NVAO • THE NETHERLANDS

INITIAL ACCREDITATION

MASTER'S PROGRAMME
ARTIFICIAL INTELLIGENCE & ENGINEERING SYSTEMS
Eindhoven University of Technology

SUMMARY REPORT
2 DECEMBER 2021

1 Peer review

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 focus is on the curriculum, the teaching and learning environment, and student assessment.

The Accreditation Organisation of the Netherlands and Flanders (NVAO) takes a formal decision on the quality of the new programme based on the outcome of the peer review. This decision can be positive, conditionally positive or negative. Following a positive NVAO decision with or without conditions the institution can proceed to offer the new programme. Upon completion of the programme graduates are entitled to receive a legally accredited degree.

This summary report contains the main outcomes of the peer review. A full report with more details including the panel's findings and analysis is also available. NVAO bases an accreditation decision on the full report.

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

Because of COVID-19 temporary measures apply for this peer review.

2 Panel

Peer experts

- Prof. dr. ir. Inald Lagendijk (*chair*), Distinguished Professor of Computing-based Society, and captain of science of Dutch Digital Delta, the Dutch top sector for missions and innovation in ICT.
- Prof. dr. Maarten de Rijke, University Professor of Artificial Intelligence and Information Retrieval at the University of Amsterdam. He is also the scientific director of the national Innovation Center for Artificial Intelligence;
- Prof. dr. Bo Wahlberg, professor of Chair in Automatic Control at KTH Royal Institute of Technology; Sweden;
- Wietske Rem (BSc) (*student member*), master student Mechanical Engineering, Universiteit Twente.

Assisting staff
Fiona Schouten (secretary)
Frank Wamelink (NVAO policy advisor and process coordinator)

Site visit (online)
22 oktober 2021

3 Outcome

The NVAO approved panel reaches a conditionally positive conclusion regarding the quality of Artificial Intelligence & Engineering Systems offered by TU/e. The programme complies with two standards of the limited NVAO framework and partially complies with one standard.

AI&ES will be a two-year, fulltime, English-taught and government-funded master's programme. It aims to educate engineers at the interface of Engineering Systems and Artificial Intelligence and offers students a multidisciplinary curriculum containing 6 tracks focusing on specific application areas. AI&ES will be offered in a co-operation of 7 departments of TU/e, with the Department of Electrical Engineering as the leading department. In summary, an AI&ES graduate is able to contribute to the multidisciplinary development of complex engineering systems, from a solid disciplinary basis and from a thorough grasp of AI-technology.

The panel is convinced that the master's programme Artificial Intelligence & Engineering Systems responds well to the professional field's need for T-shaped trained engineers capable of integrating Artificial Intelligence in various Engineering Systems or solutions. The panel finds that the 6 tracks have a clear profile due to their focus on application areas. In contrast, the panel considers the overall profile of the programme less clear. The panel therefore recommends starting from coherence and alignment within the various tracks, working on a common understanding of how to build a curriculum on the shared goals and developing multidisciplinarity further to strengthen the overall profile.

The panel concludes that the intended learning outcomes formulated for AI&ES tie in with the level expected for an academic master's programme. They are tuned to international requirements and in line with the academic and professional domains the programme intends to cover. The panel recommends sharpening the ILOs and profile by reflecting on their relation to the KION criteria for AI programmes, by aligning the ILOs of track 5 'AI foundations and science applications' with the other tracks, and by representing the status of 'Humans and Ethics' more realistically.

According to the panel, AI&ES has the teaching staff, facilities, management, research and education environment, and experience with interdepartmental master's programmes that are necessary for successfully offering this programme. However, the panel thinks the relation between the actual courses, the general setup of the AI&ES curriculum and the intended qualification profile of the graduate need strengthening. This is needed to give the curriculum focus and internal coherence, to strike a clear balance between AI and engineering systems, to promote multidisciplinarity in and between tracks, and to develop a system of continuous evaluation with which to promote and strengthen the added value of combining all disciplines and AI in a single M.Sc. program. The panel formulated a concrete condition to be met within two years. This is an important issue to act upon in the coming years. The panel is confident that AI&ES has what it takes to successfully implement this condition.

The panel is convinced that student assessment in AI&ES will be done according to the policies and regulations in place at TU/e and the Department of Electrical Engineering. The programme has an adequate assessment policy and assessment system. The implementation of the assessment policy and system for the AI&ES program as described in the documents provided to the panel is currently being developed. The Examination Committee is yet to be appointed. The panel finds that work is still to be done, but it is confident that quality of assessment in AI&ES will be guaranteed.

4 Commendations

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

1. Intended learning outcomes -- The objectives of the programme answer to demands of the professional field. There is a clear need for generalist AI engineers who can work in multidisciplinary environments.

2. Intended learning outcomes -- The programme ties in with TU/e's focus area Artificial Intelligence and the recently founded EAISI Institute (Eindhoven Artificial Intelligence Systems Institute).

3. Teaching-learning environment – The complex organisation of the programme, with seven departments involved, is in the hands of experienced and capable university staff members who have ample experience with interdepartmental programmes and who are embedded in a solid quality culture.

4. Teaching-learning environment –The academic and didactic quality of the teaching staff is good.

5. Teaching-learning environment –The facilities that the programme offers access to are good.

5 Recommendations

Next to the condition formulated by the panel it suggests a number of follow-up actions for improvement.

1. Intended learning outcomes – develop a clearer common understanding of what AI & Engineering Systems entails and relate to KION criteria.

2. Teaching Staff – foster a higher level of obtainment of the University Teaching Qualification (UTQ) among teaching staff.

3. Teaching-learning environment – promote the wider introduction of challenge-based-learning and innovative teaching methods into the programme.

4. Curriculum – specify the proper balance between the domain-specific areas of the ILOS in the curriculum: Systems Engineering; Data and Algorithms and Humans and Ethics.

6 What comes next?

NVAO grants initial accreditation to a new programme on the basis of a panel's full report. The decision is valid for a maximum of six years. For conditional accreditatie other regulations apply. Upon accreditation the new programme will follow the NVAO review procedures for existing programmes. NVAO publishes the accreditation decision together with the full report and this summary report. [1]

Each institution has a system of quality assurance in place ensuring continuous follow-up actions and periodic peer-review activities. Peer reviews help the institution to improve the quality of its programmes. The progress made since the last review is therefore taken into consideration when preparing for the next review. The follow-up activities are also part of the following peer-review report. For more information, visit the institution's website. [2]

7 Summary in Dutch

Het panel oordeelt positief onder voorwaarden over de kwaliteit van Artificial Intelligence Engineering Systems van Technische Universiteit Eindhoven Dit is de uitkomst van de kwaliteitstoets uitgevoerd door een panel van peers op verzoek van de Nederlands-Vlaamse Accreditatieorganisatie (NVAO). Voor deze beoordeling heeft het panel gesprekken gevoerd met de opleiding op 22 oktober 2021. AI&ES beweegt zich op het snijvlak van *engineering* en kunstmatige intelligentie (AI) en biedt studenten een multidisciplinaire opleiding met 6 specialisatierichtingen die op verschillende toepasingsdomeinen gericht zijn. AI&ES is een samenwerking van 7 TU/e-afdelingen.

[1] https://www.nvao.net/nl/besluiten
2 https://www.tue.nl/en

AI&ES komt tegemoet aan de behoefte in het werkveld aan breed onderlegde *engineers* die verbanden kunnen leggen tussen verschillende vakgebieden en disciplines. De opleiding heeft 6 helder gedefinieerde tracks met elk een specifieke toepassingsoriëntatie. Het overstijgende profiel van de opleiding vindt het panel juist minder duidelijk. Ook de beoogde leerresultaten verdienen aanscherping, bijvoorbeeld door te verduidelijken hoe ze zich verhouden tot de KION-criteria voor AI-opleidingen, door de leerresultaten van track 5 gelijk te trekken met die van de andere tracks, en door een realistisch beeld te schetsen van de aandacht die de opleiding besteedt aan Mens en Ethiek.

Volgens het panel beschikt AI&ES over de docenten, de faciliteiten, het management, de onderzoeks- en onderwijsomgeving die nodig zijn om deze opleiding goed vorm te geven. Wel adviseert het een sterkere afstemming tussen de doelen en beoogde leerresultaten, de cursussen en de toetsen. Zo kan het curriculum meer coherent en gefocust worden en is voor studenten duidelijker welke keuzes ze kunnen maken en wat de gevolgen zijn. Multidisciplinariteit zou sterker moeten worden aangezet door het programma heen. Ook zou de opleiding procedures rondom kwaliteitszorg en toetsing duidelijk moeten vastleggen en implementeren. Hoewel het panel er alle vertrouwen in heeft dat de opleiding dit op gedegen wijze zal oppakken, constateert het dat de afstemming en samenhang op dit moment nog verbeterd moeten worden.

Sterke punten van de opleiding zijn:
- AI&ES sluit aan op een behoefte uit de arbeidsmarkt en bij de strategische focus van de TU/e op AI.
- AI&ES wordt vormgegeven door een ervaren en goed onderlegd team dat ingebed is in een solide kwaliteitscultuur.

Aanbevelingen:
- Voorzie studenten en staf van een helder overzicht van alle keuzes binnen het programma en de beperkingen die daaraan gesteld worden.
- Introduceer meer vernieuwende onderwijsvormen in het curriculum.

Meer informatie over de NVAO-werkwijze en de toetsing van nieuwe opleidingen is te vinden op www.nvao.net. Voor informatie over de Technische Universiteit Eindhoven verwijzen we naar de website van de instelling. [3]

Als gevolg van de beperkende omstandigheden door COVID-19 geldt voor deze kwaliteitstoets een tijdelijke procedure.

[3] https://www.tue.nl

The summary report was written at the request of NVAO and is the outcome of the peer review of the new programme Artificial Intelligence & Engineering Systems of Technische Universiteit Eindhoven

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NVAO

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