Netherlands Quality Agency

NQA

Hogeschool van Arnhem en Nijmegen

HAN University of Applied Sciences

Hogeschool van Arnhem en Nijmegen

Master of Automotive Systems

Limited Study Programme Assessment

February 2014

Introduction

This is the assessment report of the Master of Automotive Systems degree programme offered by Hogeschool van Arnhem en Nijmegen (HAN University of applied sciences). The assessment was conducted by an audit panel compiled by NQA commissioned by HAN. The panel has been compiled in consultation with the study programme and has been approved prior to the assessment process by NVAO.
In this report Netherlands Quality Agency (NQA) gives account of its findings, considerations and conclusions. The assessment was undertaken according to the *Assessment frameworks for the higher education system* of NVAO (22 November 2011) and the *NQA Protocol 2013 for limited programme assessment*.

The site visit took place on 26 and 27 November 2013.
The audit panel consisted of:
Prof. ir. J.P.M. De Wachter, (chairperson, representative discipline)
Mr Prof. B.J.H. Jacobson, (representative profession and discipline)
Mr ir. ing. R.M.A.F. Verschuren (representative profession)
Mr J.G.S. van Uden, BSc Electrical Engineering (student master of Automotive Technology)

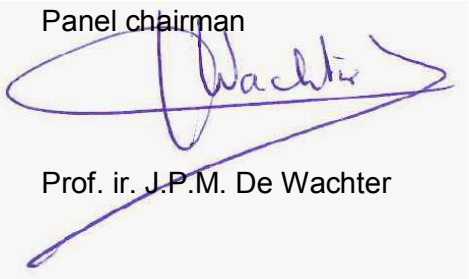
Mr drs. ing. A.G.M. Horrevorts, NQA-auditor, acted as secretary of the panel.

The study programme offered a critical reflection; form and content according to the requirements of the appropriate NVAO assessment framework and according to the requirements of the *NQA Protocol 2013*.
The panel studied the critical reflection and visited the study programme.
Critical reflection and all other (oral and written) information have enabled the panel to reach a deliberate judgement.

The panel declares the assessment of the study programme was carried out independently.

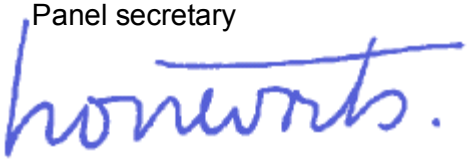
Utrecht, 5 February 2014

Panel chairman



Prof. ir. J.P.M. De Wachter

Panel secretary



drs. ing. A.G.M. Horrevorts

Summary

The audit panel assesses the quality of the *hbo master* study programme *Automotive Systems of HAN University of Applied Sciences* as ***satisfactory.***

Standard 1 Intended learning outcomes.
The visitation committee assesses standard 1 for the master programme Automotive Systems as **good**.

The hbo-master graduate plays a crucial role in the field of applied research and the (interdisciplinary) development of automotive products, and has a broad view of automotive processes. The masters graduate is a specialist, mastering technology and being able to apply it in a complex environment. He understands the results of fundamental research and may contribute to its application.
The intended learning outcomes (seven final qualifications) of the Master of Automotive Systems are well described. The final qualifications are based on an analysis of international professional profiles, the master programmes of other universities and international employment advertisements. Furthermore representatives of the professional made their contribution to the final qualifications. The Dublin descriptors for master programmes were used to draw up the MAS final qualifications. The level of the professional master is well defined. Criteria for judging the final qualifications are clearly specified.

According to the visiting committee the Body of Knowledge and Skills (BoKS) reflects the master level of the MAS study programme. The BoKS is primarily based on the Research Vision of HAN, internationally recognised literature and the professional profile demanded by the international automotive industry.

The MAS programme is professional and international oriented and is based on current and future developments in the automotive industry. Examples are light-weight design, advanced (electrified) vehicle power transmission, advanced vehicle control systems. The international orientation of the programme is well defined in the intended learning outcomes and is made concrete in various student and staff related activities. According to the visiting committee, this illustrates the pro-active role the MAS study programme wants to play.

Standard 2 Teaching and learning environment
The visitation committee assesses standard 2 for the master programme Automotive Systems as **satisfactory**.

According to the visiting committee the educational learning environment makes it possible for students to realize the intended learning outcomes. The learning outcomes of the courses of the MAS programme are formulated in such a way that they contribute to the preparation of the student for a future job in the career field at master's level. The master's degree programme has a full-time and part-time version. The content of both versions is identical.

Various didactical methods are used that are appropriate for the learning outcomes of the modules and projects. The master's degree programme is practically-oriented and assignments are directed to solve concrete problems within an organisation. The students develop an attitude of enquiry in a multidisciplinary setting. The visiting committee observes that the professional reality in the automotive field forms the basis of the programme and the working methods play an important role. The Curriculum Committee is responsible for ensuring coherency of the study programme.

The lecturers, course coordinator and administrator of the MAS programme are well aware of the students' requests for guidance. Students are satisfied with the guidance and support the study programme offers. Lecturers are responsive to questions of students.

Staff of the MAS programme are qualified for their tasks as lecturers and researchers. Lecturers combine theoretical knowledge with practical experience that is of the level to be expected of a master programme. The staff have knowledge of and experience from the professional field through their own research and / or work in the professional field. The lecturers are strongly internationally-oriented.

The facilities of the MAS study programme enable the MAS students and lecturers to carry out up-to-date research activities. The Applied Research Laboratory-Automotive (ARL-A) , are of an excellent quality.

The study programme as a whole has the potency to develop to the judgement good. Issues to be dealt with are reporting skills and the fact that math could be more related to application in automotive practice. Furthermore the organisation of the full-time programme and the accomplishment of the quality assurance cycle (PDCA-cycle) need specific attention.

Standard 3 Assessment and achieved learning outcomes
The visitation committee assesses standard 3 for the master programme Automotive Systems as **satisfactory**.

The assessment system of the MAS has been under construction in the past two years. According to the visiting committee the system is well defined and protocols and procedures are in place that contribute to valid and reliable tests. Assessors have been trained in test development and assessing students. The quality of the written exams is satisfactory. Special attention should be paid to the level of math and electronics.

According to the visiting committee the study programme has a decent assessment system in place for the final thesis. This assessment protocol is in a developmental stage. The grading format for the thesis is fine-tuned and the use of the assessment criteria and its effect on the quality of the final assessment will further be evaluated by the study programme in the coming years.

The visiting committee states that the fifteen theses reviewed by the committee at least meet the minimum standards of a master thesis. Extra attention could be paid to the format of the reports and reporting skills (structure and readability), proper use of scientific sources (including way of referring). The technical aspects addressed in the master theses are, according to the visiting committee, of a satisfactory to good level. The reports provide sound information for a company or research group in the field of automotive systems.

Contents

1 Basic data of the study programme

Administrative data of the study programme

1. Name study programme as in CROHO	Master of Automotive Systems
2. Registration number in CROHO	70104
3. Orientation and level study programme	Hbo master
4. Number of study credits	90 EC
5. Specialisations	Major in Dynamic Systems Major in Light-Weight Design
6. Variant(s)	Fulltime / parttime
7. Location(s)	Arnhem
8. Previous year of audit visit and date decision NVAO	Previous visit: March 2009 Decision NVAO: July 2009
9. Code of conduct	Signed

Administratieve institutional data

10. Name institute	Hogeschool van Arnhem en Nijmegen, HAN University of applied sciences
11. Status institute	Programme not funded by government grants
12. Result institute audit	Positive

Quantitative data regarding the study programme

1. In - through- and out-stream data of – if possible – the last six cohorts

Announcement	Cohort	2010	2011	2012	2013
Full-time		13	10	8	13
Part-time		2	6	2	12
EMAE		8	11	3	5
Total		23	27	13	30

Enrolment	Cohort	2010	2011	2012	2013
Full-time		13	10	8	13
Part-time		2	6	2	12
EMAE		8	11	3	4
Total		23	27	13	29

Average lead time graduated student	Cohort	2010	2011	2012	2013
Full-time		>2,4	>1,8	n.a.	n.a.
Part-time		2,7	n.a.	n.a.	n.a.
EMAE		1,0	n.a.	n.a.	n.a.
Total					

Lead time drop out students	Cohort	2010	2011	2012	2013
Full-time		3	n.a.	n.a.	n.a.
Part-time		1	n.a.	n.a.	n.a.
EMAE		3	3	n.a.	n.a.
Total					

2. Realized teacher – student ratio 1:16

3. The number of face-to-face instruction hours per phase of the study is included in Annex 2 of this report (Curriculum of Master of Automotive Systems).

2 Assessment

The panel describes the findings, considerations and conclusions of each standard of the NVAO assessment framework. The final judgement concerning the study programme will be presented in chapter 3.

Standard 1 Intended learning outcomes

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

Findings

Final qualifications

The Master of Automotive Systems (MAS) started in 2009 with nine final qualifications (*Accreditation framework for new degree courses in Higher Education, 2008).* The final qualifications are based on an analysis of international professional profiles, the master programmes of other universities and international employment advertisements. In June 2012 the final qualifications were evaluated and reduced to seven. The seven final qualifications are described in the *Degree Statute, September 2013*. The original nine final qualifications and the new final qualifications of MAS are presented in appendix 1 of this report. The Dublin descriptors for master programmes were used to draw up the MAS final qualifications (*Dublin descriptors and MAS final qualifications*). In the *Critical Reflection* and policy documents of the study programme the Dublin descriptors for the master level are well defined. The criteria for judging the final qualifications are clearly set for instance in the newly developed master thesis assessment forms and in the examination forms (criteria for written examinations and research assignments).

The difference between the professional (hbo) bachelor level and professional (hbo) master level is clearly defined. The hbo master graduate plays a crucial role in the field of applied research and the (interdisciplinary) development of automotive products, and has a broad view of automotive processes. The masters graduate is a specialist, mastering technology and being able to apply it in a complex environment. He understands the results of fundamental research and may contribute to its application. In a table in the *Critical Reflection* the criteria for bachelor, master and PhD levels are compared with each other. This overview sets, according to the visiting committee, a good standard for the level of the professional master[1]. According to the visiting committee the Body of Knowledge and Skills (BoKS) reflects the master level of the MAS study programme.

[1] MAS refers to the analysis of E. Jansen and B. Heine, who distinguish three different levels of research according to Bachelors, Masters and PhD. *Hogeschoolbrede competentiedefinitie 'onderzoek doen'*.

The BoKS is primarily based on the Research Vision, internationally recognised literature and the professional profile demanded by the international automotive industry (*Master of Automotive Systems Body of Knowledge and Skills*).

Professional master

The MAS programme is professional oriented and is based on developments in the automotive industry. The new final qualifications were presented to and discussed with the professional field, as represented by the Master Advisory Council (MAC). The MAC member whom the visiting committee interviewed, was positive about the new set of final qualifications and the way the expertise of the MAC-members is used to keep up with the ever changing context and standards of the internationally oriented automotive industry. An example of this is the Major in Light-Weight Design. The members of MAC come from the domestic and international automotive industry, research institutes and educational institutions. Real-life experience is considered essential for every professional engineering programme. These include technical specialisations, design and sustainability, communication, globalisation, attitude, teamwork, and professional and ethical responsibilities. All master thesis projects are based on real-life problems provided by automotive companies.

Profile

The MAS programme also takes into consideration future developments in automotive industry. In 2010 the Dutch automotive sector presented its vision for development towards the year 2020[2]. The Dutch automotive sector wishes to play a leading role in innovation and the development of applications in two focus areas: Smart mobility and Future power train. The MAS profile is future oriented and covers the areas:

- Applied vehicle dynamics;
- Advanced (electrified) vehicle power transmissions;
- Advanced vehicle control systems in relation to vehicle control and driver support;
- Vehicle electronics;
- Automotive light-weight design.

The profile correspond with current developments in the car industry which link with the choices of the Dutch automotive sector, and are affirmed by the representative body AutomotiveNL (AutomotiveNL Innovation Programme, June 2012). According to the visiting committee, this illustrates the pro-active role the MAS study programme wants to play.

International orientation

The MAS programme is offered to national and international students (medium of instruction is English). The MAS programme maintains contacts with foreign universities of applied sciences and academic universities in the areas of knowledge, student and staff exchange. The MAS programme has teamed up with the Czech Technical University (CTU) in Prague and ENSTA, a French state graduate and research institute in Brest. Together, these three educational institutes offer the Master European Master of Automotive Engineering (EMAE).

[2] R. Berger, Vision for the Dutch automotive sector 2010 – 2020, September 2010

The HAN Automotive Institute participates in several international networks such as:

- Advanced Vehicle Control (AVEC); the 2004 AVEC conference was organised by HAN-AR in Arnhem;
- International Forum for Road Transport Technology (IFRTT);
- Dutch Innovation Centre for Electric Road Transport (D-Incert);
- Higher Automotive education:
  - University of Helsinki (PhD project of one of HAN-AR's research associates, also active at MAS);
  - Eindhoven University of Technology (two PhD projects with HAN-AR research associates, one of which was recently completed successfully);
  - Czech Technical University, Prague. The director of HAN Automotive Research maintains contact with the CTU concerning course content, and contributes to the series of lectures on vehicle dynamics;
  - Chalmers University of Technology, Gothenburg;
  - KTH Royal Institute of Technology, Stockholm, with one of HAN-AR's professors acting as an opponent for a PhD examination, in cooperation with the Scania truck company.

According to the visiting committee the international orientation of the programme is well defined in the intended learning outcomes and is made concrete in various student and staff related activities.

Considerations and conclusion

The final qualifications of the Master of Automotive Systems are very relevant for the automotive sector. The final qualifications are the result of internal discussions (lecturers, professors, member of the research groups at HAN) and consultations with representatives of the Dutch and international automotive industry. The Dublin descriptors for the master level are well defined and criteria for judging the final qualifications are clearly set for instance in the newly developed master thesis examination form. The MAS study programme has a future oriented profile and keeps up with the changing environment in automotive industry. The Master Advisory Council (MAC) meets twice a year with the Course Board to discuss topical issues.

Based on above mentioned considerations the audit team comes to the judgement **good**.

Standard 2 Teaching-learning environment

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

Introduction

The Master of Automotive Systems programme is offered as a full-time programme (1.5 years) and part-time (2.5 - 3 years). The content for the part-time programme is identical to that of the full-time programme. The medium of instruction is English. The MAS starts with a general module on the basic elements of vehicle design, such as power trains, vehicle technology, transmission, mechanics, mathematics, and electronics. In the second semester, two specialisations are offered:

1. Intelligent vehicles, with an emphasis on vehicle control, advanced (electrified) power trains, automotive electronics, system control analysis;
2. Light-weight vehicle design, including topics such as light materials, structural mechanics, fatigue assessment, and FEM analysis.

The MAS is supported by applied research carried out by HAN Automotive Research (HAN-AR), consisting of the two research groups Mobility Technology and Vehicle Mechatronics. HAN-AR carries out applied research projects for industry and government, involving students (about 40 per year) and HAN faculty staff. These groups are directly linked to the HAN Automotive Institute and its Automotive Research Lab (ARLA).

The MAS programme focuses on the following four areas:

1. Electrification of the power train;
2. Optimisation of fuels, engines and emissions;
3. Light-weight automotive design;
4. Advanced vehicle control and driver support.

<u>Organisation of master programmes at HAN</u>

All master programmes of HAN (nineteen) are brought under one administrative roof: the HAN Masters Programmes Institute (HMP). The institute constitutes of four faculties: Engineering (3 master programmes), Education (4 master programmes), Health (7 master programmes) and Management and Coaching (5 master programmes). One of the reasons to establish MHP is to bring research expertise together and to achieve improved conceptual clarity and higher standards in relation to the quality of education and practice oriented research.

There are also links with the HAN research group Control Systems Engineering. MAS lecturers also teach on the Master of Control System Engineering programme, and vice versa.

Findings

Contents of the curriculum

The study programme presents the relation between the intended final qualifications (including the Dublin descriptors) and course content in a table the Critical Reflection. The study programme has translated the final qualifications into subjects that are dealt with in the educational programme and the module descriptions (*Master of Automotive Systems Course Guide 2012 – 2013, Description of the Masters (MAS) modules).* The content of the program covers the seven final qualifications of the master programme. The study programme states in the critical reflection that the relationship between course content and final qualifications could be worked out more explicitly and consequently in the course documents. This action will be carried out in the near future.

Based on the literature list and overview of the Body of Knowledge and Skills the visiting committee concludes that students are provided with a theoretical background to automotive technologies and specialised scientific knowledge of advanced automotive engineering such as modern power trains, intelligent vehicles and light-weight vehicle design. Also included is knowledge of macroeconomic and societal trends as main drivers for automotive research and development. Theory is applied within an automotive context (automotive systems and components) with an emphasis on the performance of the automotive end products. Theory is always linked with automotive company processes and their improvement. This means that not only technical achievements but also the consequences for financial efficiency, quality management and cost-benefit relationships are addressed in MAS assignments, practical work and minor and thesis projects.

According to the visiting committee the programme is well focused on automotive knowledge and skills. The course content is relevant, up-to-date and of a more than adequate master level. The project work, assignments and research topics cover a broad scope of automotive practice. Because of its focus on automotive practice the study programme can be labelled as an efficient automotive study programme. The course content matches the learning outcomes and meets international standards. The visiting committee observes that the math course could be more related to application in automotive practice.

Students acquire research skills and develop an attitude of enquiry in an integrated way during projects, assignments and in the master thesis project. The research areas are vehicle dynamics, vehicle-human interface, alternative power trains, vehicle control systems and light-weight design. Students work in several modules on literature research, modelling and parameter studies. In the minor project students carry out research on a specific topic. At the end of the MAS programme students have to demonstrate their ability to carry out a research project independently (master thesis). Non-technical skills are also addressed, including working in teams (multidisciplinary, and with an international focus), self-management of the learning process and research skills *(Master of Automotive Systems Course Guide 2012 – 2013).* Reporting and presentation skills are part of the programme. Students obtain guidelines and receive feedback on their communication skills for a majority of their presentation and reporting assignments.

The visiting committee observes that reporting skills of the students could be enhanced and in some cases are weak. (see also standard 3).

The international orientation of the MAS programme is reflected in the medium of instruction (English), the diversity of nationalities of students, use of textbooks and participation in international projects both by students and professors. The full-time student body is mainly of foreign origin (Western and Eastern European countries, India, Latin-America). The student body of the part-time variant is mainly Dutch. The textbooks and study materials used are of a good level, internationally recognised and also used at foreign universities. Students have the opportunity to complete their master thesis abroad, for example at FEV in Aachen, Siemens in Regensburg or Ford in Cologne or Lommel. The professors have many international contacts and play an important role in the development of the international dimension. The HAN Automotive Institute collaborates with CTU (Czech Technical University) in Prague on the programme European Master of Automotive Engineering (EMAE). The HAN Automotive Institute also participates in the German network Arbeitskreis der Professoren für Fahrzeugtechnik an der Fachhochschulen. The objective of this network is to stimulate cooperation (including student exchanges) between the universities of applied science.

Structure of the curriculum and didactic concept and methods

A schematic diagram of the programme for the full-time and part time version is presented in annex 2 of this report. Part-time students take two years for the first two semesters of the study programme, including the minor project, practical exercises and lab activities. Each semester consists of 20 weeks, including examination periods. The methods used in the modules are a combination of lectures, assignments and exercises on one specific topic. Satisfactory (pass) grades are required for all parts of any module. The first semester includes a basic programme starting with an introduction to automotive systems. Here the foundation is laid for the rest of the programme. Students work on possible deficiencies from prior (foreign) bachelor's degree programmes (see standard 3). In the first semester students work on practice research projects (research skills) and get acquainted with the Dutch educational culture in which students are activated to self study, ask critical questions and discuss issues with fellow students and the lecturers (group process of learning). The module descriptions (*Master of Automotive Systems Course Guide 2012 – 2013)* show that the contents of the full-time and part-time versions of the MAS programme are identical. The second and third semester deal with more in-depth knowledge and skills within the wider field of automotive engineering.

The visiting committee observes that the curriculum deals with theory, practical application of theory, research skills and general professional skills. Furthermore the study programme aims to educate engineers having an attitude that is oriented towards concurrent engineering[3] and taking responsibility.

[3] Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including, manufacturing and support. This approach is intended to cause the developers from the very outset to consider all

The graduates of MAS must be able to communicate with people from different nationalities and disciplines. According to the visiting committee the educational methods used by the MAS study programme contribute to acquiring knowledge and (research) skills and developing an attitude that promotes cooperation between researchers of different disciplines and nationalities. Methods used are:

- Team and individual assignments;
- Experimental research and laboratory exercises;
- Model development and simulation exercises;
- Group cases;
- Minor project and master thesis project covering the final qualifications, including literature survey, oral presentations and reporting.

Supervision of students

The Course Board considers it important that students themselves feel free to ask for help if needed. Guidance and supervision on matters related to the course content is provided by the course lecturers. Students requiring assistance of a personal or individual nature concerning their study progress can contact the course coordinator and the course administrator. Where social and practical matters are concerned, for example housing, medical assistance and finances students can contact the course administrator.

Each module coordinator is responsible for the proper instruction of his module in the relevant period of the course, including lectures, the organisation of field trips, guest speakers and the setting and marking of coursework and module examination papers.

The visiting committee observes that the staff (lecturers, course coordinator and administrator) are well aware of the students' requests for guidance and their views on the organisation, administration and development of the programme as a whole. At the end of each semester, it is standard procedure to ask students to fill in a feedback questionnaire on the course in that semester. This feedback questionnaire is an important part of the course monitoring process. Besides this formal way of monitoring students contact lecturers and course administrator directly. Assistance during the master thesis phase is provided by the thesis supervisor. This supervisor monitors progress and the quality of the thesis content and discusses this with the student. For the duration of the thesis project, the supervisor has regular contact with the student regarding progress (*Master of Automotive Systems Course Guide 2012 – 2013*). The frequency of guidance depends on the wishes and needs of the student. Students interviewed by the visiting committee, are satisfied with the guidance and support the study programme offers. Lecturers are responsive to questions of students. However, both students and lecturers expressed the wish to spend more time on Problem-Solving-Sessions.

Elements of the product life cycle, from conception to disposal, including quality, cost, schedule, and user requirements. Winner, et al., 1988.

Different learning paths

The master's degree programme has a full-time and part-time version. The content of both versions is identical. Students enrolled in the full-time version follow lessons and workshops two days a week. The other three days they are supposed to study on their own. The students enrolled in the part-time version follow lessons and workshops one day a week. The other days they work and are supposed to study on their own.
The number of students enrolled in the MAS study programme (part-time and full-time) is small. In order to deliver the MAS programme in a cost-effective way the modules are taught only once to a combination of part-time and full-time students. Since the part-time students have restricted time to attend lessons (one day a week) the MAS modules are scheduled in two days (Wednesday and Thursday). In the first year part-time students follow the modules of semester 1 on Wednesday and in the second year they follow the modules of semester 2 on Thursday. Because of the restricted time available to part-time students, the full-time programme is organised to fit the needs of the part-time students. Full-time students prefer to have their lessons more spread over the week. The organisation of the programme is, according to the full-time students, not in accordance with their situation. They experience the programme as a pressure cooker. The visiting committee understands that at present the organisation of the full-time MAS programme has to comply with the restrictions as described above. It is hoped that the organisation of the MAS full-time programme can be changed in the future if the number of enrolments increase. The organisation of the programme does not negatively affect the quality of the programme of the full-time version (see standard 3).

Students receive exemption for the first semester of the MAS study programme if they have attained 95 percent of the study points of the first semester of the EMEA study programme at Prague (*EMAE Exemption Regulations*)[4]. Another way to receive exemptions is based on an individual screening of knowledge and skills of students. Students who have gained relevant experience of a given subject elsewhere and can demonstrate this, may receive full or partial exemption for subjects in the first semester. Students have to present documents that proof they master the knowledge and skills.

Staff quality

According to the to the visiting committee the staff of the MAS programme are qualified for their tasks as lecturers and researchers. Proof for that is found in their cv's and list of publications. Lecturers combine theoretical knowledge with practical experience that is of the level to be expected of a master programme. Maintenance of this knowledge through participation in research and regular communication with colleagues (by means of scientific publication) is a standard requirement.

[4] HAN participates in an international master's degree course (EMAE). The other partners in this Masters course are the Czech Technical University in Prague (CTU) and ENSTA (École Nationale Supérieure d'Ingénieurs) in Brest, France. Students enrolled on this EMAE course follow a one-year post-initial master's course in Prague. In the second year, they can choose to specialise in Intelligent Vehicles or Light-Weight Design at HAN in Arnhem, or to focus on vehicle design in a broader context at ENSTA. Those who choose to come to Arnhem follow the second MAS semester and a master thesis project. Students are awarded an MSc degree from the Czech Technical University in Prague if they succeed in passing a state exam. One of HAN-AR's professors has been formally appointed as a member of the State Exam Committee by the Czech authorities.

HAN/HMP strives for the goal 100 percent of lecturers having at least a master degree for master's degree courses *[Strategic Staffing Policy Plan for HAN Masters courses 2013-2017].* The Course Board has hired lecturers on the basis of specific subject knowledge and skills. The majority of the lecturing staff has a master's degree or higher (19 of 27) The MAS lecturer team has seven lecturers with a PhD title (including the professors) and three PhD candidates. The course staff also has experience from the professional field. Lecturers maintain their connections with the field through their own research (research activity in the professional field) as part of HAN-AR projects, often combining this with the supervision of students. Lecturers also work in the professional field. The lecturers are also strongly internationally-oriented, as the automotive industry is a global one. Lecturers attend foreign conferences and command the specific knowledge, qualifications, training and experience deemed appropriate to lecturers.
Many MAS lecturers and module coordinators satisfy all of the following criteria:

- They have professional relations with the automotive sector, either through their own experience or through their active network;
- They have an understanding of R&D and can apply skills in relation thereto;
- They have experience in presenting and publishing automotive R&D results;
- They have relevant up-to-date knowledge of automotive systems;
- They have a relevant network in the automotive scientific community and/or the automotive professional field.

Thesis supervisors, recruited from among MAS lecturing staff, are fit for the job, meaning that they have sufficient professional and in-depth background knowledge to cover the subject of the final project, as is clear from their research activities, publications, and understanding/experience of professional international industrial automotive research. They have pedagogical skills (formal qualifications or certifications) suitable for teaching Dutch and international master students. Students interviewed by the visiting committee are satisfied with the communication skills of the lecturers.

Lecturers receive additional training whenever necessary. For example, training was given in respect of testing and testing criteria. The achievements of MAS staff are evaluated, based on their own personal assessment of these achievements and the response from students. Where MAS staff members are employed by HAN, their involvement in MAS is part of their annual personal performance assessment. Staff of the HAN Institute of Engineering are motivated and encouraged to take part in international conferences and exhibitions.

Quality of specific facilities of the study programme

The MAS study programme uses the facilities of the HAN Automotive Institute such as lecture rooms, rooms for group work and special facilities (automotive lab and research facilities) The immediate availability of the research staff offers an advantage to the students. The visiting committee inspected the programme-specific facilities and is very impressed with the quality of the equipment and software facilities. The facilities are frequently used for research activities. Research is the driving factor behind many of the modifications of facilities, investments and test/research vehicles.

The Applied Research Laboratory-Automotive (ARL-A) operates as an independent organisation as a partner of the bachelor's degree programme and the research teams. In the previous round of accreditation for the undergraduate programme, these facilities were rated 'excellent'. The visiting committee of the master's degree programme endorses this view. The facilities enable the MAS students and lecturers to carry out up-to-date research activities.

Via HAN-Scholar (HAN's electronic learning environment) students can view course information, carry out assignments and collaborate with other students and lecturers online. Rules are in place for the publication of course readers, articles and PowerPoint presentations. The visiting committee is positive about the HAN-Scholar platform. Students interviewed by the visiting committee are very satisfied with the facilities.

Quality of the educational learning environment guaranteed

Several committees / boards are involved in the quality assurance of the MAS programme. It is the task and responsibility of the Curriculum Committee to take decisions regarding changes in the content of the programme. The Course Board gathers information regarding the course content via formal course evaluations that take place at the end of each subject. The students evaluate subjects by means of a questionnaire. If necessary, the evaluations are assessed at the end with the lecturers concerned. Furthermore the Coarse Board receives input from the Degree Course Committee (that represents the interests of the students and lecturers) and the Master Advisory Council (which functions as an advisory body in respect of the course content). The panel appreciates this specific role of the MAC in the quality assurance of the study programme. The Course Board acquires evaluation data concerning the global content of the course through the annual Nationale Studenten Enquête (NSE) questionnaire. The outcomes of the above mentioned evaluation instruments serve as input for improvements of the course content. (*Kwaliteitszorg MAS, 2013-2014)*. Lastly, the Internal Audit Team of HAN provide advice concerning the design of the course (*Rapportage Interne Audit [Internal Audit Report], 2012*). The visiting committee observes that the national evaluation instruments such as *NSE* and *HBO-Spiegel* have a very low response and thus are statistically of too low relevance to depend upon.

Besides the formal evaluations and feedback also informal feedback from students is used to improve and change the content and/or organisation of the course. Students interviewed by the visiting committee are satisfied with the way the study programme responds to their remarks and suggestions. At this level, many issues can be dealt with quickly and efficiently.

The intake procedure and entrance programme contribute to assure the quality of the programme. The Board of Examiners and the Course Board are responsible for intake and admission to the programme. Students must have a bachelor's degree in a relevant technical discipline.

The visiting committee observes that the study programme gathers information on the quality of relevant aspects of the programme: such as relevance of end qualifications, workload, guidance and support, quality of end qualifications, organisation of the programme.

The quality assurance system is a working system: the quality of the program is checked by the study programme using different instruments and input form different relevant committees. The visiting committee observes that changes and improvements have been carried out by the curriculum committee. However, an overview or plan of the major activities that are being changed is not in place.
The visiting committee is very positive about the internal audit carried out by the HAN internal audit committee (2012). The audit report shows that the study programme reflects in a critical way on its own performance. The visiting committee could not find an overview of the follow up activities of this report. A state of the art report could have been presented to the visiting committee. An activity plan and an overview of results achieved thus far would have made the PDCA-cycle complete.

Considerations and conclusion
Coherent educational learning environment
According to the visiting committee the educational learning environment makes it possible for students to realize the intended learning outcomes.
The learning outcomes of the courses of the MAS programme are formulated in such a way that they contribute to the preparation of the student for a future job in the career field at master's level. Students develop skills and knowledge. Various didactical methods are used that are appropriate for the learning outcomes of the modules and projects. The master's degree programme is practically-oriented and assignments are directed to solve concrete problems within an organisation. The students develop an attitude of enquiry in a multidisciplinary setting. The visiting committee observes that the professional reality forms the basis of the programme and the working methods play an important role. The Curriculum Committee is responsible for ensuring coherency of the study programme.

The study programme has the potency to develop to the judgement good. Issues to be dealt with are reporting skills and the fact that math could be more related to application in automotive practice. Furthermore the organisation of the full-time programme and the accomplishment of the quality assurance cycle (PDCA-cycle) need specific attention.

Based on above mentioned considerations the audit team comes to the judgement ***satisfactory.***

Standard 3 Assessment and achieved learning outcomes

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

Findings

Assessment system

HAN's testing policy is outlined in the memo *'Eenheid in verscheidenheid'* [Unity through Diversity]. The testing policy of the MAS is based on the *Kaderstellend toetsbeleidsplan HMP-masterprogramma's* [*HMP Test Policy Plan Framework for Master Courses*], *2012*) and is further worked out in the MAS testing plan (*Toetsbeleid Master of Automotive systems HAN Master programma's* [*HAN Masters Courses Testing Policy for Master of Automotive Systems], November 2012*). This testing plan was drafted in collaboration with MAS lecturers in the summer of 2012. The Curriculum Committee and lecturers analysed the content of the MAS study programme and checked whether the knowledge and skills related to the final qualifications are dealt with in the modules and subjects (see also Standard 2) and whether they are properly tested. The result of this analysis is presented in an overview of modules, types of testing and their relation with the final qualifications and Dublin descriptors (*Relation MAS end qualifications an Dublin descriptors with the modules and examinations*) The visiting committee concludes that the seven end qualifications of the MAS programme are covered by the testing programme.

Methods of testing

The testing methods used are: written examinations, reports, presentations, exercises, model assignments, research assignments, lab assignments and the final master thesis project. Knowledge, skills and attitude are tested simultaneously within the various projects and assignments. This mix of testing methods is according to the visiting committee suitable to test knowledge, skills and the combination of knowledge and skills. In the minor project and the master thesis project, the final qualifications are appraised by means of an assessment.

In the course statute (*Master of Automotive Systems Course Guide and MAS Course Statute*) students are notified about the content of the module, the method of testing, test criteria and to which end qualifications the module contributes. Students interviewed by the visiting committee are well aware of the content of the modules, the learning outcomes and criteria to be met.

Students work in groups of two or three (minor project) or individually (master thesis). The subject lecturer sees to it that every student delivers results individually that contribute to the group result. The student must show (in a presentation or interim report) that he masters the various competences of the group assignment. In order to guarantee that students are capable of applying and explaining the acquired knowledge and skills individually the students are also individually tested in exams. Students have the opportunity to review the completed, assessed test and to ask for feedback if desired.

The visiting committee studied tests made by students and the feedback given by lecturers. The tests are of a level that, according to the visiting committee, can be expected of a master level. However, some modules and tests (notably of mathematics and electronics) are of a basic level. The modules and tests are meant to rectify the entrance level of students up to the bachelor level. The visiting committee proposed to remediate the starting level of electronics and math before students enter the programme and early in the study programme. Some lecturers proposed to spend more time on making exercises by means of web based tests or workshops, thus increasing the students' necessary basic knowledge by means of guided self-study. The level of the electronics and math modules has the attention of the lecturers and the Curriculum Committee that is responsible for the final level of the modules and the study programme as a whole. Monitoring of the final level is the task of the Board of Examiners.

Quality assurance of tests and assignments

Exams and assignments are made by the lecturer in cooperation with a colleague. At least two assessors are present to take the assessment for the minor project. The results of the tests are always discussed with the course director. Every year the curriculum committee makes random checks of the assessments. Lecturers give students feedback on the minor project and the various assignments. This is done orally during a presentation session or in writing via email. The course coordinator regularly (at least once a year) reviews this feedback by means of random checks.

The Course Board ensures the quality of the tests, firstly by analysing the written tests and adjusting the questions on the basis of student analysis and commentary. Secondly, the professional products are exchanged between the lecturers to ensure the uniformity of the assessment. In addition, the Masters Advisory Council will attend thesis defences on a random basis. This rule is in use since April/May 2013. And finally, the quality of the master thesis is assessed by the Professor of Control System Engineering. He selects several thesis reports and focuses on whether they meet the requirements of the masters' degree level.

Lecturers followed a course on the validation of tests, the drafting of test guidelines, testing and assessment criteria. Protocols for writing test assignments have been developed. The Curriculum Committee closely monitors the quality of the tests yearly (sample survey).

The student who works on his master thesis is supervised by the company and by a MAS supervisor. For the master thesis, the student carries out an assignment within an external organisation (graduation internship). The Course Board assigns an assessor as well as a MAS supervisor for the assessment. The assessment is made by the MAS supervisor, the company supervisor and the assessor. The assessor takes a global view, assessing the report and oral defence. The MAS supervisor looks at how the final product has been achieved and also assesses the report and oral defence. The company supervisor assesses the work submitted. All examiners use the thesis assessment form (*Masters thesis examination form*). The thesis examination form as used in the 2012 - 2013 is according to the visiting committee a good guide for the discussion between assessors and supervisor about the results of the thesis.

For every MAS end qualification several criteria are described that are scored by the examiners. This form is, according to the visiting committee, an improvement of the formerly used examination forms. The Course Board evaluated in 2013 the improvements made in the last academic year. The examination forms are fine-tuned based on feed back given by students and examiners. The visiting committee sees that the examination forms are used by examiners to motivate their judgement about the thesis. The criteria compel examiners to specifically discuss and underpin their score of each end qualification.

The visiting committee observes that the study programme has protocols and procedures in place that are being used by lecturers, supervisors, the Board of Examiners and the Course Board in order to guarantee the quality of testing and the overall quality of the programme (the master level). The master programmes of the faculty of Engineering have one Board of Examiners. The board consists of representatives from the three master programmes of the faculty. At present, the MAS provides the secretary of the Board of Examiners. Based on the policy documents, interviews with members of the various committees and lecturers (assessors) and inspection of tests and products of projects the visiting committee concludes that the assessment system of the MAS programme is adequate. However, a general observation of the visiting committee is that the reporting skills of the students are weak. The assessment system does not affect (remediate or improve) the reporting skills of students (both structural as well as lingual). According to the visiting committee, the MAS could pay more attention to this. See also comments made by the visiting committee that visited MAS in 2009 (initial accreditation) regarding the definition of the level of the learning outcomes of the communication skills of MAS students.

Realisation of the intended learning outcomes

There are two important course elements in which students have to show that they master the end qualifications of the MAS programme. Knowledge and skills are both tested in the minor project and the thesis project. The minor project focuses primarily on the learning skills and progress of the student. The student receives written feedback from the assessor of his minor project on the end qualifications so that he knows where he stands and what can be improved. In the third semester of the study programme the students have to show in the master thesis project that they are able to solve a problem related to and generated in the professional automotive field. The master thesis project focuses on the application of the knowledge and skills that the student has learned and his ability to function at master level at an automotive company or at an automotive research centre. (Description of minor project in *OER; Toetsbeleid Master of Automotive Systems HAN Master programma's, November 2012)* Students may only start the graduation phase when they have attained 55 or more study points.

The visiting committee reviewed fifteen theses. The theses were rated in the range low, medium and high. The visiting committee states that the fifteen theses reviewed at least meet the minimum standards of a master thesis. The thesis that is rated low by the study programme is also rated low by the visiting committee. Some theses have a high level that, according to the committee, have been rated accordingly by the examiners.

Extra attention could be paid to the format of the reports and reporting skills (structure and readability), proper use of scientific sources (including way of referring).

The Masters Advisory Council is satisfied with the quality of the products of the graduates and states that the theses meet the master level (source: interview with member of the MAC). As stated above a member of the MAC attends thesis defences on a random basis.

Considerations and conclusion
The assessment system of the MAS has been under construction in the past two years. According to the visiting committee the system is well defined and protocols and procedures are in place that contribute to valid and reliable tests. Assessors have been trained in test development and assessing students. The quality of the written exams is satisfactory. Special attention should be paid to the level of math and electronics. According to the visiting committee the study programme has a decent assessment system in place that is in a developmental stage. The grading format for the thesis is fine-tuned and the use of the assessment criteria and its effect on the quality of the final assessment will further be evaluated in the coming years.
The technical aspects addressed in the master theses are, according to the visiting committee, of a satisfactory to good level. The reports provide sound information for a company or research group in the field of automotive systems.

Based on above mentioned considerations the audit team comes to the judgement ***satisfactory.***

3 Final judgement of the study programme

Assessments of the standards

The visiting committee comes to the following judgements with regard to the standards:

Standard	Assessment Full-time	 Part-time
1 Intended learning outcomes	Good	Good
2 Teaching-learning environment	Satisfactory	Satisfactory
3 Assessment and achieved learning outcomes	Satisfactory	Satisfactory

Considerations
Weighing of the judgements with regard to the three standards based on the justification for the standards and according to the assessment rules of NVAO:

- The final conclusion regarding a programme will always be “unsatisfactory” if standard 3 is judged “unsatisfactory”. In case of an “unsatisfactory” score on standard 1, NVAO cannot grant a recovery period.
- The final conclusion regarding a programme can only be “good” if at least two standards are judged “good”; one of these must be standard 3.
- The final conclusion regarding a programme can only be “excellent” if at least two standards are judged “excellent”; one of these must be standard 3.

Conclusion
The audit panel assesses the quality of the *hbo master* study programme *Automotive Systems of HAN University of Applied Sciences* as ***satisfactory.***

4 Recommendations

Standard 1 Intended learning outcomes
No specific recommendations

Standard 2 Educational learning environment
Improve reporting skills. Attention could be given to the format of the reports and reporting skills (structure and readability), use of and referring to scientific sources. The visiting committee suggests to give students a report template.

The math course could be more related to application in automotive practice.

Improve reporting of quality assurance measures.

Be aware of the low responses of the evaluation instruments *HBO-Spiegel* and *NSE.* Find ways to enhance the response. Or use only the internal qualitative and quantitative evaluation instruments for analysis of the quality of education.

Standard 3 Assessment system and achieved learning outcomes
Modules and tests notably of mathematics and electronics are of a basic level. The modules and tests are meant to rectify the entrance level of students up to the bachelor level. The visiting committee proposes to remediate the starting level of electronics and math before students enter the programme and further early in the study programme.

5 Annexes

Annex 1: Final qualifications of the study programme

The final qualifications for the Master of Automotive Systems (MAS) are defined as follows:

1. Problem cycle:
To be able to critically analyse the automotive problem through active communication with the problem owner, to translate this into a problem formulation, feasible solution approaches and scientifically valid conclusions and recommendations, to be recommunicated to the problem owner.

2. Abstract level model formulation:
To be able to systematically translate the automotive problem to a model at an abstract level, (i.e. reduce it to its essentials in terms of model and problem requirements) and to validate results against the real-life situation and problem formulation.

3. Scientific knowledge and skills:
To have gained specialised scientific knowledge and skills in the field of automotive engineering.

4. Automotive company processes:
To be able to place automotive engineering activities within the perspective of automotive company processes, including quality control principles.

5. Economic and societal trends:
To be able to incorporate economic (cost) and societal (safety, sustainability) consequences in the design or development process.

6. Multidisciplinary & international context:
Being able to work on a problem within a multidisciplinary context in an industrial environment.
Being able to work on a problem in an international automotive context in an industrial environment.

7. Learning skills:
To be able, through self-reflection, to improve one's own professional behaviour.

The original nine final qualifications for the Master of Automotive Systems (MAS) were defined as follows:

GENERAL

1 To work from an incentive to solve a problem within a multidisciplinary and international context.

2 To effectively manage (self-management) and control his own learning process and that of others (team members, project participants, etc.).

ROLE IN APPLIED RESEARCH

3 To analyse and interpret automotive technologies and technological development, in relation to scientific, macroeconomic and societal developments and trends.

4 To critically analyse the automotive problem through active communication with the problem owner, to translate this to problem formulation, feasible solution approaches and scientifically valid conclusions to then be recommunicated to the (non-specialist) problem owner(s).

5 To systematically translate the automotive problem to a model at an abstract level, i.e. reducing it to its essentials in terms of model framework and problem requirements, and to (qualitatively and quantitatively) validate results against the real-life situation and problem formulation.

6 Specialised scientific knowledge and skills (product, techniques, strategies for experiments, standards) in the broad field of Advanced Automotive Engineering and, particularly, Intelligent Vehicles including knowledge of the changing conditions, influences and uncertainties in research work.

DEVELOPMENT OF AUTOMOTIVE PRODUCTS

7 To derive a feasible (improved) end product from the selected solution approaches (see 4).

UNDERSTANDING OF AUTOMOTIVE PROCESSES AND EVALUATION

8 To advise on optimisation and improvement of automotive company processes within the context of automotive engineering, based on a thorough understanding of these interrelated processes including quality control principles.

9 Assessment of an automotive system/component as part of the automotive end product (the vehicle), i.e. in terms of vehicle performance.

Annex 2: Curriculum Master Automotive Systems

MAS full-time curriculum

Schedule MAS Dynamic Systems 1st year (start september 2013)

program 1st year MAS fulltime students

master	Module	semester 1, per. 1			semester 1, per. 2			semester 2, per. 3			semester 2, per. 4				
		contact hrs	personal work	total period 1	contact hrs	personal work	total period 2	contact hrs	personal work	total period 3	contact hrs	personal work	total period 4	total hrs	total EC
MAS	CPM	16	12	28										28	1
	IAS- introduction	20	8	28										28	1
	MM	28	36	64	21	27	48							112	4
	CBT + pract.	25	36	61	25	26	51							112	4
	VDV	21	35	56	21	35	56							112	4
	DT	28	36	64	20	28	48							112	4
	PMS	28	28	56	14	14	28							84	3
	minor project	3	55	58	4	190	194							252	9
	AVD							28	28	56	28	28	56	112	7
	-mod/sim							12	16	28				28	
	-project										16	40	56	56	
	AVC									0	28	56	84	84	4
	-project										4	24	28	28	
	VE							46	66	112				112	5
	-pract							12	16	28				28	
	CSE - intro mod.							18	18	36				36	4
	-intro contr.							24	24	48				48	
	-lab view										16	12	28	28	
	AM							32	80	112				112	4
	APT - lecture										18	18	36	36	3
	- practical work										24	24	48	48	
	IVHS										20	64	84	84	3
	Total	169	246	415	105	320	425	172	248	420	154	266	420	1680	60

= all cohort 2012 fulltime program, Wednesday afternoon, evening + Thursday afternoon, evening + Friday

after semester 2 students are expected to do a master thesis project for a full semester **30 EC**

MAS part-time Dynamic Systems curriculum

Schedule MAS Part time Dynamic Systems (start september 2013)

program 1st year MAS parttime students cohort 2012 Wednesday afternoon, evening
program 2nd year MAS parttime students cohort 2012 Thursday afternoon, evening

master	Module	semester 1, per. 1			semester 1, per. 2			semester 2, per. 3			semester 2, per. 4					
		contact hrs	personal work	total period 1	contact hrs	personal work	total period 2	contact hrs	personal work	total period 3	contact hrs	personal work	total period 4	total hrs first year	total hrs second year	total EC
MAS	CPM	16	12	28										28		1
	IAS- introduction	20	8	28											EVC	1
	MM	28	36	64	21	27	48							112		4
	CBT + pract.	25	36	61	25	26	51							112		4
	VDV	21	35	56	21	35	56							112		4
	DT	28	36	64	20	28	48								112	4
	PMS	28	28	56	14	14	28								84	3
	minor project	3	55	58	4	190	194								252	9
	Total	169	246	415	105	320	425									30
	AVD							28	28	56	28	28	56	112		7
	-mod/sim							12	16	28				28		
	-project										16	40	56	56		
	AVC										28	56	84		84	4
	-project										4	24	28		28	
	VE							46	66	112					112	5
	-pract							12	16	28					28	
	CSE - intro mod.							18	18	36					36	4
	-intro contr.							24	24	48					48	
	-lab view										16	12	28		28	
	AM							32	80	112				112		4
	APT - lecture										18	18	36		36	3
	- practical work										24	24	48		48	
	IVHS										20	64	84	84		3
	Total							172	248	420	154	266	420	756	896	30

after year 2 students are expected to do a master thesis project for a full semester up to 1 year 30 EC

Schedule MAS Light Weight Design (start september 2013)

program 1st year MAS parttime students cohort 2012 Wednesday afternoon, evening
program 2nd year MAS parttime students cohort 2012 Thursday afternoon, evening

master	Module	semester 1, per. 1			semester 1, per. 2			semester 2, per. 3			semester 2, per. 4					
		contact hrs	personal work	total period 1	contact hrs	personal work	total period 2	contact hrs	personal work	total period 3	contact hrs	personal work	total period 4	total hrs first year	total hrs second year	total EC
MAS	CPM	16	12	28											28	1
	IAS- introduction	20	8	28											EVC	1
	MM	28	36	64	21	27	48							112		4
	CBT + pract.	25	36	61	25	26	51							112		4
	VDV	21	35	56	21	35	56							112		4
	DT	28	36	64	20	28	48								112	4
	PMS	28	28	56	14	14	28								84	3
	minor project	3	55	58	4	190	194								252	9
	Total	169	246	415	105	320	425									30
	AM							32	80	112				112		4
	MeMa							18	18	36	18	30	48	84		3
	FEA							18	14	32	25	13	38	70		7
								27	33	60	26	40	66		126	
	CM							6	12	18	11	21	32	50		5
								3	14	17	25	48	73		90	
	MoMa							13	25	38	20	26	46	84		3
	DLC							6	12	18	21	22	43	61		8
	- assignment							44	52	96	27	40	67		163	
	Total							167	260	427	173	240	413	797	855	30
		after year 2 students are expected to do a master thesis project for a full semester up to 1 year														30 EC

EMAE curriculum

Schedule MAE 2nd year (start september 2013)

program 2nd year MAE fulltime students

master	Module	semester 1, per. 1			semester 1, per. 2			semester 2, per. 3			semester 2, per. 4					
		contact hrs	personal work	total period 1	contact hrs	personal work	total period 2	contact hrs	personal work	total period 3	contact hrs	personal work	total period 4	total hrs	total EC	
MAE																
	Research project															
	HAN Automotive		252	252		392	392							644		
	AVD							28	28	56	28	28	56	112	7	
	-mod/sim							12	16	28				28		
	-assignment	4	52	56										56		
	AVC										28	56	84	84	4	
	-assignment	4	24	28										28		
	VE							46	66	112				112	5	
	-pract							12	16	28				28		
	CSE - intro mod.	18	18	36										36	4	@MCSE
	-intro contr.	24	24	48										48		@MCSE
	-lab view				16	12	28							28		@MCSE
	AM							32	80	112				112	4	
	APT - lecture										18	18	36	36	3	
	- practical work										24	24	48	48		
	IVHS										20	64	84	84	3	
	Total	50	370	420	16	404	420	130	206	336	118	190	308	1484	30	
		= all	cohort 2012 fulltime program, Wednesday afternoon, evening + Thursday afternoon, evening + Friday													
			after semester 2 students are expected to do a master thesis project for a full semester												**30 EC**	

List of abbreviations of subjects / modules

AM	Automotive Management
APT	Alternative Power Trains
AVC	Advanced Vehicle Control
AVD	Advanced Vehicle Dynamics
CBT	Combustion and Thermodynamics
CM	Composite Materials
CPM	Communications and Project Management
CSE	Control System Engineering
DLC	Design Light weight Constructions
DT	Driveline and Transmissions
FEA	Finite Element Analysis
IAS	Introduction Automotive Systems
IVHS	Intelligent Vehicle Highway Systems
MeMa	Mechanics of Materials
MM	Mechanics and Mathematics
MoMa	Modelling of Materials
MP	Minor Project
PMS	Practice Modelling and Simulation
VE	Vehicle Electronics
VD	Vehicle Dynamics
MeMa	Mechanics of Materials

Annex 3: Expertise members audit panel and secretary

Expertise of the Panel Members and Secretary Master Of Automotive Systems, Hogeschool van Arnhem en Nijmegen

Additional information concerning panel members and secretary:

Mr prof. ir. J.P.M. De Wachter
Mr De Wachter has primarily been asked because of his professional area of expertise in the domain of technique and because of his knowledge of international developments. Mr De Wachter is professor at Karel de Grote Hogeschool, department Industrial Science and Technology: mechanics, thermodynamics, climate control, engines, CAD/CAM, ecology, communication and management. For more than 15 years he has been head of the master Electromechanics at the same school. For a few years Mr De Wachter has been active in internationalisation projects, for example in developing the master curriculum of CarEcology. Since October 2013 a new curriculum development started: G-DRIVE, a cooperation between the Universities Bradford, Bilbao, La Rochelle and Jakarta.
Mr De Wachter gives guest lectures abroad, including Turku, Radom, Valencia, Valladollid and Tessaloniki. Mr De Wachter received our manual for panel members and has individually been briefed on the audit visit process, accreditation in higher education and NQA's working method.

Education:

1969 – 1974	Electro-Mechanical Engineering - University of Leuven

Work Experience:

1998 – present	Head of the master Industrial Science and Technology - Karel de Grote Hogeschool
1978 – present	Teacher - Karel de Grote Hogeschool and University Antwerpen
1975 – 1977	Employee - Ministry of Post and Telecommunications, Algiers

Mr Prof. B.J.H. Jacobson
Professor Jacobson has primarily been asked due to his expertise in the domain of automotive systems. He is professor in Vehicle Dynamics and group leader for the group Vehicle Dynamics at Chalmers University of Technology, Göteborg, Sweden. His experiences are from modeling and control of powertrain, chassis and active safety systems, as well from academia as industry. He has been individually briefed on the audit visit process, accreditation in higher education and NQA's working method.

Education:

1998	Teknisk Docent, Machine & Vehicle Design
1993	PhD (Teknisk Doktor), Machine Elements
1987	MSc (civil-ingenjör), Mechanical Engineering

Work experience:

2011 – present	Chalmers University of Technology
2001 – 2010	Volvo Car Corporation, Vehicle Dynamics & Active Safety
1987 – 2000	Chalmers University of Technology
1983 – 1987	Volvo Bus Corporation

Others:

- Member of editorial board for International Journal of Vehicle Systems Modeling and Testing (IJVSMT)
- Member of council for Fuel Cell and Hybrid Electric Vehicle research program at Swedish Energy Agency
- Member of Board of Experts in the Italian Ministry of Education, University and Scientific Research (MIUR). For evaluation of research proposals within Automotive Engineering.
- Leading Ford Motor Company in global Industry Standardization Projects (AUTOSAR, chassis and driving dynamics work package)
- Some 5 patents filed/to be filed. Some 10-15 invention disclosures. Filed patents in the areas: Yaw Control by Steering Wheel Torque, Post Impacty Stability Control, Roll Control by Steering.
- Henry Ford Technology Award, for Global Advanced Engineering project "Integrated Vehicle Dynamics Control #1", 2003. With Peter redlich and Rainer Busch at Ford Germany.
- Technical Specialist, Volvo Cars Corporation (Functional Architecture + Dynamic Safety + Responsible for Lane

Publications (2013 and 2012; more on request)

2013 Edrén, Johannes; Jonasson, Mats; Trigell, Annika Stensson; Sundström, Peter; Jacobson, Bengt; Andreasson, Johan: Road friction effect on the optimal vehicle control strategy in two critical manoeuvres. *International Journal of Vehicle Safety*,

2012 Yang, Derong; Gordon, T. J.; Jacobson, Bengt; Jonasson, M.: A nonlinear post impact path controller based on optimised brake sequences. *Vehicle System Dynamics*, 50 pp. 131-149.

2012 Yang, Derong; Jonasson, Mats; Jacobson, Bengt; Gordon, Tim: Closed-loop Controller for Post-Impact Vehicle Dynamics Using Individual Wheel Braking and Front Axle Steering. *Proceedings of the 2012 International Conference on Advanced Vehicle Technologies and Integration, Changchun, China, July, 2012.* ,

2012 Yang, Derong; Gordon, Tim; Jacobson, Bengt; Jonasson, Mats: Quasi-linear Optimal Path Controller Applied to Post-Impact Vehicle Dynamics. *IEEE transactions on intelligent transportation systems*, 13 (4) pp. 1586-1598.

Mr ir. ing. R.M.A.F. Verschuren

Mr Verschuren has primarily been asked because of his field of expertise. Mr Verschuren works as a specialist at vehicle dynamics at TNO, where his activities include B2B (business to business), contract research especially in the field of active suspension, hydraulic controls, servo systems, control and vehicle dynamics. Mr Verschuren received the manual for panel members and has individually been briefed on the audit visit process, accreditation in higher education and NQA's working method.

Education:

1995 – 1999	Mechanical Engineering, Major: Vehicle Dynamics, with honors - Delft Technical University
1990 – 1994	Mechanical Engineering - Technische Hogeschool Rijswijk
1983 – 1989	Gymnasium β - Gymnasium Bernrode, Heeswijk-Dinther

Work experience:

2010 – 2013	Specialist at vehicle dynamics - Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO
2007 – 2010	Project lead engineer - DAF Trucks N.V., Eindhoven Vehicle Control group
1999 – 2007	Project Manager - Business unit TNO Automotive - Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO

Mr J.G.S. van Uden

Mr Van Uden has been invited as a student panel member. He studies the master degree of Automotive Technology at Technical University in Eindhoven. As a team member of University Racing Eindhoven (URE) Mr Van Uden is responsible for the electronics in the racing car of URE. This year, after five petrol cars, URE is working for the second time on an electrical formula racing car, which has been designed, built and tested by students. His role within the team includes: designing, making and testing the electronic systems. This requires close cooperation with other disciplines within the team. Mr Van Uden represents the students' view on teaching methods, facilities and quality of field work. He has been given additional individual briefing about audit visit procedures and NQA's working method.

Education:

2011 – 2013	Master Automotive Technology, Technical University, Eindhoven
2004 – 2011	Bachelor Electrical Engineering, Technical University, Eindhoven
1997 – 2004	VWO, Strabrecht College, Geldrop

Work experience:

2006 – present	Employee sales kitchen department - IKEA
2005 – 2006	Employee technical service and sales - Computerland
2004 – 2005	Employee Production & Repair - Prodrive Electronics
2002 – 2004	Sales employee - Slijterij De Wijnhoeve

Other activities:

2006 – present	Team member Electronics - University Racing Eindhoven
2006 – 2008	Board Member (secretary) - ESRAC (Eindhovense Studenten Radio Amateur Club)
2007 – 2009	Editor of Faculty Magazine Connecthor – Technical University Eindhoven
2008 – 2009	Financial Control Committee - e.t.s.v. Thor, Eindhoven
2006 – 2007	Yearbook Committee - e.t.s.v. Thor, Eindhoven
2005 – 2006	Activities Committee - e.t.s.v. Thor, Eindhoven
2004 – 2006	Team Member Public Relations - Formula Student Racing Team Eindhoven (FSRTE)

Mr drs. ing. A.G.M. Horrevorts

Mr Horrevorts has been asked to serve as an NQA auditor. Apart from more than ten years' experience with audit visits in almost all sections of *HBO* [higher professional education], his auditor qualities are based on many years of assessment experience as well as having auditing courses at INK and Lloyd's Register. In 2000 he attended the postgraduate course Institutional Management and Change in Higher Education' at the Centre for Higher Education Policy Studies (CHEPS), Twente University and Open University, United Kingdom. In the autumn of 2010 Mr Horrevorts completed an NVAO training course which made him a qualified secretary.

Education:

2004	Training INK-auditor
2000	Certificate Postgraduate course 'Institutional Management and Change in Higher Education' at the Centre for Higher Education Policy Studies (CHEPS), Twente University and Open University, United Kingdom.
1977 – 1983	Social Geography, 'Vrije' University Amsterdam
1969 – 1973	Metallurgy, HTS Utrecht
1963 – 1968	HBS-B, Pius X College, Almelo

Working Experience:

2004 – present	Senior auditor NQA
2000 – 2003	HBO-council, quality assurance department. Secretary of various auditing committees.
1993 – 2000	Programme Assistant Higher Education and Development Cooperation, Nuffic. Managing educational projects at Universities in the Philippines, India and Bangladesh.
1985 – 1992	Project leader 'Development education' in a project of Foundation Tool, HBO-council and Nuffic. Developing of educational materials in cooperation with Technical Schools of Higher Education. Theme: Technology and Society / internationalisation / development cooperation.
1974 – 1977	Teacher technical education in the Philippines

Annex 4: Program for the site visit

26 November 2013	Program part	Participants
13:30 16:30 – 17:30	Laboratory tour HAN Automotive Consulting hour	Visiting committee Dr. Ir. Joop Pauwelussen, MbA, Lector Ing Thymen Kamerling, Program manager MAS Students and lecturers did not make use of this facility to speak with the visiting committee

Time	Program part	Participants
27 November 2013		
08.30 – 09.15	Block content I: final thesis	Lecturers + external supervisors/ assessors (industry representatives) of the selected thesis documentation) • Dr. Ir. Peter Mesman HAN Lecturer • Ing. Menno Merts HAN Research Engineer • Dr. Ir. Joop Pauwelussen MBA HAN Professor • Ing.Thymen Kamerling HAN Lecturer • Ir. Saskia Monsma HAN Lecturer • Arjan Heinen e-Traction Managing Director • Ir. Thijs Purnot DTI Drivetrain Systems Engineer • Bert van Leeuwen MEE Application engineer R&D • P. March TRW
09.30 – 10.15	Block Content II: Graduation phase	Graduates and students in graduation phase (graduated max. 2 year), if possible, the students of the selected thesis • Sathvick Shiva Kumar Graduate 12-09-2013 • Anirudh Kurra Graduation phase • Ruben Keizer Graduate 02-02-2012 • Timothy van Seventer Graduate 04-08-2011 • Wessel Kuijten Graduate 09-10-2013 • Kartik Balaji Venkatapathy Graduation phase
10.30 – 11.15	Block content III: Main course	Students main course • Abhishek Singh Tomar (Bachelor) Manipal University India (batch 2013) • Johnathon Stewart (Bachelor) University of New South Wales Sidney (batch 2013) • Raja Anirudh Garapati (Bachelor) SRM University India (batch 2013) • Niels van Groningen (Bachelor) HAN Automotive (batch 2013 part time)

		• Thijs Jacobs (Bachelor) HAN Automotive (batch 2013 part time) • Thijs Boonen (Bachelor) HAN Automotive (batch 2012 part time) • Andrew Manoj Balachander (Bachelor) Karunja University India (batch 2012) • Arpit Karsolia (Bachelor) SRM University India (batch 2012)
11.30 – 12.15	Interview with lecturers	Representatives of teaching staff, dispersal subjects (supervising, research group) The Master of Automotive Systems has 2 theoretical semesters • Ir. Egon Haffmans Control Systems Engineering • Dr. Ir. Stefan van Sterkenburg Vehicle Electronics, Advanced Power trains Research group • Karel Kural Msc. Advanced Vehicle control, Dynamics Research group • Ir. Pieter van Baardwijk Automotive Management • Drs. Johan de Vries Mathematics • Dr. Ir. Joop Pauwelussen MBA Professor, Vehicle Dynamics and Vibrations, Advanced Vehicle Dynamics, Advanced vehicle Control, Minor Project, Research group Supervising • Ir. Saskia Monsma Vehicle Dynamics and Vibrations, Advanced Vehicle Dynamics Research group • Ir. Nick den Uijl Mechanics, Design Light weight Constructions, Material Science, Finite element Analysis, Research group
12.15 – 13.15	Lunch + discussion, extra review material	Visiting committee
13.15 – 14.00	1e interview with management	Management • Ing Thymen Kamerling Program manager MAS • Drs. Ans Gielen Managing director HMP • Ir. Marc de Leeuw Managing director HAN Automotive
14.15 – 15.00	Block quality assurance	Board of examination, Degree course committee, Master advisory council, curriculum committee

		• Dr. Hans Bosma Research group HAN Automotive Degree course committee • Ing. Chris van Beekum Board of examination • Karel Kural Msc Research group HAN Automotive Curriculum committee • Ir. Gerard van Lankveld Benteler Engineering Manager Engineering Master Advisory Council • Ing. Thijs Boonen Part time Student MAS DAF Trucks: Engineer Non Standard Orders Degree course committee
15.15 – 16.30	Evaluation and discussion	Visiting committee
16.30 – 17.00	Presentation of the results of the visit by the visiting committee	Management and lecturers

Annex 5: Documents examined

Document	Code/ location
The new final qualifications for MAS	Folder 1 tab 1
Accreditation framework for new degree courses in Higher Education - Proposal for a Master of Automotive Systems (MAS)	Folder 1 tab 2
Dublin Descriptors and MAS final qualifications	Folder 1 tab 3
Minutes MAC [MAC minutes]	Folder 1 tab 4
OS/OER, Studiegidsen [OS/OER Study Guides] 2012-2013, 2013-2014	Folder 1 tab 5
Civil Engineering Body of Knowledge for the 21st Century, ASCE Report (2008)	Folder 1 tab 6
E. Jansen, B. Heine.: *Hogeschool brede competentiedefinitie "onderzoek doen"* [Broad definition of "doing research" for universities of applied science]	Folder 1 tab 7
Master of Automotive Systems Body of Knowledge and Skills	Folder 1 tab 8
www.automotivenl.com	Internet
Jaarverslag 2012 Kenniscentrum technologie en samenleving [2012 Annual Report of the Knowledge Centre for Technology and Society]	Folder 1 tab 9
Strategisch kwaliteitszorgplan HMP juli 2013 [HMP Strategic Quality Assurance Plan, July 2013]	Folder 1 tab 10
Kwaliteitszorg MAS [MAS Quality Assurance] *2013-2014*	Folder 1 tab 11
Alumni overzicht MAS [MAS alumni overview]	Folder 1 tab 12
Rapportage interne audit, 2012 [Internal audit report, 2012]).	Folder 1 tab 13

Document	Code/ location
Master of Automotive Systems Course Guide 2012 – 2013	Folder 2 tab 1
OS/OER Studiegidsen [OS/OER Study Guides] 2012-2013, 2013-2014	Folder 1 tab 5
Master of Automotive Systems Body of Knowledge and Skills	Folder 1 tab 8
Examinationform AVD assignment [AVD assignment examination form]	Folder 2 tab 2
http://www.han.nl/onderzoek/kennismaken/technologie-en-samenleving/lectoraat/mobiliteitstechnologie/	Internet
http://www.han.nl/onderzoek/kennismaken/technologie-en-samenleving/lectoraat/voertuigmechatronica/	Internet
www.acemobility.nl	Internet
Lijst publicaties [List of publications]	Folder 2 tab3
Literatuurlijst MAS [MAS literature list]	Folder 2 tab 4
Algemene notulen curriculumcommissie [General minutes of the Curriculum Committee]	Folder 2 tab 5
EMAE exemption regulations	OS/OER
Strategisch Personeelsbeleidsplan HAN Masterprogramma's 2013-2017 [Strategic Staffing Policy Plan for HAN Masters courses 2013-2017]	Folder 2 tab 6
Overzicht docentenprofiel [Overview of lecturer profiles]	Appendix 7
CV's docenten [Lecturer CVs]	Folder 2 tab 7
https://www1.han.nl/insite/home/	Intranet
http://www.han.nl/international/english/about-han/international-office/	Internet
Kwaliteitszorg MAS 2013-2014	Folder 2 tab 8
Rapportage Interne Audit, 2012 [Internal audit report, 2012]).	Folder 1 tab 13
HBO-spiegel survey *2013*	Folder 2 tab 9
'Eenheid in verscheidenheid' ['Unity through Diversity'] memo	Folder 2 tab 10

Document	Code/ location
Kaderstellend toetsbeleidsplan HMP-masterprogramma's [HMP Test Policy Plan Framework for Master Courses], *2012*	Folder 3 tab 1

Toetsbeleid Master of Automotive systems HAN Master programma's [HAN Masters Courses Testing Policy for Master of Automotive Systems]*, November 2012*	Folder 3 tab 2
Master of Automotive Systems Course Guides 2012-2013, 2013-2014	Folder 2 tab 1
Opleidingsstatuut MAS [MAS Course Statute]*/OER* 2012-2013, 2013-2014	Folder 1 tab 5
Curriculumbeschrijvingen [Curriculum descriptions]	OS/OER
MAS_AM_PVB_case_casenaam_beoordelingsformulier assessment form	Folder 3 tab 3
CBT literature review examination form	Folder 3 tab 4
Minor project examination form	Folder 3 tab 5
AVD-project feedback report	Folder 3 tab 6
AVD assignment examination form	Folder 3 tab 7
Stramien voor het schrijven van toetsopdrachten [Guidelines for writing test assignments]	Folder 3 tab 8
Individuele vakbeoordelingscriteria [Individual subject assessment criteria]	Folder 3 tab 9
EMAE exemption regulations	OS/OER
Vrijstellingsdocumenten [Exemption Documents]	Folder 3 tab 10
Gebundelde besluiten en notulen examencommissie [Collected Decisions and Minutes of the Board of Examiners]	Folder 3 tab 11
Regulations of the Board of Examiners for the Masters courses Automotive Systems (MAS), Information Systems Design (MISD) and Control Systems Engineering (MSCS) 2012-2013	OS/OER
Regulations of the Board of Examiners for the Masters courses Automotive Systems (MAS), Information Systems Design (MISD) and Control Systems Engineering (MSCS), September 2013 cohort	OS/OER
Implementation rules of the Examination Commitee (*EC*), Regulations for the Masters degree course in Automotive Systems (MAS)	OS/OER
HANdboek EXAMENZAKEN STUDIEJAAR [EXAM HANdbook ACADEMIC YEAR] *2013-2014*	Folder 3 tab 12
Minor project description	OS/OER
Thesis project assignment format	Folder 3 tab 13
Thesis project examination form	Folder 3 tab 13
HBO-spiegel survey	Folder 2 tab 9
Kwaliteitszorg MAS 2013-2014	Folder 3 tab 14
Beoordelingsformulier masterthesis [Masters thesis assessment form]	Folder 3 tab 15
Besluit m.b.t. de beoordeling en de vaststelling van de uitslagen van tentamens en examens cursusjaar 2012 – 2013 [Decision concerning the assessment and determination of test and exam results for the academic year 2012-2013].	Folder 3 tab 16

Annex 6: Summary theses

List of students whose theses have been examined by the panel.

Student numbers cohort 2010
486659
420975
486692
415749
487193
486676
487199
487201

Student numbers cohort 2011
486650
429643
502180
502122
502179
502113
480871

Annex 7: Declaration of Comprehensiveness and Accuracy

Netherlands Quality Agency

NQA

Verklaring van volledigheid en correctheid van de informatie

Betreffende de visitatie van de opleiding:

Master of Automotive Systems

Instelling: HAN.

Visitatiedatum: 26 en 27 november 2013

Ondergetekende: Mevr. Drs. A.P.M. Gielen

vertegenwoordigend het management van de genoemde opleiding,

in de functie van: Directeur Interfacultair Instituut HAN Masterprogramma's.

verklaart hierbij dat alle informatie ten behoeve van de visitatie van de genoemde opleiding in volledigheid en correctheid ter beschikking wordt gesteld, *waaronder informatie over alternatieve afstudeerroutes die momenteel en/of gedurende de afgelopen 6 jaar (hebben) bestaan,* zodat het visitatiepanel tot een op juiste feiten gebaseerde oordeelsvorming kan komen.

Handtekening:

Hogeschool van Arnhem en Nijmegen
HAN Masterprogramma's

Datum: 22-10-2013