Assessment report
Limited Programme Assessment

Master Software Engineering

University of Amsterdam

Contents of the report

1. Executive summary

In this executive summary, the panel presents the main considerations with respect to the assessment of the quality of the Master Software Engineering programme of the University of Amsterdam, this programme having been assessed according to the Assessment Framework (22 November 2011) of NVAO (Dutch-Flemish Accreditation Organisation).

The panel has observed that the programme management has taken up the suggestions for improvement, made by the panel that conducted the previous review of the programme in 2007. In particular, the intake requirements concerning computer programming knowledge and skills have been tightened, evaluation criteria for the master's thesis have been specified and the topics for the master's theses have become more focused, to bring these in line with the research themes addressed in the courses.

The panel considers the programme's objectives to be relevant for a master's programme in the software engineering field. The objectives include relevant scientific as well as professional knowledge and skills. As the graduates of the programme are to gain scientific knowledge and skills, they will be able to address software engineering problems in a scientific way, thereby contributing to the success of software engineering projects. The learning outcomes are rather focused but cover the software engineering domain in a sufficiently complete way. The panel has ascertained the learning outcomes to comply fully with the requirements of a master's level programme. The intended learning outcomes meet the SWEBOK framework and the ACM Computing Science Curriculum and, therefore, correspond to the international requirements in the software engineering field. The panel finds the profile of the programme, addressing both theory and practice and both technology and the human factor interesting and very useful in the professional field.

The panel considers the entry requirements for the programme to be relevant and the admission process to be conducted in a responsible manner, only admitting the students who have a fair chance of completing the programme. The pre-master programme for students with a hbo-bachelor diploma is fit-for-purpose and gives these students the chance to start the programme at the required level. The panel finds the students are well-informed about the challenging nature of the programme. The study modes (full-time and part-time), which are offered, give different student groups of students the opportunity to complete this programme.

The panel has observed the curriculum to meet the intended learning outcomes. The course contents as well as the literature are at an academic master's level. The panel considers the courses in this one-year programme to have been very well chosen. The structure of the curriculum is logical and clear, although the panel advises to consider introducing electives to allow some form of specialization. The programme management is very active in improving the curriculum and in keeping the course contents up-to-date. The panel regards the professional field to be satisfactorily represented but advises to install an advisory board to inform the programme management first-hand about current developments in the professional field.

The expertise and educational abilities of the lecturers in the programme meet the requirements. The panel was, especially, impressed by the drive and the motivation of the teaching staff to promote the learning processes of the students. The panel has some concerns about the continuity of the programme. As the number of incoming students tends to increase, the work load of the lecturers will undoubtedly rise further. Since the student-teacher ratio is already rather high (nearly 29.0) and as some of the lecturers may leave the programme in the coming years, the panel recommends to take measures to maintain and, preferably, to raise the number of qualified lecturers in the programme.

The educational model of the programme and the study methods derived from this model contribute, in the panel's opinion, strongly to the learning processes of the students and allow them to achieve steep learning curves. The programme is challenging for the students, who regularly spend more than 40 hours per week. The study guidance and supervision which the programme management has implemented, are both very intense and play a prominent role in keeping the study load manageable. The role of the student advisor is important, especially in case of study problems. Although the housing and the material facilities are appropriate, the panel recommends to find a designated space for the programme within the Faculty of Science campus where both students and teaching staff work in close proximity. A specific location for the programme would promote further the learning processes of the students. The panel is positive about the formal and informal evaluation mechanisms which have been put in place.

The assessment policy of the programme is appropriate, the regulations being in line with the university's policy. The panel has observed the programme's board of examiners is in the process of implementing measures to fully ensure examinations quality control. For the panel, the knowledge and skills the students are to have acquired, may be appropriately tested by means of the papers, essays, written examinations and assignments. The examinations the panel has studied, are of an appropriate quality and level. The feedback on the draft assignments, undoubtedly, fosters the learning processes of the students. The master project process is perfectly adequate with very frequent meetings of the student and the supervisor. The assessment of the theses is appropriate as well, as the assessment criteria are very relevant and the examination committee with three to four examiners ensures a reliable assessment.

The panel has studied the master theses. The quality of these theses and the level the graduates have reached, are definitely more than just satisfactory. The contents of the theses are relevant for the software engineering field, the scientific structure and quality are up to standard and the level of complexity more than meets the requirements. The panel feels that on account of the very effective learning processes and the steep learning curves, the students achieve a high level of relevant knowledge and appropriate skills in this one-year programme.

The panel has assessed each of the standards of the NVAO Assessment Framework for the Master Software Engineering (full-time and part-time) of the University of Amsterdam as good. Therefore, the panel advises the NVAO to prolong the accreditation the Master Software Engineering programme (full-time and part-time) of the University of Amsterdam, assessing this programme to be good.

Rotterdam, 2 October 2013

Chair of the assessment panel
Prof. A. van Deursen Ph.D.

Secretary
W.J.J.C. Vercouteren MSc, RC

2. Assessment process

Certiked VBI has received a request to conduct an assessment for the accreditation of the Master Software Engineering programme of the University of Amsterdam.

Certiked has requested the approval by NVAO of the proposed panel of experts to conduct this assessment. NVAO have given their approval. The panel consisted of (for more detailed information please refer to Annex 4: Composition of the assessment panel):

- prof. A. van Deursen Ph.D., panel chair, professor of Software Engineering and head of the Software Engineering Research group of Delft University of Technology;
- prof. T. Mens Ph.D., panel member, professor of Software Engineering and head of the Software Engineering Lab at Université de Mons, Belgium;
- prof. R. van Solingen Ph.D., panel member, professor of Computer Science at Delft University of Technology and chief technical officer at Prowareness;
- Y. Oualhadj, student member, studying the master programme Dutch Language and Culture at Leiden University.

On behalf of Certiked, W. Vercouteren MSc, RC was responsible for the process co-ordination and for drafting the panel's report. The panel members and the secretary have signed a statement of independence and confidentiality.

The panel has conducted this assessment in accordance with the NVAO Assessment Framework (22 November 2011).

The following procedure has been adopted. The members of the panel studied the documents presented beforehand by the programme management, including a number of theses (please refer to Annex 2 and 3: Documents reviewed and Theses reviewed). As the programme is offered in a full-time as well as a part-time study mode and as the number of full-time students and part-time students does not differ substantially, 15 theses of part-time students and 15 theses of full-time students have been selected. The theses were selected randomly in pre-specified strata of grades, to ensure a fair distribution of grades.

Prior to the site visit, every one of the panel members and the process co-ordinator/secretary discussed their preliminary findings concerning the quality of the programme and with respect to the quality and the level of the theses. The panel members presented a number of questions to be put to the programme representatives during the site visit. On the basis of this input, the secretary drew up a complete list of questions.

On 18 June 2013, the panel conducted a site visit at the premises of the programme on the campus of the Faculty of Science of the University of Amsterdam. The site visit was conducted in accordance with the schedule drawn up beforehand (please refer to Annex 1: Schedule of site visit). The programme management communicated the open office hours to the lecturers, the students and other persons involved in the programme. No one presented themselves during the open office hours.

Immediately after the meetings of the site visit, the members of the panel shared their considerations for each of the standards of the NVAO Assessment Framework. These considerations were based on the findings during the site visit, building upon the evaluation of the documents submitted by the institution. At the end of the site visit, the chair of the panel presented a broad outline of the findings to the programme representatives.

A draft version of this report has been finalised by the secretary, having taken into account the information presented as well as the findings and considerations of the panel. The draft report was, then, sent to the members of the panel. The panel members corrected and amended the draft report. Finally, the secretary drew up the final report. This report was sent to the programme management to correct for any errors. After having corrected the errors, the report was sent to the programme management to accompany their request for re-accreditation.

3. Overview of the programme

3.1 Basic information about the programme

Administrative information about the programme:

Name programme as in CROHO:	M Software Engineering
Orientation and level programme:	Academic Master
Grade:	Master of Science
Number of credits:	60 EC
Specializations:	N.A.
Location:	Amsterdam
Mode of study:	Full-time and part-time
Registration in CROHO:	60228

Administrative information about the institution

Name of institution:	University of Amsterdam
Status of institution:	Publicly funded university
Institution's quality assurance test:	Positive

Quantitative data about the programme

Percentage of students who have completed the programme in two years for full-time students or three years for part-time students (September enrolments)

Cohort	2008	2009	2010
Full-time students	73,3 %	100,0 %	71,4 %
Part-time students	60,1 %	91,6 %	75,0 %
All students	65,8 %	95,2 %	73,3 %

Percentage of lecturers with the following qualifications

Qualification	Master's degree	Ph.D.	BKO
Percentage of lecturers	100 %	88 %	25 %

The student-to-staff ratio is 28.66. In calculating this ratio, every one of he part-time students have been given a weight of 0.5 per year.

The number of contact hours is 17.35 hours per week for full-time students. The number of contact hours for part-time students is either one day (about 8 hours) per week or two days (about 16 hours) per week, depending on the schedule they have chosen.

3.2 Main facts about the institution

The Master Software Engineering programme is one of the programmes of the Graduate School of Informatics of the Faculty of Science of the University of Amsterdam. The Graduate School of Informatics offers six master programmes in total, being Master in Artificial Intelligence, Master Computational Science, Master Information Studies, Master Software Engineering, Master System and Network Engineering and Master of Logic.

The Faculty of Science is one of the seven Faculties of the University of Amsterdam. The Faculties are the Faculties of Humanities, Economics and Business, Social and Behavioural Sciences, Law, Science, Medecine and Dentistry. The University of Amsterdam was founded in 1632. It is one of the largest comprehensive universities in Europe, having 35,000 students, over 5,000 staff members, a yearly number of 400 doctorates and a budget of 600 million Euros (figures of 2011/2012).

The University of Amsterdam seeks to offer an inspiring international academic environment in which both staff and students can develop their talents. Characterised by a critical, creative and international atmosphere, the University wants to maintain a tradition of open-mindedness and engagement with social issues, in keeping with the spirit of the city with which it is linked.

Within each of the Faculties, teaching and research take place in separate institutes. The University of Amsterdam strives for international prominence as a research university, aiming to maintain and strengthen the University's reputation in both fundamental and socially relevant research. The University's doctoral programmes are meant to provide a foundation for engaging in high-quality teaching and research.

3.3 Intended learning outcomes

The intended learning outcomes of the Master Software Engineering programme, have been divided in general learning outcomes and specific learning outcomes.

General learning outcomes. The graduates:

- Have insight in the most important theories, methods and techniques in the domain of software engineering and have sufficient background to familiarize themselves with new methods and techniques.
- Can apply this insight to find innovative solutions for existing and new problems, while applying theories in the right way in practice. They can analyze and solve domain-specific problems as well as general software engineering problems.
- Can make a valuable contribution to complex software projects that require the independent and critical application of academic knowledge and skills.
- Have sufficient technical knowledge and intellectual capacities to play, after some years of practical experience, a managerial or advisory role in the software engineering profession.
- Can formulate a vision regarding software engineering and can contribute to the evolution, innovation and policy development needed for software systems.
- Can solve software engineering problems using abstraction and modeling, and can create solutions that take their societal context into consideration, even if only partial information is available.
- Can clearly report on their findings, both orally and in writing, and can explain problems at the right level of abstraction.
- Can act well in multi-disciplinary teams.

- Have research skills at the academic level and can autonomously perform research in the domain of software engineering.
- Can understand the experiences of others and can reflect on their own accomplishments and can, therefore, continuously develop themselves.
- Have the skills to explore (search, read, assess) the many forms, both regarding contents and medium, of documentation and literature in the domain of software engineering.

Specific learning outcomes. The graduates:

- Master the methods and techniques needed to analyze an existing software system and to enable it to evolve, given changing requirements (Software Evolution).
- Can produce formal specifications of modest-sized samples of software and are able to use formal specifications to generate relevant tests for them (Software Specification and Testing).
- Know how to employ model-driven and language-driven approaches in software construction. The graduates are, also, able to reason about and reflect upon aspects of design, code quality, and software construction methods (Software Construction).
- Can translate system requirements into a software architecture, handle trade-offs between conflicting requirements, motivate choices made, and assess an architecture document for different stakeholders, having different priorities (Software Architecture).
- Understand why users needs are so hard to express, capture and understand. The graduates know the shortcomings of best practices like product owner, prototyping, interviewing and use cases. The graduates have had a first experience with data-driven methods for requirements engineering like Contextual Design (Requirements Engineering).
- Understand why big software engineering projects are prone to failure. The graduates have insight in how performance is influenced at different levels: that of the individual software engineer, the team and the whole organization. The graduates are able to understand why a method like RUP or Scrum is sometimes successful and sometimes not and how to adapt a method based on a situational analysis (Software Process).

3.4 Outline of the curriculum

In the table below the courses in the curriculum are presented .

Software Architecture	6.0 EC
Software Testing	6.0 EC
Software Evolution	6.0 EC
Requirements Engineering	6.0 EC
Software Construction	6.0 EC
Preparation Master Project Software Engineering	6.0 EC
Software Process	6.0 EC
Master Project Software Engineering	18.0 EC
Total credits for curriculum	60.0 EC

4. Overview of the assessments

The programme management offers a full-time programme as well as a part-time programme. These programmes are essentially the same and only differ in scheduling and duration.

Standard	Assessment
Standard 1. Intended learning outcomes	Good
Standard 2: Teaching-learning environment	Good
Standard 3: Assessment and achieved learning outcomes	Good
Programme as a whole	Good

5. Findings, considerations and assessments per standard

5.1 Standard 1: Intended learning outcomes

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

Findings
The programme's objectives are to teach students to become software engineers at a master's level, to be able to understand and conduct scientific research in this field, to have appropriate technical skills in the software engineering domain and to understand and address the human factor in software engineering projects. Particularly, the programme management wants the students to be able to make appropriate decisions, to reflect on the approaches chosen and to critically assess assumptions and ideas on which the software engineering processes rest. The programme management stresses the graduates' ability to adopt scientific methods to address software engineering problems.

The intended learning outcomes which the programme management has drafted and which have been listed in paragraph 3.3 of this report reflect the objectives of the programme. The learning outcomes, having been divided in general learning outcomes and specific learning outcomes, encompass scientific knowledge and research skills (e.g. G1 and G9), professional abilities, to be able to play a managerial or advisory role in the software engineering profession and to address software engineering problems (e.g. G2 – G6), technical skills, encompassing being able to analyze software systems, to produce formal specifications and to translate system requirements into a software architecture (e.g. G1, G2, G4, G6, S1 – S6) and soft skills, comprising communications skills, coping with uncertainty and working in multidisciplinary teams (e.g. G5 – G9).

The learning outcomes of the programme meet the requirements of the Software Engineering Body of Knowledge (SWEBOK). SWEBOK is an internationally accepted framework which specifies the knowledge an experienced software engineer ought to have. The programme management has drafted a number of tables in which the relations between the SWEBOK requirements and the learning outcomes have been indicated. From these tables can be derived that the SWEBOK requirements are all met in the programme's learning outcomes. In the intended learning outcomes, special emphasis has been put on some of the SWEBOK items, like software construction, software maintenance and software quality.

The programme management has drafted a table comparing the intended learning outcomes to the Dublin-descriptors. From this table can be derived that the learning outcomes meet the Dublin-descriptors and, therefore, meet the master's level.

The programme management has compared the programme to a number of other master degree programmes, in the Netherlands as well as abroad. A substantial number of universities in Europe and worldwide offer dedicated software engineering programmes. This University of Amsterdam programme distinguishes itself from other programmes in addressing both theory and practice and both technology and the human factor.

The programme was designed in 2003. In this period of ten years, the programme management has made serious efforts to keep the intended learning outcomes up-to-date, meeting the state of the art of the field. So, the intended learning outcomes match the most recent release of SWEBOK and, also, meet the most recent ACM Computing Science Curriculum requirements.

Considerations
The panel considers the programme's objectives to be relevant for a master's programme in the software engineering field. The objectives include the professional knowledge and skills which are required, emphasize the scientific and research knowledge and skills and address the soft skills which are relevant for the professional practice. For the panel, these are important requirements for a master software engineering programme. The panel is positive about the importance which the programme management has attached to the scientific knowledge and skills. As the graduates of the programme are to gain scientific knowledge and skills, they will be able to address software engineering problems in a scientific way and, thereby, to contribute to the success of software engineering projects.

The panel regards the learning outcomes to be appropriate representations of the programme's objectives. The learning outcomes are rather focused, addressing specific scientific and professional knowledge and skills. The panel has, however, verified the learning outcomes to cover the software engineering domain adequately and in a sufficiently complete way. For the panel, the professional knowledge and skills the graduates are to master, are comprehensive, including both technical skills and soft skills and are in line with the requirements of the professional practice. In the intended learning outcomes, so the panel has observed, scientific knowledge and skills like demonstrating a critical attitude and dealing with uncertainties in software processes testify to the academic master's level of the programme. From the comparison of the intended learning outcomes to the Dublin-descriptors the panel has been able to deduce that all of the Dublin-descriptors are represented in the learning outcomes. The panel considers the learning outcomes to comply fully with the requirements of a master's level programme.

As the intended learning outcomes meet the SWEBOK framework, these outcomes are, in the opinion of the panel, perfectly in line with the international requirements in the software engineering field. The panel was pleased to hear the learning outcomes match the most recent ACM Computing Science Curriculum as well. For the panel, this testifies to the learning outcomes being in line with the current developments in the software engineering domain.

In the comparison the programme management has made to other programmes in the Netherlands and abroad, the specific features of this programme become evident. The panel finds the profile of the programme, addressing both theory and practice and both technology and the human factor interesting and very useful in the professional field.

For the input of the representatives of the professional field with regard to the learning outcomes, please refer to standard 2, below.

Assessment of this standard
These considerations have led the assessment panel to rate the standard 1 *Intended learning outcomes* as good.

5.2 Standard 2: Teaching-learning environment

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

Findings
The number of students enrolled in the programme were 26 students in 2009, 22 students in 2010, 51 students in 2011 and 57 students in 2012. The number of students applying is much larger, from 126 students in 2009, 66 in 2010, 127 in 2011 and 286 in 2012. The programme management adopts a fairly strict admission procedure. As has been indicated in chapter 2, above, the number of full-time students is comparable to the number of part-time students, the number of full-time students being about 60 % of the total intake and the number of part-time students being about 40 %. A number of students come from abroad.

The students applying for the programme have to go through an intake procedure, to check whether they meet the entry requirements. The students who want to enter the programme are to have substantial knowledge and skills regarding computer programming as well as language and writing skills. The latter requirement has been introduced, because in previous years the level of required reading in the courses and the academic level of the master's thesis have been raised markedly. The candidates are to submit a personal dossier, including their diploma and a letter of motivation. The admission procedure consists of a written assessment and an extensive face-to-face interview. In case the student is abroad, this interview will be conducted via Skype. In the course of the admission procedure, the programme management stresses the challenging nature of the programme, in order to prevent students entering the programme with too optimistic views about completing the programme. The students with whom the panel has met, have confirmed having been appropriately informed about the study load of the programme. Students having a bachelor degree in Computer Science of a Dutch university are admitted directly. Even then, however, some of these students have been advised not to apply, because they were considered not to be able to complete the programme. For students who come from abroad, the international office of the Faculty checks the level of their bachelor diploma. In most cases, students who have a hbo-diploma have to take a number of pre-master courses. The number of courses they are to take, ranges from three to seven and address topics like mathematics, logic, data structures and designing computer programmes. On top of the entry requirements, the part-time students need to make enough time available to take the courses and to complete the master project.

The programme is offered in a full-time study mode as well as in a part-time study mode. These study modes are offered to accommodate various groups of students. The part-time programme, especially, is meant to meet the demands of students who intend to combine their studies with a job. The contents of the curriculum for the full-time students and the part-time students are the same. Only the schedules differ. The schedules are as follows:

- The full-time students have a schedule of 12 months which is divided in two semesters. These semesters are made up of three blocks each, the first two blocks of eight weeks per block and the third block taking four weeks. The full-time students take two courses of 6 EC each per block in the first semester. Starting in the first semester and extending into the second semester, the students do their preparation for the master project of 6 EC. In the second semester they take two courses and they do their master project (18 EC).

- The part-time students have a schedule of two years. These students take one course of 6 EC per block instead of two courses. The students have to do their master project partly, for at least eight weeks full-time. In the part-time study mode the students may choose for either a one-day per week schedule or for a two day per week schedule. In the one-day schedule they attend classes one day per week and have to spend about 12 hours per week of self-study. In the two-day schedule the students attend classes two days per week, the number of self-study hours being about 4 hours per week. The programme management considers the part-time programme to be, especially, challenging and recommends the students to opt for the two-day schedule, the one-day schedule being very hard to sustain, next to a job.

From a table, drafted by the programme management, may be deduced the intended learning outcomes are all covered by the programme components. As has been indicated in paragraph 3.4, above, the curriculum consists of six courses and the master project, which is preceded by the preparation master project. Three of the courses (Software Specification and Testing, Software Evolution and Software Construction) focus on formal and technical aspects of software engineering, whereas the other three courses address human and organizational aspects (Software Architecture, Requirements Engineering and Software Process). In their master project the students are required to address either a business or an academic research problem. In the preparation master project, the students have to produce a problem statement for their project. In the courses the process of iteration, quite important in software processes, is addressed. In the courses, the students have to write papers or have to do assignments which have open-ended questions and strict time-slots. This way, they learn how to handle situations of uncertainty and how to focus on important issues.

Over the years, the programme management has carried out a number of improvements in the courses. These measures have, mainly, strengthened the formal and theoretical focus of the courses. From 2013/2014 onwards, the programme management intends to add a specialization to the programme, covering the subject matter of technical software systems development. With this specialization the programme management wants to offer a master software engineering programme for students who have a technical profile.

The sequence in which the courses are offered, is consciously chosen. The curriculum starts with courses like Software Specification and Software Architecture, giving the students the opportunity to acquire more in-depth knowledge about logic. At the end of the curriculum, courses like Software Construction and Software Process are offered, in which various aspects are brought together and are integrated. The students are required to take the courses in the prescribed order, as courses require knowledge and skills from specific other courses.

The students are exposed to the professional practice. The programme management and lecturers are in touch with the professional field during the master projects, since a substantial number of these projects is business-related. In a number of courses, guest lecturers take part. They are requested to address specialized topics as well as to highlight the course contents from the business or professional practice perspective. This way, the students are informed about the practical relevance of the course contents.

The lecturers in the programme are experienced researchers in their field of expertise, holding a professorship or a Ph.D. degree. The lecturers divide their time between lecturing and research, in most cases on an equal basis. Periodically, the lecturers have a meeting with the research director to assess their achievements. Their teaching results are part of this assessment and are input for their chances of being promoted within the organisation. Although the number of lecturers having a BKO is 25 % at present, the programme management plans to raise this percentage to 90 % in 2014. The actual low percentage is, partly, due to the fact that three lecturers are very experienced and do not have to complete the BKO. The results of the lecturers in the student evaluations range from 7.0 to 8.0.

The number of incoming students has risen from about 25 students in previous years to about 50 students in the last two years. This increase has led to a markedly higher work load for the lecturers. As the lecturers are very experienced in the programme, they are very efficient in their teaching, being able to handle a very substantial work load. On the other hand, some of the core lecturers will end their teaching in the coming years.

The educational model of the programme implies self-directed learning by the students, complemented with frequent and intense feedback by the lecturers on the students' progress. The study methods include lectures (to acquire theoretical insights), tutorials or lab sessions (to put the theory into practice and to work on the papers and the assignments) and paper sessions (addressing academic skills like reading strategies, writing, selecting literature and designing research). In a number of assignments, the students learn how to work in teams. The groups are composed in the first course by the programme management in order to promote the effectiveness of the groups.

The study load for the students in the programme is substantial. In general, the students spend more than 40 hours per week studying. For the part-time students the programme is, especially hard to complete. In three of the courses, the best students are invited to take advanced tracks which give these students the chance to achieve an even higher level of knowledge and skills.

The lecturers tend to have very frequent meetings with the students, as a group as well as on a one-to-one basis. These contacts take part during the courses as well as in the supervision of the master project. The supervision in the master project is scheduled to be ½ hour per week. Taking an estimated six months for this project, the supervision is about 12 to 13 hours per student. The students with whom the panel has spoken, have expressed to be very content with the guidance and supervision by the lecturers.

The students are informed about the programme by means of e-mail and blackboard. Additional information may be obtained by the students at the Education Service Center of the Faculty. During the paper sessions the lecturers discuss the study progress with the students. The students may turn to the student advisor for advice on the study programme and in case of any study problems.

The programme is located at the Science Park campus where all the Faculty of Science teaching and learning activities are located. The campus has classrooms, larger lecture rooms, computer rooms, rooms for self-study and a library. The staff and students do not have their own, designated space within the campus buildings.

The programme management takes care of evaluating the courses by means of formal, written surveys and by means of informal meetings between students and staff. The evaluation results have improved over the years.

Considerations
The panel considers the entry requirements for the programme to be relevant and the admission process to be conducted in a responsible manner, only admitting the students who have a fair chance of completing the programme. The pre-master programme for students with a hbo-bachelor diploma is fit-for-purpose and gives these students the chance to start the programme at the required level. The panel finds the students are well-informed about the challenging nature of the programme. The study modes (full-time and part-time), which are offered, give different student groups of students the opportunity to complete this programme.

The panel has verified that all the intended learning outcomes have been covered in the programme. The courses of the curriculum address the knowledge and skills which are required to achieve these learning outcomes. The panel has studied the components of the curriculum and has verified the curriculum to achieve the international requirements of SWEBOK and the ACM Computing Science Curriculum. The course contents, definitely, are at an academic master's level, the literature used being in line with this level. The panel considers the courses in this one-year programme to have been very well chosen.

The structure of the curriculum is satisfactory in the opinion of the panel, indicating a clear and logical study path for the students. The panel advises the programme management to consider introducing electives in the programme in order to allow for some degree of specialization for the students.

The panel feels the programme management is very active in improving the curriculum and in keeping the course contents up-to-date. The new specialization, intended to be offered from 2013/2014 onwards, is a good example of the programme management's efforts to incorporate new developments.

The panel regards the professional practice to be satisfactorily represented in the curriculum but advises to install an advisory board of representatives of the professional field. This advisory board may inform the programme management first-hand about current developments in the professional field.

The panel has a high esteem for the lecturers in the programme. Their expertise and educational abilities meet the requirements. The panel was, especially, impressed by the drive and the motivation of the teaching staff to foster the learning processes of the students. Regarding the percentage of BKO-lecturers, the panel advises the programme management to follow the plan to attain 90% BKO-lecturers in 2014.

The panel has some concerns about the continuity of the programme. As the number of incoming students tends to increase, the work load of the lecturers will undoubtedly rise further. Since the student-teacher ratio is already rather high (nearly 29.0) and as some of the lecturers may leave the programme in the coming years, the panel recommends to take measures to maintain and, preferably, to raise the number of qualified lecturers in the programme.

The panel is very positive about the educational model of the programme and the study methods derived from this model. The students are offered the opportunity to acquire knowledge and skills at a very high pace in an intense learning environment. The learning curves of the students, generally, proves to be very steep.

The programme is challenging for the students, who regularly spend more than 40 hours per week. For the part-time students the programme is even more demanding. The panel is convinced the efforts of the programme management are directed towards keeping the study load manageable. The study guidance and supervision which are both very intense, play a prominent role in this respect. The role of the student advisor is important, especially in case of study problems.

The panel regards the housing and the material facilities to be, generally, appropriate for the programme. To further foster the learning processes of the students, the panel recommends to find a designated space on the Faculty of Science campus to house the programme.

The panel is positive about the formal and informal evaluation mechanisms the programme management has put in place.

Assessment of this standard
These considerations have led the assessment panel to assess the standard 2 *Teaching-learning environment* to be good.

5.3 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.

Findings
At the end of 2010, the University of Amsterdam drafted an assessment policy document for all of the university's programmes and courses. The programme management is committed to comply with the university's policy. The programme's teaching and examination regulations (OER) include the required regulations. The programme's board of examiners is responsible for the quality and the level of the examinations and for safeguarding the learning outcomes the graduates of the programme will have achieved. A representative of the board of examiners is present at all of the master thesis defenses to assess the quality and level of the master projects. With regard to the examinations, the board of examiners is in the process of implementing measures to monitor the quality thereof.

The examinations the students are to complete, are drafted by one of the lecturers and are peer-reviewed by one of the other lecturers. The examinations are assessed by the lecturer who is in charge of the course to which the examinations refer.

In each of the courses, the results of the students are assessed by means of a number of different examinations, like assignments, essays, papers and written examinations. The students have to complete about 50 examinations in the whole of the curriculum. Some of the assignments, papers and essays are the result of group efforts. In any one of the courses, there is always an individual examination to prevent students to succeed solely on the basis of the results of group work. While working on their assignments, the students receive very frequent feedback on the preliminary or intermediate drafts of these assignments. The students are to present these drafts at the scheduled date. This feedback which is taken very seriously by the lecturers, tends to accelerate the learning processes of the students.

For their master project, the students may either study a business problem or address a research topic. Every year the programme management organizes a thesis fair in which representatives of businesses and students meet to discuss thesis subjects. After the students have selected their subject, they are to present a project planning. In the preparation master project course the students have to formulate a research question. During the master project which is an individual project, the students are entitled to a number of supervision hours (please refer to standard 2). The master thesis is assessed, using a standardized set of assessment criteria. These criteria are derived from the standards of scientific research. The students defend their master thesis before an examination committee, consisting of three to four examiners, including the master project supervisor. Every one of the examiners gives a grade, leading to an overall grade for the thesis.

As has been put forward in standard 2, above, the requirements for the master theses have been raised substantially the last six to seven years. As a consequence, a number of students have difficulty in completing the master project. Most of the students who fail to complete the programme, do so during the master project. This is one of the main reasons for a less favourable success rate. The programme management intends to take measures, such as not scheduling any courses in parallel with the master project.

In the last few years, since 2008, about seven theses have led to a publication. About all of the graduates have, quite easily, obtained a job in the software engineering field. Some seven graduates have chosen to pursue a Ph.D. trajectory. The results of the survey among the programme's graduates concerning the quality of the programme and the way in which they have been prepared for the job market, is, generally, very positive.

Considerations
The panel regards the assessment policy of the programme to be appropriate, the regulations being in line with the university's policy. The panel has observed the programme's board of examiners is still in the process of implementing measures to fully ensure examinations quality control. The panel suggests the board of examiners no longer to participate directly in the assessment of the master project but to take on a more supervisory role with regard to this assessment.

The panel considers the examination forms the programme management has chosen to be valid methods to test the students' results. The knowledge and skills the students are to have acquired, may be appropriately tested by means of the papers, essays, written examinations and assignments the students are to complete. The panel has studied the examinations and has found these to be of a good quality and level and to meet the learning objectives of the courses. The panel is convinced the feedback on the draft assignments fosters the learning processes of the students.

The panel regards the master project process to be perfectly adequate with very frequent meetings of the student and the supervisor. The assessment of the theses is appropriate as well. The assessment criteria are very relevant and the examination committee with three to four examiners ensures a reliable assessment.

The panel has studied the master theses. The quality of these theses and the level the graduates have reached, are definitely more than just satisfactory. The contents of the theses are relevant for the software engineering field, the scientific structure and quality are up to standard and the level of complexity more than meets the requirements.

The panel feels the learning processes of the students are very effective and the learning curves tend to be steep. Therefore, the students achieve a relatively high level of relevant knowledge and appropriate skills in this one-year programme.

Assessment of this standard
The considerations have led the assessment panel to assess standard 3 *Assessment and achieved learning outcomes* to be good.

Annex 1: Schedule of site visit

Amsterdam, 18 June 2013

08.30 h. – 09.30 h.	Arrival and deliberations panel (closed session)
09.30 h. – 10.00 h.	Senior management J. Meerburg LL.M. (director Education, Faculty of Science), A. Pimentel Ph.D. (director Graduate School of Informatics), prof. P. Klint Ph.D. (director Master Software Engineering)
10.00 h. – 11.20 h.	Programme management prof. P. Klint Ph.D. (director Master Software Engineering), H.L. Dekkers MSc (lecturer), J.J. Vinju Ph.D. (lecturer)
11.30 h. – 12.15 h.	Board of examiners I. Bethke Ph.D. (chair, unable to attend), H. Dekkers MSc (member), R. Kellermann Deibel MSc (student advisor)
12.15 h. – 13.30 h.	Lunch, deliberations panel and documents review (closed session), including open office hours 12.15 h. – 12.45 h. and a visit to the programme's teaching facilities
13.30 h. – 14.30 h.	Lecturers, including member of educational committee prof. D.J.N. van Eijck Ph.D.(lecturer), prof. P. Klint Ph.D. (lecturer), T. van der Storm Ph.D. (lecturer), J.J. Vinju Ph.D. (lecturer), prof. H. van Vliet Ph.D. (lecturer), J. van Ginkel (member educational committee), H.L. Dekkers MSc (lecturer)
14.30 h. – 15.30 h.	Students and alumni, including member of educational committee I. van Dongen MSc (alumnus), D. Landman MSc (alumnus), S. Plug BSc (student, member educational committee), K. van der Vlist BSc (student), C. Aytekin BSc (student), W. Kwakernaak BSc (student)
15.30 h. – 17.15 h.	Deliberations panel and documents review (closed session)
17.15 h. – 17.45 h.	Presentation of main findings by panel's chair to programme management

Annex 2: Documents reviewed

The assessment panel has studied the following documents, presented prior to the site visit:

- Critical reflection of Master's programme Software Engineering
- Realization of the learning outcomes
- Education and Examination Regulations (OER)
- Software Engineering in Part Time
- Follow-up on remarks in previous visitation
- Detailed numbers for study success
- List of recent master's theses
- Example thesis evaluation form
- Intake form and questionnaire
- Pre-master programme
- Former staff
- Results of alumni questionnaire
- Keuzegids
- Elsevier Hoger Onderwijs enquête 2012
- Report WO Monitor University of Amsterdam graduates 2007/2008 and 2009/2010

On the day of the site visit, the programme management presented the following documents:

- Study guide
- Course descriptions
- Course material
- Assignments
- Literature
- Examinations and assessments
- Curricula vitae of lecturers
- List of guest lecturers
- Course evaluations
- Alumni survey
- Board of examiners documentation
- Educational committee documentation
- University of Amsterdam and Faculty of Science Policy documents

Annex 3: Theses reviewed

The theses of the following full-time students have been selected for review by the panel:

- 10185712
- 10255222
- 10231722
- 10256601
- 10199306
- 10232567
- 5619440
- 10168591
- 10003135
- 5790832
- 0242047
- 6137172
- 10072608
- 6190677
- 6024998

The theses of the following part-time students have been selected for review by the panel:

- 10124446
- 6019110
- 10120971
- 6193013
- 5841747
- 5939399
- 6135617
- 0305979
- 6061990
- 0010790
- 5973732
- 5892783
- 5910404
- 5963680
- 5953928

Annex 4: Composition of the assessment panel

The assessment panel had the following composition:

- Prof. A. van Deursen Ph.D., panel chair, professor of Software Engineering and head of the Software Engineering Research group of Delft University of Technology;
- prof. T. Mens Ph.D., panel member, professor of Software Engineering and head of the Software Engineering Lab at Université de Mons, Belgium;
- Prof. R. van Solingen Ph.D., panel member, professor of Computer Science at Delft University of Technology and chief technical officer at Prowareness;
- Y. Oualhadj, student member, studying the master programme Dutch Language and Culture at Leiden University.

Prof. A. van Deursen Ph.D., panel chair
Currently being a full professor of Software Engineering at Delft University of Technology, Mr Van Deursen has been a professor in this field since 2004. He is, among other positions, a member of the Jacquard software engineering research programme of NWO, a member of the Dutch Computer Science Chamber and a board member of the Institute for Programming research and Algorithms. Mr Van Deursen is active in numerous international conferences, is a member of the editorial board of a number of high-ranking journals and has published widely.

Prof. T. Mens Ph.D., panel member
Mr Mens, currently, is a full professor of Software Engineering at Université de Mons, Belgium. He started as a lecturer at Université de Mons in 2003 and became a full professor in 2008. His main research interest lies in the underlying foundations, and support tools for, developing and evolving software. He has been a co-organiser and programme committee member of numerous international conferences. He, also, is the founder and director of the ERCIM Working Group on Software Evolution. Mr Mens has published numerous articles in important journals.

Prof. R. van Solingen Ph.D., panel member
Mr Van Solingen is a professor of Computer Science at Delft University of Technology and chief technical officer at Prowareness. Previously, he worked as a principal consultant software engineering and as a competence development manager for the IT service company LogicaCMG. He, also, was employed as the chief technology officer of Mavim. His main research interest lies in the improvement of software and system development processes, especially for geographically dispersed development teams.

Y. Oualhadj, student member
Mr Oualhadj is studying the master programme Dutch Language and Culture at Leiden University since 2011. Previously, he studied Public Administration/Public Management at Haagse Hogeschool. He was the founder and chairman of the Student Union of The Hague. Also, he was a policy advisor and a member of the board of the Landelijke Studenten Vakbond. Mr Oualhadj is a trainer and discussion leader on a free-lance basis.

Annex 5: Declarations of independence