

Assessment report  
Limited Programme Assessment

**Master System and Network Engineering**

University of Amsterdam

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## 1. Executive summary

In this executive summary, the panel presents the main considerations with respect to the assessment of the quality of the Master System and Network 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).

As the panel has observed, 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, academic and research skills (dealing with uncertainties, presentation of data and drafting hypotheses) have been given a more prominent place in the curriculum, supervision during the research projects has been intensified and independent work and reflection have been given more weight in the research project's assessment.

The panel considers the programme's objectives to be relevant for a master's programme in the system and network engineering field. The learning outcomes are appropriate representations of the programme's objectives, addressing the general requirements for the programme as a whole as well as the specific requirements for the two specializations, Networking and Forensics. In the learning outcomes domain-specific knowledge and understanding, knowing how to apply these to problems in professional practice, are addressed, as well as general academic skills and research skills and the interdisciplinary nature of the programme. As two minor points, the panel recommends to address the ethical, societal and social aspects more strongly and to give the business organization aspects a more prominent place. The learning outcomes are aligned with Dutch and international external frameworks and with the business requirements. The programme management, adequately, keeps the learning outcomes up-to-date. The learning outcomes comply fully with the requirements of a master's level programme. The programme has a clear profile in addressing Open Technology and in emphasizing security subjects. With respect to Open Technology, the panel considers the programme to occupy a unique place in the world. The panel recommends to consider changing the name of one of the two specializations from Forensics to Security, because the latter name matches the contents of this specialization, being broader than the subject of forensics alone.

The entry requirements for the programme are relevant and the admission process is conducted in a very effective way. Also, 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 advises to keep the student number at a maximum of 40, because admitting more students may hamper the effect of the educational model, thereby depriving the programme of one of its most distinctive features.

All the intended learning outcomes have been covered in the programme, the courses addressing the domain-specific knowledge and skills, general academic skills and academic research skills. The panel is enthusiastic about the build-up of the courses, theory and practice being closely related. The panel recommends to give the colloquia a more formal place in the curriculum and to award credits for these. The structure of the curriculum is coherent, the students being taught and trained the core of this field. The programme management is very active in keeping the course contents up-to-date, incorporating new technological developments and the research outcomes. The professional practice is strongly represented in the curriculum and the resonance group ensures the programme management to be in touch with the professional field.

The panel has a high regard for the lecturers in the programme. Their expertise and educational abilities meet the requirements and their research orientation is strong. The teaching staff is focused on enhancing the effect of the learning processes. The panel advises to attain 90% BKO-lecturers in 2014.

The educational model of the programme and the study methods are excellent and one of the main factors for the programme's success. Because of the very intensive guidance by the lecturers and the lab teachers, the students acquire knowledge and skills at a very high pace. The programme is challenging for the full-time students, who regularly spend more than 40 hours per week. The part-time students attend classes on three days of the week, which is very challenging as well. The programme management is keeping the study load manageable, by means of intense guidance.

Having visited the programme's lab, the panel considers the facilities to be more than adequate for this technology-oriented programme. The panel is positive about the formal and informal evaluation mechanisms the programme management has put in place.

The panel regards the assessment policy of the programme to be appropriate, the regulations being in line with the university's and the Faculty of Science's policies. As the programme's board of examiners is in the process of implementing measures to regularly review the examinations, the panel recommends to accelerate this process. The examination methods of the programme, assignments, papers and written examinations are valid methods to test the students' results. The panel has found the examinations to be of a good quality and level. The programme management has taken appropriate measures to prevent students from free-riding in case of group assignments. The research projects processes have been thoroughly organized, stressing the academic research contents of the projects. The assessment of projects is organized equally well, the academic examiners as well as the assessment components ensuring a reliable and valid assessment.

The research projects demonstrate creative thinking, a strongly developed scientific structure and a substantial level of complexity. A number of projects have been submitted to scientific journals and have led to scientific publications. The graduates acquire relevant positions in the professional field and, for a programme in this field, a relatively large number of graduates choose to pursue a Ph.D.-trajectory. The success rate of the programme is impressive, about 90% of the students completing the programme within two years.

The panel has assessed two of the standards of the NVAO Assessment Framework to be good and one of the standards as excellent for the Master System and Network Engineering (full-time and part-time) of the University of Amsterdam. As a consequence, the panel advises the NVAO to accredit the Master System and Network Engineering programme (full-time and part-time) of the University of Amsterdam, assessing this programme to be good.

Rotterdam, 11 October 2013

Chair of the assessment panel  
G. Dierick MSc

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 System and Network 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):

- G. Dierick MSc, panel chair, network & security expert at Vlaamse Radio- en Televisieomroep (VRT) and a lecturer at the Katholieke Hogeschool Leuven;
- K.M. Begnum Ph.D., panel member, associate professor at Oslo Akershus University of Applied Sciences;
- O.M. Kolkman MSc, panel member, director of NLnet Labs;
- B. van Os BSc, student member, studying the master's programme Artificial Intelligence at University of Groningen.

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). The programme is offered in a full-time as well as a part-time study mode. As the number of full-time students and part-time students differs substantially, 15 theses of full-time students and 8 theses of part-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 27 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 but the panel received one letter. This letter has been taken into consideration.

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 System and Network Engineering
Orientation and level programme:	Academic Master
Grade:	Master of Science
Number of credits:	60 EC
Specializations:	Networking Forensics
Location:	Amsterdam
Mode of study:	Full-time and part-time
Registration in CROHO:	60227

*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	2009	2010
All students	75%	79%

Percentage of lecturers with the following qualifications

Qualification	Master's degree	Ph.D.	BKO
Percentage of lecturers	82%	64%	36%

The student-to-staff ratio is 6.77 : 1.

The number of contact hours is 17.65 hours per week for full-time students.

### 3.2 Main facts about the institution

The Master System and Network 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, Medicine 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 System and Network Engineering programme, have been divided in general learning outcomes and specific, specialization-dependent learning outcomes.

General learning outcomes. Graduates should:

- Have insight in the most important technological developments and related scientific results in the field of system and network engineering (G1).
- In the interest of the innovation and modernization of systems and networks, have the capacity to apply this insight (G2).
- Have participated in active scientific research such as are being performed in the Informatics Institute of the University of Amsterdam or in comparable research groups (G3).
- Have the capacity to address system and network engineering problems using abstraction and model formation, and be capable of formulating solutions in general, mathematical and technical terms (G4).
- Have the capacity to communicate clearly, both orally and in writing and be skilled in giving presentations to groups and know how to explain problems and solutions at the appropriate level of abstraction (G5).
- Be able to function well in teams and be capable of discussing technical topics in both small and large groups, and be well equipped to distribute and co-ordinate technical tasks among group members (G6).
- Be aware of the societal, ethical and social aspects of system and network engineering (G7).

- Be skilled in exploring (searching, reading and evaluating) the many forms of documentation and literature concerning system and network engineering, with regard to both content and medium and be familiar with the Internet Society (ISOC), the World Wide Web Consortium (W3C), the Institute of Electrical and Electronics Engineers (IEEE) and other international bodies that develop and publish in the area of computer systems and networks (G8).
- Be highly familiar with the usual configurations and procedures for the regular and crisis administration of a variety of current systems and networks, middleware and applications (G9).
- Have knowledge about methods and principles of systems based on Open Technology, which consists of Open Standards, Open Software (including Open Source) and Open Security and be able to apply this knowledge in existing, complex environments and to integrate Open Technology with (partly) proprietary solutions (G10).
- Be highly familiar with the security functions of systems and networks, be capable of contributing actively to the architecture and the configuration of systems and networks that conform to current security standards and be able to determine whether systems or networks conform to particular security standards (G11).

Specific learning outcomes of the Networking specialization. The graduates should:

- Have the technical knowledge of communication protocols, network components and business systems that will need to accurately justify choices and steps relating to administration and security, including those regarding configuration, procedures and security architecture (SN1).
- Have a good understanding of the world of Internet Service Providers and routing issues in local networks and the global Internet (SN2).
- Have sufficient insight into the organizational contexts within systems and networks functions, to channel the needs of organizations and users, and to translate them into appropriate technical support (SN3).
- Have sufficient technical knowledge and intellectual capacity to assume positions of leadership in the field of system and network engineering within a few years, and have the capacity to develop their own vision of the field of system and network engineering, thus contributing to evolution and innovation in concrete system environments (SN4).

Specific learning outcomes of the Forensics specialization. The graduates should:

- Understand methods for gathering digital traces from a computer system and have the knowledge to assure that information is suited for forensics analysis (SF1).
- Have the knowledge and capabilities to build systems supporting the forensic investigation process with tools enhancing the human capacity to perceive, understand and reason about complex and dynamic data and situations (SF2).
- Be able to understand and develop the tools and techniques for analyzing and fighting cybercrime.
- Be able to gather and manage the computational resources required to analyze large amounts of complex, dynamic, and distributed data (SF3).
- Understand the relation between forensic processes and cybercrime on the one hand and the security and vulnerability of systems on the other hand (SF4).

### 3.4 Outline of the curriculum

In the table below the courses in the curriculum are presented. The students may either choose for the Networking specialization or for the Forensics specialization. The differences between the specializations consist of two courses.

Essential Skills	6.0 EC
Classical Internet Applications	6.0 EC
Security of Systems and Networks	6.0 EC
Distributed Internet Applications	6.0 EC
Research Project 1	6.0 EC
Large Installation Administration	6.0 EC
InterNetworking and Routing (Networking) or CyberCrime and Forensics (Forensics)	6.0 EC
Offensive Technologies	6.0 EC
Advanced Networking (Networking) or Visual Analytics (Forensics)	6.0 EC
Research Project 2	6.0 EC
Colloquia	0.0 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	Excellent
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 management has listed the objectives of the programme. These objectives are, among other, to know on an abstract level the operations of computers and networks, to be able to implement system and network configurations, using the abstract knowledge acquired, to be able to evaluate innovative technologies, to become acquainted with research methods in the system and network domain, to know Open Technology, comparing this to proprietary technology, to be able to address and solve security issues and to be familiar with ethical and juridical aspects of the domain.

The intended learning outcomes which the programme management has drafted and which have been listed in paragraph 3.3 of this report reflect the programme's objectives. The learning outcomes, having been divided in general learning outcomes and learning outcomes for each of the two specializations which are offered (Networking and Forensics), encompass a number of areas, being:

- Domain-specific knowledge of the main technological developments in system and network engineering, of important scientific results in this domain and of the innovations in this domain (G1, G2, SN1, SN4, SF1, SF2).
- Knowledge about Open Technology and about security issues are separately specified. The graduates are to have in-depth knowledge of these two areas and are to be able to address subjects and problems in the professional practice (G10, G11).
- Professional abilities, being able to apply the knowledge which has been acquired to address and to solve real-world system and network engineering problems. As the programme has a rather strong vocational focus, the graduates are to be able to handle real-world situations, adopting the theoretical knowledge and understanding they have gained (G4, G8, G9, SN2, SN3, SF3, SF4, SF5).
- General academic skills such as being able to communicate, orally and in writing, and to be able to work in teams and to distribute and co-ordinate technical tasks among team members. Graduates are to be able to explain problems and solutions at the appropriate level of abstraction (G5, G6).
- Research skills are considered to be essential for the graduates working in this domain. Research in the professional practice where the majority of the graduates will work, is not considered to involve creating any new knowledge but to imply to acquire skills regarding scientific methods (G3).
- Graduates are to be aware of ethical, societal and social aspects of system and network engineering (G6).

The intended learning outcomes encompass the graduates being able to address problems from an interdisciplinary perspective, interdisciplinary meaning bringing together knowledge and understanding of system engineering, network engineering, security engineering and business organization (the organizational embedding of system and network administration procedures).

The intended learning outcomes have been matched to a number of external frameworks. Firstly, the programme's objectives match the domain-specific framework, which draws upon the Dutch Research Agenda of the Royal Netherlands Academy of Arts (Dutch abbreviation: KNAW) for this domain. This institution has listed a number of research questions concerning the system and network domain, to be addressed in the coming years. Internationally, the programme's learning outcomes have been derived from the job descriptions, initially drafted by the System Administrators Guild (SAGE). Thirdly, the learning outcomes reflect the needs of the professional field. Representatives of businesses and organizations, assembled in the programme's resonance group, advise the programme management about the learning outcomes.

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. Each of the Dublin-descriptors is covered by more than one course in the programme.

In the Netherlands, there are no comparable master's programmes. The programme management has compared the programme to one specific programme abroad, being the master's programme Network and System Administration of Oslo University College. Although the programme in Norway is a two-year programme and topics may, therefore, be addressed more in-depth, the two programmes cover the same subjects. Distinctive about the Amsterdam programme as compared to the Oslo programme and to the programme of Rochester Institute of Technology in New York, is the focus on Open Technology. Also, the programme in Amsterdam emphasizes security issues.

### *Considerations*

The panel considers the programme's objectives to be relevant for a master's programme in the system and network engineering field. The objectives include in-depth knowledge of topics in the system and network engineering domain and the skills to address real-world problems. In the objectives the graduates' abilities to evaluate innovative technologies are stressed. The panel has observed the objectives to include academic research skills.

The panel regards the learning outcomes to be appropriate representations of the programme's objectives. For the panel, the learning outcomes cover the systems and network engineering domain adequately and comprehensively. Knowledge on an abstract level, adopting knowledge and understanding to problems in the professional practice and evaluating innovative technologies, are all addressed. The general academic skills as well as the research skills are covered appropriately. As two minor points, the panel recommends to address the ethical, societal and social aspects more strongly and to give the business organization aspects a more prominent place.

The panel is convinced the intended learning outcomes are aligned with the Dutch and international external frameworks, which have been drafted to describe the system and network engineering domain. The programme management ensures the learning outcomes to meet the business needs as well. By matching the learning outcomes to these external frameworks and to the requirements of the professional practice, the programme management keeps the learning outcomes up-to-date as well.

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.

From the comparison of the programme to similar programmes abroad the specific features of this programme are evident. The programme covers the subjects of the field, having a clear profile in addressing Open Technology and in emphasizing security subjects. With respect to Open Technology, the panel considers the programme to be special and to occupy a unique place in the world.

The panel recommends to consider changing the name of one of the two specializations from Forensics to Security, because the latter name matches the contents of this specialization, being broader than the subject of forensics alone.

*Assessment of this standard*

These considerations have led the assessment panel to assess 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 21 students in 2009, 19 students in 2010, 21 students in 2011 and 38 students in 2012. The number of students enrolling has risen the last years. Previously, the programme was limited to one group of students but in 2012, the programme management was forced to create two groups on account of the increasing influx. The composition of the group of students has changed as well. In previous years, many students with a HBO bachelor's diploma (HBO: higher vocational education) entered the programme. Now, this group constitutes 40% of the influx. Another 40% has an academic bachelor's degree. About 20% of the students come from abroad. The programme is offered in a full-time and a part-time study mode. Most of the students opt for the full-time study mode. Only a few of the students study part-time.

Students who want to enter the programme are to have a bachelor's degree in Computer Science or a closely related field from a Dutch university. Foreign applicants are to have a similar bachelor's degree and have to demonstrate a satisfactory command of the English language. Applicants having a HBO-diploma in Informatics or in a closely related field, may enter the programme, only if they complete a number of tests with regard to general scientific skills (analytical skills, writing skills, verbal skills) and technical skills (elementary knowledge of Unix or Linux, TCP/IP and shell scripting). Also, the programme management conducts an interview, in which the intrinsic motivation of the applicant is checked. As the programme is exceptionally demanding, the intrinsic motivation is a very important predictor for the study success. The applicants are informed about the challenging nature of the programme.

The contents of the curriculum for the full-time and 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 into 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. The courses are the same for every student, irrespective of their specialization. In the last block, they do their first research project. In the second semester the students choose two courses which differ and are specialization-specific. Two courses are the same for all of the students. In the last block, they do their second research project. All the students are required to attend colloquia, half a day per week. The students do not obtain credits for the colloquia.
- The part-time students have a schedule of two years. These students take one course of 6 EC per block instead of two courses. They are to attend classes for three days per week. The part-time students take the same courses, do their two research projects and attend the colloquia. The part-time students either choose the first year or the second year for the colloquia.

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 eight courses of 6.0 EC, two research projects of 6.0 EC each and a series of colloquia.

The first course Essential Skills gives an overview of the domain and is, also, meant to bring all of the students at the same level of knowledge and understanding. In the courses, the students acquire domain-specific knowledge and skills, emphasizing the Open Technology and security topics. The courses consist of both lectures and practical lab sessions. In the lectures, the students acquire theoretical knowledge. In the lab sessions, they work on assignments. In the assignments, the interdisciplinary nature of the programme is covered, the students having to consider the subject from different perspectives. In the lab sessions, the students are expected to work together and to help each other. For these assignments, the students have to meet very strict deadlines. They are to give a presentation about their assignments. In this way, they acquire their general academic skills. In the colloquia, the students are taught statistics and research methods and techniques, in this way preparing themselves for the two research projects they are to do. The colloquia and the research projects address the academic research skills. The literature prescribed consists of recent books and articles.

The programme management keeps the curriculum and the course contents up-to-date by adapting these to new developments in the field. The system and network engineering field may be characterized by the high pace of technological innovation. As the programme is closely related to the System and Network Engineering research group of the University of Amsterdam, research outcomes of this group are incorporated in the courses as well, being an additional driver of change for the curriculum. One of the examples of curriculum changes is the introduction of the Forensics specialization in 2009.

The programme has a strict structure with a number of compulsory courses, addressing the main subjects in the domain. The curriculum does not include electives. There are only limited differences between the two specializations. In the first and second block of the second semester one of the courses in the block is specialization-related. So, the difference between the two specializations is two courses. Of course, the research projects must be specialization-related as well.

The students are exposed to the professional practice. In the courses, they are assigned real-world problems, to be solved during the lab sessions. The research projects may be business-related, although the programme management is hesitant to accept these projects, because they tend not to meet the academic standards. Guest lecturers from organizations and enterprises are invited to lecture on specific topics, highlighting these topics from a business perspective.

The lecturers in the programme are experienced researchers in their field of expertise. The number of master degrees and Ph.D.'s is substantial. Most of the lecturers are very closely related to the System and Network Engineering research group of the Faculty of Science. The chair of this research group has a prominent position in the programme, being responsible for the research projects. Although the number of lecturers having a BKO (Dutch for Basic Qualification Education) is 36% at present, the programme management plans to raise this percentage to 90% in 2014. The results of the lecturers in the student evaluations are 3.9 on a five-point scale (figures of 2012).

The educational model of the programme is directed towards maximizing the learning effect for the students. Informally, this model is known as the *pressure cooker*. Lecturers, lab teachers and the system engineer guide the students daily and very intensely through the lectures and the lab sessions. They assist the students in finding their own answers to questions and in solving the problems they may encounter in the assignments and the research projects. As a consequence, the learning effect of the time spent in the lectures and the lab sessions tends to be extraordinarily large.

The study load for the students in the programme is substantial. In general, the full-time students spend more than 40 hours per week studying. For the part-time students, the study load is commensurate.

The students are informed about the programme by means of e-mail and a Wiki. Additional information may be obtained by the students at the Education Service Center of the Faculty. The programme management has adopted a number of instruments to ensure the study guidance. The lecturers and the students have biweekly meetings to discuss study progress and to solve any study problems. The lab teachers who are always present during the practical lab sessions, guide the students on a day-to-day basis. The lecturers in their capacity as a tutor meet regularly with students individually. The students have their own logbooks in which they are required to register their study progress. The lab teacher has access to this logbook and may intervene in case of unsatisfactory progress. If they want advice on study problems or study progress, the students may turn to the student advisor.

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 have their own, designated space within the campus buildings. The programme has the facilities needed to allow the students to work on the assignments and research projects.

The programme management takes care of evaluating the courses and the facilities. The programme management conducts written student evaluations at the end of each of the courses. As has been noted above, every two weeks the lecturers and the students meet to discuss pressing matters. At the end of the year the curriculum is evaluated by the students and the lecturers, 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 very effective way. The programme management ensures admitting only students who have a fair chance to complete the programme. 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 recommends to keep the number of students admitted to the programme at a maximum of 40 students. Any influx surpassing that number may, in the opinion of the panel, seriously hamper the effect of the educational model of the programme, thereby depriving the programme of one of its most special and distinctive features.

The panel has verified that all the intended learning outcomes have been covered in the programme. Having studied the course contents, the panel has verified that the courses address the domain-specific knowledge and skills, for the system and network field in general and for the two specializations. The panel has observed the Open Technology and the security subjects to be prominently represented in the curriculum. The panel is enthusiastic about the build-up of the courses, theory and practice being both addressed and being very closely related. The students are taught general academic skills, like being able to work in groups and communication skills. In the colloquia and the research projects, the students acquire academic research skills. The panel regards the colloquia to be essential with respect to the academic research skills. The panel recommends to give these colloquia a more formal place in the curriculum and to award credits for these.

In the opinion of the panel, the structure of the curriculum is coherent, indicating a clear and logical study path for the students. The study path does not allow for electives and differs only slightly for the two specializations. For the panel, the students are taught and trained the core of the system and network engineering field.

The panel feels the programme management is very active in improving the curriculum and in keeping the course contents up-to-date. The programme management incorporates the technological developments in the curriculum, as well as the research outcomes of the System and Network Engineering research group of the Faculty of Science.

The panel regards the professional practice to be clearly and strongly represented in the curriculum. The course contents reflect the professional practice and guest lecturers convey their business views to the students. The resonance group ensures the programme management to be in touch with the professional field.

The panel has a high regard for the lecturers in the programme, their expertise and educational abilities, definitely, meeting the requirements. The research orientation of the lecturers is strong. The panel is very positive about the motivation of the teaching staff to guide the students and the enhance the effect of their learning processes. Regarding the percentage of BKO-lecturers, the panel advises the programme management to follow the plan and to attain 90% BKO-lecturers in 2014.

The panel regards the educational model of the programme and the study methods derived from this model to be excellent and to be one of the main factors for the success of the programme. Because of the very intensive guidance by the lecturers and the lab teachers, leading to a substantial number of contact hours, the students acquire knowledge and skills at a very high pace. The students study at least 40 hours per week and the learning effect of these hours is considerable. Therefore, the students learning curve is very steep and they complete the programme, having made giant steps in their knowledge and skills, compared to the beginning. The panel advises to consider changing the name of the educational model from *pressure cooker* to a name with a more positive connotation.

The programme is challenging for the full-time students, who regularly spend more than 40 hours per week. The part-time students attend classes on three days of the week, which is very challenging as well. The panel feels the programme management is keeping the study load manageable. The study guidance and supervision which are both very intense, play a prominent role in this respect.

The panel regards the housing and the facilities to be outstanding. The programme has its own designated space in the Faculty of Science building. Having visited the programme's laboratory, the panel considers the facilities to be excellent for this technology-oriented programme, strongly contributing to the success of the programme's educational model.

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 excellent.

### 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 Faculty of Science has listed a number of guidelines for the assessment policy. The programme management is committed to comply with the university's and faculty's policies. 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 ensuring the graduates will have achieved the intended learning outcomes of the programme. The board of examiners does not yet review the programme's examinations on a regular basis.

The programme management has adopted a number of different examination methods. For four of the courses the examination method is confined to a written examination. The other courses have a mix of examination methods, namely a combination of assignments, papers and/or a written examination. The assignments may be individual or group assignments. In most of the courses, group assignments tend to be supplemented with individual written examinations. In case of group assignments, the presentations which the students are to give and the discussions of the results in which they are to take part, are meant to detect free-riders. In some cases the grades of the group products are differentiated, depending on the efforts and the results of the students in the group. The group composition differs throughout the year.

As the core staff lecturers work together very closely, they monitor each other's written examinations and assignments, thereby peer-reviewing the examinations and the grading of the examinations.

The students are only allowed one resit per course. If they fail the resit, they have to take the course once again. Once a year, the students are allowed to do a retake for assignments they may have failed. The students can only begin working on a research project, if they have completed 75% of the courses of the semester.

For their research projects, the students may either suggest a topic themselves or take a subject from the list of subjects compiled by the chair of the System and Network Engineering research group, who is the co-ordinator of the research projects. The topics suggested by the students themselves are about 10% to 20% of the total number. Research topics come from the research group or from institutions like Netherlands Forensics Institute or Netherlands Police. The programme management is rather hesitant to accept proposals for research projects from businesses, as they, often, do not meet the academic research standards. The chair of the research group has to approve the proposal. Once approved, the students draft their research question. These research questions need the approval of the research chair as well. The students working on their research project, are entitled to the help and guidance of a supervisor. The projects have a tight schedule, demanding a strict planning and execution on the part of the students. The research projects may be group work as well. The presentation and the discussion are important to detect any free-riding by students. The first research project is presented before a limited audience, whereas the presentation of the second project is before a (much) larger audience. The projects are assessed by two lecturers, who both have to have an academic status.

The projects are assessed on the basis of the research contents (40%), the process of completion (20%), the report (20%) and the presentation of the results (20%). All these components are to have at least a grade of 4.0. The research project as a whole has to be graded at least 6.0. The programme management checks for plagiarism.

A number of reports of research projects have been submitted to scientific journals and a number of students have been the co-author of a scientific article.

The graduates of the programme have a strong position on the labour market and relatively easy find a job. About 75% of the graduates obtained a relevant position within one month after their graduation and 90% of the graduates found such a position within three months after the graduation. In a recent survey among alumni, they rated the programme with 8.4 (on a ten-point scale). About 10% of the graduates embark upon a Ph.D.-trajectory. Of the students who enter the programme about 80% completes the programme within two years (full-time students) or three years (part-time students).

#### *Considerations*

The panel regards the assessment policy of the programme to be appropriate, the regulations being in line with the university's and the Faculty of Science's policies. The panel has observed the programme's board of examiners is in the process of implementing measures to regularly review the level and quality of the examinations. The panel recommends the board of examiners to accelerate this implementation process.

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 assignments, papers and written examinations 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 programme management has taken appropriate measures to prevent students from free-riding in case of group assignments.

The panel is impressed by the thorough and strict organization of the research projects processes and by the consequent emphasis placed on the academic research contents of the projects. The projects are assessed equally thoroughly, the academic examiners as well as the assessment components ensuring a reliable and valid assessment.

The panel has studied the reports of the research projects. The quality of these reports are, definitely, more than satisfactory. The research projects demonstrate creative thinking, a strongly developed scientific structure and a substantial level of complexity. A number of projects having been submitted to scientific journals and having led to scientific publications, adds to the recognition of the relatively high level the graduates have reached.

The panel is very positive about the positions the graduates acquire in the professional field and, for a programme in this field, by the relatively large number of graduates who choose to pursue a Ph.D.-trajectory. The success rate of the programme is impressive.

#### *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), K. Koymans Ph.D. (director Master System and Network Engineering programme)
10.00 h. – 11.20 h.	Programme management K. Koymans Ph.D. (director Master System and Network Engineering programme), J. van Ginkel (lecturer), N. Sijm MSc (system engineer), C. Dumitru MSc (lab teacher)
11.30 h. – 12.15 h.	Board of examiners I. Bethke Ph.D. (chair), prof. C. de Laat Ph.D. (member, chair of System and Network Engineering Research Group), R. Kellermann Deibel MSc (student advisor)
12.15 h. – 13.30 h.	Lunch, deliberations panel and documents review (closed session); visit to the System and Network Engineering programme lab facilities and open office hours 12.15 h. – 12.45 h.
13.30 h. – 14.30 h.	Lecturers, including member of educational committee P. Grosso Ph.D. (lecturer, chair educational committee), A. Belloum Ph.D. (lecturer), J. van Ginkel (lecturer), T. van Inge MSc (lab teacher), prof. C. de Laat Ph.D. (co-ordinator research projects)
14.30 h. – 15.30 h.	Students and alumni, including member of educational committee F. Alizade BSc (student Networking track), P. Lexis BSc (part-time student, Forensics track), S. Plug BSc (student Networking track, member educational committee), P. Siekerman MSc (alumnus), Th. Kinkhorst MSc (alumnus), E. Petridou MSc (alumna)
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 System and Network Engineering
- Domain-specific reference model
- Exit qualifications
- Programme overview
- Oslo overview
- Personnel
- Contact hours
- Throughput
- Requirements
- Recent master theses
- Alumni survey

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
- 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:

- 10257314
- 10255443
- 10289585
- 10220348
- 10286500
- 6185754
- 10297138
- 10115617
- 10003405
- 10119833
- 6108776
- 10118934
- 6181139
- 5977118
- 6185010

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

- 10118942
- 10095306
- 10124489
- 6186750
- 6186815
- 6124402
- 0283827
- 5992648

## Annex 4: Composition of the assessment panel

The assessment panel had the following composition:

- G. Dierick MSc, panel chair, network & security expert at Vlaamse Radio- en Televisieomroep (VRT) and lecturer at the Katholieke Hogeschool Leuven
- K.M. Begnum Ph.D., panel member, associate professor at Oslo Akershus University of Applied Sciences;
- O.M. Kolkman MSc, panel member, director of NLnet Labs;
- B. van Os BSc, student member, studying the master's programme Artificial Intelligence at University of Groningen.

### **G. Dierick MSc, panel chair**

Mr Dierick, currently, is a network & security expert at Vlaamse Radio- en Televisieomroep (VRT) and a Computer Science lecturer at Katholieke Universiteit Leuven. He obtained a MSc in Computer Science at Katholieke Universiteit Leuven. He, also, was employed as a network and system administrator at this institution. As a guest lecturer, he taught networking, security and forensics courses at Institut Paul Lambin (Brussels) and Fachhochschule Joanneum (Kapfenberg, Austria). Mr Dierick is one of the authors of a textbook on ethical and social issues related to information technology.

### **K.M. Begnum Ph.D., panel member**

Mr Begnum, currently, is an associate professor at Oslo Akershus University of Applied Sciences. He obtained his Ph.D. in Informatics from University of Oslo. Before his current position, he was, among other, a system consultant at Linpro AS and a senior advisor for the Norwegian System Architects and an assistant professor at Oslo Akershus University of Applied Sciences. He has developed and taught a number of courses in his field of expertise, at the bachelor's level and at the master's level. Mr Begnum has published widely.

### **O.M. Kolkman MSc, panel member**

Mr Kolkman, currently, is the director of NLnet Labs, this being a research and development group focusing on aspects of internet technology, such as IP, routing, DNS and DNS security. He obtained his MSc in Astronomy at University of Groningen. Having completed his studies, he became a scientific programmer, the chair of a number of internet-related working groups and a member and the chair of Internet Architecture Board, a very important internet body. Mr Kolkman has published numerous articles in his field of expertise.

### **B. van Os BSc, student member**

Mr Van Os is studying in the master's programme Artificial Intelligence at University of Groningen, having completed the bachelor's programme Artificial Intelligence in Groningen. He has been, among other, a member of the course committee of these programmes and a member of the faculty council of Faculty of Mathematics and Natural Sciences. As a co-ordinator, Mr Van Os has been involved in the preparation of the accreditation of the Artificial Intelligence programmes in Groningen.

## **Annex 5: Declarations of independence**