NVAO • THE NETHERLANDS

INITIAL ACCREDITATION

HBO-MASTER

APPLIED DATA SCIENCE

HAN University of Applied Science

FULL REPORT

18 NOVEMBER 2022

Content

1 Peer review

The Accreditation Organisation of the Netherlands and Flanders (NVAO) determines the quality of a new programme on the basis of a peer review. This initial accreditation procedure is required when an institution wishes to award a recognised degree after the successful completion of a study programme.

The procedure for new programmes differs slightly from the approach to existing programmes that have already been accredited. Initial accreditation is in fact an ex ante assessment of a programme. Once accredited the new programme becomes subject to the regular review process.

The quality of a new programme is assessed by means of peer review. A panel of independent peers including a student reviews the plans during a site visit to the institution. A discussion amongst peer experts forms the basis for the panel's final judgement and the advisory report. The agenda for the panel visit and the documents reviewed are available from the NVAO office upon request.

The outcome of this peer review is based on the standards described and published in the limited NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2019, nr. 3198). Each standard is judged on a three-point scale: meets, does not meet or partially meets the standard. The panel will reach a conclusion about the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

NVAO takes an accreditation decision on the basis of the full report. Following a positive NVAO decision with or without conditions the institution can proceed to offer the new programme.

This report contains the findings, analysis and judgements of the panel resulting from the peer review. It also details the commendations as well as recommendations for follow-up actions. A summary report with the main outcomes of the peer review is also available.

Both the full and summary reports of each peer review are published on NVAO's website www.nvao.net. There you can also find more information on NVAO and peer reviews of new programmes.

2 New programme

2.1 General data

Institution	HAN University of Applied Science (Hogeschool van Arnhem en Nijmegen)
Programme	hbo-master Applied Data Science
Variants	Fulltime: No. Parttime: Yes. Dual: No.
Degree	Master of Science
Tracks	-
Locations	Arnhem
Study load	60 EC[1]
Field of study	Techniek

2.2 Profile

The Master's Programme Applied Data Science (MADS) aims to *train professionals who make a significant contribution to the creation, development and deployment of data analytics solutions that businesses and organisations use to enhance processes, support decision making, or build models. These professionals help organisations create value from data*. It is a two-year part-time programme, consisting of 60 EC. Students are required to have a relevant workplace during the programme. The programme is primarily targeted at professionals with several years of work experience. The programme is taught in English.

The programme was developed by three different Schools within HAN University of Applied Science (HAN): School of Engineering and Automotive (AEA), School of Applied Biosciences and Chemistry (ATBC) and School of IT and Media Design (AIM). The three Schools provide lecturers and research projects for the programme, which is embedded in the research environments of the Schools. AIM acts as the lead School. AIM offers two Bachelor's programmes (HBO-ICT and Communication & Multimedia Design) and has four professorships *(lectoraten).*

2.3 Panel

Peer experts

- dr. ir. Marlies van Steenbergen (*chair*), Professor Digital Ethics at HU University of Applied Sciences Utrecht;
- dr. Celia van Gelder, Programme Manager Learning at Dutch Techcentre for Life Sciences (DTL);
- Tristan Fransen, Head of department PXL-Digital at PXL University of Applied Sciences and Arts;
- ir. Wietske Rem (*student*), (graduated in 2021) MSc Mechanical Engineering in Design & Construction at University of Twente, currently working as Junior Mechanical Engineer.

Assisting staff

Anne-Lise Kamphuis (secretary)
Frank Wamelink (NVAO policy advisor and process coordinator)

Site visit

20 October 2022, HAN University of Applied Science

[1] European Credits

3 Outcome

The NVAO approved panel reaches a positive conclusion regarding the quality of Applied Data Science offered by HAN University of Applied Science (HAN). The programme complies with all standards of the limited NVAO framework.

The programme aims to train professionals to develop and deploy effective data science solutions for businesses and organisations. The panel is pleased with the professional profile of the programme and sees that it aligns well with the discipline of (applied) data science and with the needs of the professional field. Representatives of the professional field clearly confirm the need for professionals in applied data science who can operate as a bridge between data scientists/engineers and other stakeholders in organisations.
The final qualifications (intended learning outcomes) are well defined and appropriate for a professional Master's programme. The final qualifications are divided into six areas: problem understanding, data understanding, data analytics, deployment, professional skills and research. The panel appreciates the way the programme has integrated the two 'worlds' of business and research in data analytics solutions, which underpins the applied nature of the programme.

The curriculum, consisting of four successive units of study, is thoroughly thought-out, covering all final qualifications. The first three units of study consists of lectures, workshops and a real-life (research) project in applied data science that students work on in groups. Typically, students spend one day a week at the HAN location, while the rest of the time is spent on self-study. The fourth unit of study is the Graduation project, in which students carry out a data science project individually.

The learning environment is based on self-directed learning, focusing on the student's own learning process, which fits well with the target group. Lecturers act as coaches and expert partners to support the individual student's developments. Multiple feedback moments are scheduled in each unit of study to facilitate this. Also, extra time is allocated for lecturers to be able to provide individual coaching.

The admission requirements and procedures are appropriate. Also, the panel is pleased with the competence, enthusiasm and strong team spirit demonstrated by the lecturer team. A number of lecturers work in the professional field as well.

The programme's assessment policy and vision are adequate and embedded in existing policy and structures within HAN. The assessment plan includes a fine variety of test methods. Also, the programme takes adequate measures to enhance the reliability of grading, like the four-eyes-principle, calibration sessions and using detailed assessment forms/rubrics. The Board of Examiners is professional and competent. There are good structures and procedures in place to assure the quality of assessment.

The panel concludes that the programme's profile and final qualifications are appropriate and in line with the needs and expectations of the discipline and professional field. The teaching-learning environment is well designed and tailored to the target group. Also, the lecturer team is competent and enthusiastic. The programme's assessment policy and plan are adequate and assessment quality is properly monitored and safeguarded by the Board of Examiners.

Standard	**Judgement**
1. Intended learning outcomes	meets the standard
2. Teaching-learning environment	meets the standard
3. Student assessment	meets the standard
Conclusion	*positive*

4 Commendations

The programme is commended for the following features of good practice.

1. Professional profile – The programme aims to educate professionals in applied data science who can operate as a bridge between data scientists/engineers and other stakeholders in organisations, which aligns well with the needs and expectations of the professional field.

2. Applied research – The programme has integrated the two 'worlds' of business and research in data analytics solutions. Both research skills and the business perspective are included and integrated in the data science life cycle. The systematic approach is well represented in the Schema Applied Data Science developed by the programme, which is the basis for all project work in the programme.

3. Curriculum – The curriculum is well thought-out, with each unit of study building on the previous one.

4. Research environment – The programme is embedded in a strong research environment within HAN.

5. Lecturer team – The lecturers are engaged and motivated and the proposed programme is clearly the result of a prolonged team effort. All required disciplinary expertise and didactical qualifications are covered in the lecturer team. Also, several lecturers are still working in the professional field and the team includes ample lecturers with a PhD, some of whom also work at an academic university.

6. Assessment – The assessment policy and vision are clear and well-embedded in existing policy and structures within HAN. The variety of test methods used is balanced, supporting the student's own learning process.

7. Board of Examiners – The Board of Examiners is professional and competent in monitoring and safeguarding the quality of assessment and the exit level of the programme. The new programme will be well embedded in existing structures and procedures to assure quality of assessment.

5 Recommendations

For further improvement to the programme, the panel recommends a number of follow-up actions.

1. Professional profile – Intensify connections with the HBO-i network and align the professional profile with the HBO-i domain description of applied data science.

2. Overview curriculum design – Develop a more straightforward and coherent instrument to synchronise all aspects of the curriculum design (like the final qualifications, learning outcomes, BoKs, etc.) and maintain the overview.

3. Online learning environment – Make a clear choice for one existing platform (as opposed to working with multiple platforms) in advance and make use of existing online content where possible.

4. Workplace – Contact the student's employer, at the latest in the second year, to inform the employer about the programme and graduation project and to align expectations regarding facilitation and coaching in the workplace.

5. English proficiency lecturers – Incorporate English proficiency in the professionalisation policy and formalise the demonstration of English proficiency by having lecturers get a certificate.

6. Design of tests and rubrics –Pay sufficient and timely attention to the design of tests and rubrics and make this a team effort and responsibility.

7. Board of Examiners – Recruit a new (external) member who has experience and expertise regarding assessment on master level.

8. Advisory Board – Establish an Advisory Board as soon as possible. This committee will play a very important role in reflecting on the development of the curriculum and validating the intended learning outcomes.

6 Assessment

6.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Judgement

Meets the standard.

Findings, analysis and considerations

Programme's profile

The programme Applied Data Science trains professionals who make a significant contribution to the creation, development and deployment of data analytics solutions that businesses and organisations use to enhance processes, support decision making, or build models. These professionals help organisations create value from data. Graduates will be able to translate (organisational and research) problems into a data science approach, collect and interpret data sources, use data science and machine learning algorithms and techniques to build models, create visualisations and present findings to stakeholders. Graduates have an analytical and practice-oriented approach and possess the communication skills and professional attitude to participate in multi-stakeholder teams. In developing the professional profile, the programme took into account the data scientist profile developed within the European EDISON data science framework as well as the life cycle of data science as described in the CRISP-DM process model (Cross Industry Standard Process for Data Mining

The panel is pleased with the programme's profile and sees that it aligns well with the needs and expectations of the professional field. Representatives of the professional field, some of whom were involved in the design of the curriculum, clearly confirm the need for professionals in applied data science who can operate as a bridge between data scientists/engineers and other stakeholders in organisations. Also, the profile ties in with the needs of regional businesses and organisations. Moreover, the panel appreciates how the profile is supported and shared among the programme's lecturer team.
However, the panel wonders why the programme did not incorporate the 'applied data science' profile described in the domain description of HBO-i. It recommends the programme to intensify connections with this network and make sure the profile is aligned with its domain description.

The panel considers the name of the programme appropriate, as it matches the contents and the profile of the programme.

Final qualifications

Based on the professional profile the programme defined final qualifications (intended learning outcomes) in six areas: problem understanding, data understanding, data analytics, deployment, professional skills and research. The first four areas reflect the steps in the data science life cycle (as described in the CRISP-DM model). Professional and research skills were added to complete the qualifications of a master in applied data science. The panel agrees with the final qualifications and appreciates how they are linked to the CRISP-DM life cycle and the EDISON framework. The panel also acknowledges that the final qualifications correspond with the Master's level. This was extensively demonstrated in the application documents of the programme by the use of the Dublin descriptors, the EDISON framework and Bloom's taxonomy. According to the panel, this is also reflected in the learning outcomes, study materials and assessment.

The panel discussed the level of the final qualifications in the area of research with representatives of the programme. These interviews convinced the panel that the final qualifications regarding research are well defined and fit the applied character of a professional Master's programme. The programme described a convincing vision on the difference between research in a Bachelor's and a Master's programme. The master level is especially demonstrated in the ability to critically reflect on the chosen methodology and its limitations, to identify in which

other professional contexts the acquired knowledge may be applicable, and to work and report systematically according to a scientific structure. This view proves to be in line with 'The Professional Master Standard' of the Vereniging Hogescholen.

The panel appreciates the way the programme has integrated the two 'worlds' of business and research. This is clearly demonstrated in the 'Schema Applied Data Science' developed by the programme, in which both research skills and the business perspective (by means of the tool 'Machine learning canvas') are included and integrated in the data science life cycle. The use of the data science life cycle (CRISP-DM) underpins the applied nature of the programme.

HAN context
The new programme fits well within the strategy and mission of HAN University of Applied Sciences (HAN). Currently, HAN is investing in building a stronger data science ecosystem (i.e. by recruiting a new professor), a development that is very much in line with the new programme. Moreover, HAN's vision is to educate agile, reflective professionals with good digital skills. The intention is that the programme will be at the heart of and contribute to this broader ambition. Also, the international network of HAN (especially with organisations in Germany) is beneficial for the programme.

Conclusion
The panel is pleased with the professional profile of the programme and sees that it aligns well with the discipline of (applied) data science and with the needs of the professional field. The final qualifications (intended learning outcomes) are well defined and appropriate for a professional Master's programme.

6.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Judgement
Meets the standard.

Findings, analysis and considerations

Curriculum
According to the panel, the programme translated its profile and intended final qualifications into a well-designed curriculum providing learning activities that enable students to achieve these qualifications. The curriculum covers two academic years (part-time) and consists of 60 EC, divided into four successive units of study (UOS) of 15 EC each. These are: Data exploration (semester 1), Predictive Modelling (semester 2), Model deployment (semester 3) and Graduation project (semester 4). For each UOS learning outcomes have been formulated, using Bloom's taxonomy. In relation to this, the programme developed a Body of Knowledge and Skills (BoKS) in consultation with representatives from the professional field and in line with EDISON's data science BoKS. All topics in the BoKS have been linked to a UOS.

The panel considers the curriculum to be well thought-out and appreciates how each UOS builds on the previous one. The programme presented various tables and matrices to substantiate the level and constructive alignment of the curriculum design. Although the totality of the of tables and matrices ultimately made sense to the panel, it was quite complicated to achieve understanding. The panel trusts that the programme will be able to monitor the curriculum design in relation to the final qualifications, learning outcomes and BoKS, but it advises the programme to develop a more straightforward and coherent instrument to synchronise all aspects of the curriculum design and maintain the overview.

Teaching-learning environment

Each UOS consists of lectures (except UOS 4), workshops and a project. UOS 3 also offers capita selecta on specific topics. In general, one day a week is scheduled for lectures, workshops and project work at the HAN location. The rest of the study load consists of self-study, for which the programme provides online resources, literature and assignments. The learning environment also includes the student's workplace, primarily as a source of real-life cases for project work, as it is not the objective that students learn on the job. The panel learned that it is the programme's intention to have professors, lecturers, researchers and students work together at the same location one day a week (when the students are at the HAN location). The panel appreciates this idea, as all involved would benefit from it. It wants to encourage the programme to follow through on it.

In each UOS students work on a project in applied data science. All projects are based on real-life case studies. With the exception of UOS 4 (Graduation project), students work on their projects in groups. The projects can be provided by businesses or organisations in the professional field or by one of the HAN research groups involved in the programme. The panel is pleased that the projects may also be located in the research groups, since this reduces dependency on the professional field for providing projects. Also, having students participate in existing research projects is a win-win situation, as students can find interesting projects more easily and research groups have more manpower. The panel is satisfied with how the programme is embedded in HAN's research environment. From the interviews the panel learned that data science problems emerge in many fields of study within HAN which provides a rich source for projects.

The panel considers the graduation project to be well designed. In the graduation project students carry out a data science project individually. They can choose a project within their own workplace or at a workplace from one of the programme's network members. The panel is glad to see that there are sufficient existing projects for students to participate in, in case there is no appropriate project available in their own workplace. Before starting the graduation project, students write a project proposal, which needs to be approved. Criteria for approval guarantee the appropriateness of the graduation projects.

The panel learned that the online learning environment still needs to be fully developed. Currently the programme is looking at a mix of existing platforms and data sources. Although good use of what is already available is recommendable, the panel also warns for fragmentation and suggests to systematically assign the development of the online learning platform in the organisation. It recommends the programme to make a clear choice for one existing platform (as opposed to working with multiple platforms) in advance and make use of existing online content where possible.

The didactic approach is based on self-directed learning, focusing on the student's own learning process. Lecturers act as coaches and expert partners to support the student's developments. In order to support the student's own learning process, multiple feedback moments are scheduled in each UOS. Also, guidance and feedback are tailored to the individual student's needs and developments. In addition to the support provided by lecturers in the UOS's, each student has a study coach to guide and support him/her throughout the programme. The panel appreciates this approach and is pleased to see that extra time has been allocated for lecturers to be able to provide this relatively intensive form of coaching and support. The programme is also aware of the challenges related to the expected diversity of the student population and is prepared for it. The panel encourages the programme to continuously monitor the coaching and feedback process once the programme has started.

Admission

To be admitted to the programme, applicants must have a relevant bachelor's degree, sufficient knowledge of mathematics and statistics, sufficient programming skills and proficiency in English (B2 or higher). Also, they need to have affinity with data science and informatics and have a suitable workplace. Applicants write a motivation letter to demonstrate that they meet the requirements. This is evaluated in an admission interview. The panel agrees with the admission criteria and appreciates the clear requirements regarding prior knowledge in terms of mathematics, statistics and programming. The programme offers pre-master courses to students who do not meet the admission criteria .

With respect to the workplace criterium, the panel thinks that measures should be taken to ensure its quality and suitability. The panel advises the programme to contact the student's employer, preferably from the start of the programme but at the latest in the second year, to inform the employer about the programme and graduation project and to align expectations regarding facilitation and coaching in the workplace.

During the site visit, the chair of the Board of Examiners indicated he is part of the admission committee, along with the programme directors, and as such participates in the interviews. He explained there is a clear procedure in place for admission to other programmes in the School, but a specific regulation for this new programme still needs to be formalised based on the admission criteria as mentioned. The panel was pleased by the formalised approach of the admission process.

The programme is primarily targeted at people who have already worked for several years. A secondary target group consists of people who have recently graduated from a Bachelor's programme and have just started working. The panel has some doubts whether the programme will be feasible for this group, given the intensive nature of combining a part-time study with a new job. However, it understands that the programme does not want to exclude this group and trusts that the programme will monitor the progress of this group and will take appropriate measures if difficulties emerge.

English language

The programme is taught in English, because the professional field of data science is very much internationally-oriented. The panel confirms that the choice for English corresponds with the expectations and requirements in the professional field. During the site visit, representatives of the programme explained that another reason for teaching in English is the international background of many of its researchers and lecturers. Also, the programme intends to facilitate exchange with its consortium partner Fachhochschule Westfalen in Germany and expects around 5-10% of the incoming students to be international.

Teaching staff

The programme is taught by a team of lecturers from three different Schools within HAN: School of Engineering and Automotive (AEA), School of Applied Biosciences and Chemistry (ATBC) and School of IT and Media Design (AIM). The panel is very pleased with the lecturer team, which made a very engaged and motivated impression. Also, the lecturers demonstrate a strong team spirit and the proposed programme clearly was the result of a prolonged collaborative effort. All required disciplinary expertise is covered in the lecturer team. Didactical qualifications are adequate and there is sufficient teaching experience. The panel appreciates that several lecturers are still working in the professional field as well. Also, the team includes ample lecturers with a PhD, some of whom also work at an academic university. The panel has no reason to doubt the English proficiency of the lecturers, but it recommends the programme to incorporate English proficiency in its professionalisation policy and formalise the demonstration of English proficiency by having lecturers get a certificate.

Advisory Board

The programme expressed the intention to establish an Advisory Board (professional field committee) with representatives of the (inter)national and regional professional field, including representatives from research and academia. The Advisory board will advise the programme on the content and quality of the curriculum and will validate the intended learning outcomes. The panel underlines this intention by formulating an explicit recommendation.

Conclusion

The panel concludes that the curriculum and teaching-learning environment are well designed and fit well with the target group. The admission requirements and procedures are appropriate. Also, the panel is pleased with the competence, engagement and strong team spirit demonstrated by the lecturer team and is pleased to acknowledge this programme as the result of prolonged team effort.

6.3 Standard 3: Student assessment

The programme has an adequate system of student assessment in place.

Judgement

Meets the standard.

Findings, analysis and considerations

Assessment

The programme's assessment policy is based on the HAN assessment framework and is described in the assessment plan. The programme's vision on assessment, which is closely related to the HAN vision on assessment, is characterised by a focus on the student's learning process who largely learns by doing. The panel considers the assessment policy and vision to be clear and well-embedded in existing policy and structures within HAN. It is evident for the panel that the programme has put a lot of effort into the development of the assessment plan.

The panel is positive about the balance between formative and summative assessment and the numerous feedback moments. It is also pleased with the variety of test methods used (including different types of assignments, exams, presentations, project reports and reflection reports). The panel is happy to see that, following consultation with an educational expert, knowledge tests (exams) were added to the assessment plan (although these changes were presented to the panel only in the last weeks prior to the site visit). Also, the panel appreciates how skills are assessed in the programme (i.e. by means of oral tests). According to the panel, assessment in the programme supports the student's own learning process.

Reliability of grading is enhanced by using the four-eyes-principle. Also, the programme intends to organise calibration sessions for examiners. Examiners grade according to assessment criteria and use detailed assessment forms, which are always made available to the students in advance. The panel is also satisfied with the grading process of the graduation project, which is carried out by two (BKE certified) examiners. The final grade is based on the quality of the graduation products as well as the student's performance during the defence.

The panel suggests to pay more attention to the collaborative design of tests and rubrics and to make this a team effort and responsibility. Judging from the preliminary examples of tests and rubrics it has seen, the panel thinks there is still room for improvement. Whereas the panel can see that the curriculum design is truly the result of teamwork, this is less evident in the examples of tests and rubrics available. The panel advises the programme to apply the four-eyes-principle when designing tests and rubrics and to give it sufficient and timely attention.

Board of Examiners

Based on the interview with (representatives of) the Board of Examiners during the site visit, the panel has a very good impression of the Board of Examiners. The Board has made a professional and competent impression, convincing the panel about its ability to monitor and safeguard the quality of assessment and the exit level of the programme. The Board has good structures and procedures in place to assure quality of assessment, and the new programme will be well embedded in these procedures. The panel also appreciates that the Board of Examiners was involved and provided critical feedback during the development of the programme.

The panel inquired about the Board's experience with Master's programmes. The Board of Examiners explained that up until now it does not have experience with Master's programmes but intends to recruit a new external member who has experience with assessment on master level. The panel wants to stress the importance of recruiting a new member with this experience and expertise, as it deems this necessary.

Conclusion

The panel is pleased with the assessment policy and vision, which are embedded in existing policy and structures within HAN. The panel is positive about the assessment plan and thinks the programme takes adequate measures

to enhance the reliability of grading. The Board of Examiners made a very good impression on the panel, demonstrating its ability to monitor and safeguard assessment quality.

6.4 Degree and field of study

The panel advises awarding the following degree to the new programme: Master of Science.
The panel supports the programme's preference for the following field of study: *Techniek*.

The panel is of the opinion that the field of study '*Techniek*' is appropriate for the programme, as it matches the contents of the curriculum. The core of the curriculum consists of data science. Students learn how to apply this in a specific business or organisational context, but the core is still data science. Also, the admission criteria match this field of study, especially the criteria regarding prior knowledge in mathematics, statistics and programming.

Abbreviations

BoKS	Body of Knowledge and Skills
CRISP-DM	Cross Industry Standard Process for Data Mining
EC	European Credit
HAN	HAN University of Applied Science (Hogeschool van Arnhem en Nijmegen)
UOS	Unit of study

The full report was written at the request of NVAO and is the outcome of the peer review of the new programme hbo-master Applied Data Science of HAN University of Applied Science

Application no: AV-1355

NVAO

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