes for the better can be recognised, it still looks like there is some conceptual misunderstanding about the difference between the system of internal quality assurance and the quality of the programme. However, the panel did notice serious improvements regarding internal quality assurance in the additional documentation as well as during the recent additional meeting with representatives from VKI. This is a good basis for further developing this master after master programme.

Conclusion
The panel assesses the standard 5.1 *'Systematic approach of the internal quality assurance system'* as satisfactory.

4.5.2 Involvement of Actors in the Internal Quality Assurance System

Staff, students, alumni and the relevant professional field will be actively involved in the internal quality assurance system.

Outline of findings
In the application and in a presentation during the site visit the actors involved with quality assurance and their tasks were explained. The actors, tasks and instruments presented are:

- students elect a student representative per department who meets regularly with the head of department,
- one student delegate meets regularly with the director,
- the dean is responsible for organising the course schedule, exams, PET meetings, the information booklet and respecting rules for examination,
- the assessment committee consists of the heads of department, the dean and the director (chair). They periodically evaluate all faculty members regarding their scientific performance, their education performance and their contract work,
- the educational committee is composed of the director, the dean (chair) and one honorary professor. They evaluate faculty members periodically on educational matters. For this purpose enquiries will be organised for every course by means of a questionnaire and for the academic year after the master thesis,
- the alumni association and an alumni questionnaire (the 2006 questionnaire showed that the VKI experience is of great influence on careers, the value of the lecture series, the need to adapt to changing economical and social requirements and the importance of a strong interaction between experimental and numerical research),
- the technical advisory committee (TAC) which is established by NATO-RTO and is composed of senior professors and leaders of large research centres. The TAC makes a yearly audit of the performance of VKI regarding education and research. In 2008 the TAC concluded: "The Committee is unanimous in its recommendation of the Institute for providing excellent training and research programs of high value to NATO nations".

The flow chart presented during the site visit shows a great number of mutual relations between the actors involved including the board of directors.

Considerations
In principle all important actors are involved with internal quality in one way or another, although not always systematic. As argued earlier the panel suggests strengthening the internal critical reflection. Nevertheless the panel noticed active involvement of staff, students, alumni and professional field. It also noticed a remarkable willingness to contribute to quality assurance processes.

Conclusion
The panel assesses the standard 5.2 *'Involvement of actors in the internal quality assurance system'* as satisfactory.

4.5.3 Concluding assessment of Theme 5 'Internal quality assurance system'

The panel has assessed the two standards of the theme 'Internal Quality Assurance' as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics as satisfactory regarding the theme 'Internal Quality Assurance'.

4.6 Conditions for continuity

4.6.1 Graduation guarantee (standard 6.1)

The higher education institution ensures that students can complete the programme.

Outline of findings
The application outlines the context of VKI in general and the research master in fluid dynamics in particular. In essence this programme already runs for fifty years under relatively stable circumstances due to involvement of the Belgian government and the NATO. Students starting the curriculum can graduate if they comply with the scientific requirements set.

Considerations
Given the situation explained above, and the fact that the programme has actually been running for fifty years, the panel is convinced that VKI can ensure that students can complete the programme.

Conclusion
The panel assesses the standard 6.1 '*Graduation guarantee'* as satisfactory.

4.6.2 Investments (standard 6.2)

The higher proposed investments are sufficient to realize the programme (including the facilities and tutoring)

Outline of findings
The application, especially the five-year plan in appendix 9 shows that no extra investments are foreseen, except keeping the normal facilities up to date of facilities.

Considerations
The panel recommends investing in staff development regarding educational qualities and in setting up a suitable system for systematic quality assurance. Besides these two topics for investment the panel agrees with VKI that no other investments are needed for realising the programme.

Conclusion
The panel assesses the standard 6.2 '*Investments'* as satisfactory.

4.6.3 Financial provisions (standard 6.3)

The financial provisions are sufficient to offer the full programme.

Outline of findings
In the application it is explained that VKI is financed by NATO countries (30,64%, the Belgian federal government (11,72%) and its own scientific and sponsored research activities (57,64%). The expectation is that the present academic year will finish within the scheduled budget. No problems are expected for the next academic year.

Considerations
Since the programme has been offered successfully for the past fifty years the panel has no reason to doubt the financial provisions.

Conclusion
The panel assesses the standard 6.3 '*Financial provisions'* as satisfactory.

4.6.4 Concluding assessment of Theme 6 'Conditions for continuity'

The panel has assessed the three standards of the theme 'Conditions for continuity' as satisfactory. The panel therefore considers the master-after-master Research Master in Fluid Dynamics as satisfactory regarding the theme 'Conditions for continuity'.

5 Overview of the assessments

The panel presents its assessments per theme and per standard, as outlined in chapter 4, in the following table.

Theme	Assessment	Standard	Assessment
1 Aims and Objectives	**Satisfactory**	1.1 Subject-/ discipline-specific requirements	**Satisfactory**
		1.2 Bachelor level	**Satisfactory**
	Satisfactory	1.3 Academic orientation	**Satisfactory**
2 Curriculum		2.1 Academic orientation	**Satisfactory**
		2.2 Correspondence between aims and objectives and curriculum	**Satisfactory**
		2.3 Consistency of the curriculum	**Satisfactory**
		2.4 Workload	**Satisfactory**
		2.5 Admission requirements	**Satisfactory**
		2.6 Credits	**Satisfactory**
Staff	**Satisfactory**	3.1 Requirements for academic orientation	**Satisfactory**
		3.2 Quantify of Staff	**Satisfactory**
		3.3 Quality of Staff	**Satisfactory**
4 Services	**Satisfactory**	4.1 Facilities	**Satisfactory**
		4.2 Tutoring	**Satisfactory**
5 Internal Quality assurance system	**Satisfactory**	5.1 Systematic Approach	**Satisfactory**
		5.2 Involvement of Staff, Students, Alumni and the Professional Field	**Satisfactory**
6 Conditions for Continuity	**Satisfactory**	6.1 Graduation Guarantee	**Satisfactory**
		6.2 Investments	**Satisfactory**
		6.3 Financial Provisions	**Satisfactory**

Annex 1: Composition of the panel

Prof. dr. ir. B.J. Geurts, chair

Bernard Geurts holds the chair for Multiscale Modeling and Simulation in the Department of Applied Mathematics at the University of Twente. He is also part-time chair for Anisotropic Turbulence at Eindhoven University of Technology. His research interests are in mathematics, physics and numerics of multiscale problems in turbulence, complex fluids and computational biology. He is chair of the Scientific Program Committee of the European Research Community On Flow, Turbulence and Combustion (ERCOFTAC) and is Chair for the Computational Science program in the Twente Graduate School.

Prof. dr. ir. G. Ooms

Gijsbert Ooms studied applied physics at Delft University of Technology (TUD). After his study and military service he worked alternately for Shell and for the TUD. At Shell he was a researcher and became gradually involved in management of research. At the TUD he is a professor of fluid mechanics with special interest in turbulence and multiphase flow. He is also the scientific director of the J.M. Burgerscentrum (national research school on fluid mechanics in The Netherlands) and scientific director of the Centre for Fluid and Solid Mechanics of the federation of the three technological universities in The Netherlands.

Prof. dr. Ir. M. Baelmans

Martine Baelmans is full professor at the Department of Mechanical Engineering at the K.U.Leuven. Within the division of Applied Mechanics and Energy Conversion she leads the research group on thermal-fluid engineering. Research topics range from fundamental turbulence research to application oriented thermal-fluid engineering in micro-systems, aero-acoustics and ventilation. At present she is vice-rector for Student Affairs and Diversity Policy at the K.U.Leuven.

Ms G. Wijnen

Geri Wijnen is a master student in Real Estate Management & Development at the Faculty of Architecture Building and Planning at Eindhoven University of Technology. She frequently functions as a student member in accreditation panels at NVAO. During her studies she has been involved with educational quality as Commissioner of Education of the faculty study association, as a member of the Educational Committee and Curriculum Committee and as a tutor in study skills for freshmen students

Ms drs J. Braaksma, secretary
Johanneke Braaksma is senior advisor at IOWO, Radboud University Nijmegen. She is involved in advising on curriculum development as well as quality assurance. She has experience in (inter)national visitation procedures as chair, secretary and member of panels. She did comparative educational research and has been reference librarian at the University Library Twente.

Ms dr. M. Woutersen, NVAO process coordinator (until January 2010)
Drs. F. Wamelink, NVAO process coordinator (since January 2010)

Annex 2: Schedule of the site visit

The panel undertook a site visit on 13 October 2009 as part of the external assessment regarding the Research Master in Fluid Dynamics of the Von Karman Institute.

8.30 – 9.00	interview with the management of the programme and the coordinator of the quality assurance short presentation on the internal quality assurance
Present:	J. Muylaert, M. Riethmuller, R. Van den Braembussche, H. Deconinck
9.15 – 10.15	interview with students and alumni
Present:	students 2009-2010: R. Neitzel, S. Le Clainche Martinez, I. Sakraker students 2008-2009: L. Nettis, A. Sanna, B. Conan PhD representative: J. Michàlek
10.30 – 11.15	interview with professors and associate professors
Present:	T. Arts, C. Benocci, M. Carbonaro, O. Chazot, G. Paniagua, J. Van Beeck
11.30 – 12.15	interview with assistant professors, including members of PET-teams
Present:	Dr. Z. Alsalihi, F. Coletti, F. Tomasoni, C. Asma, L. Koloszar, A. Lani
12.15 – 13.30	lunch and assessment by the panel
13.30 – 14.00	guided tour through the laboratories and examining of the documents
14.00 – 14.30	interview with the selection committee and the assessment committee
Present:	J. Muylaert, M. Riethmuller, R. Van den Braembussche, H. Deconinck, J.M. Buchlin
14.30 – 15.30	assessment by the panel
15.30 – 16.00	second interview with the management of the programme
Present:	J. Muylaert, M. Riethmuller, R. Van den Braembussche, H. Deconinck
16.00 – 17.30	assessment by the panel

Annex 3: Documents reviewed

Aanvraagdossier Toets Nieuwe Opleiding Von Karman Institute for Fluid Dynamics
August 12, 2009

Addendum bij het aanvraagdossier Toets Nieuwe Opleiding Von Karman Institute for Fluid Dynamics
March 10, 2010

TNO – von Karman Institute: updates (13-10-2009) including also:
descriptions of the logical order/sequences of the courses in the turbomachinery department (numerical option) and the environmental and applied fluid dynamics department (experimental option), minutes of meetings of the assessment committee and the education committee and slides of the presentation on quality assurance during the site visit.

12 VKI project reports

Letter sent by the VKI after the site visit (received on 22-10-2009)
Study materials

This panel report has been written on request of the NVAO in support of the initial accreditation of the advanced master's programme *Research Master in Fluid Dynamics* of the Von Karman Institute.

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