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Master Smart Systems Engineering

Hanze University of Applied Sciences

Advisory report of the assessment of the existing programme
30 January 2025

Colophon

Institution and programme

Hanze University of Applied Sciences
Assen
Institutional Audit: yes

Programme: M Smart Systems Engineering
Site: Assen
Mode: fulltime
ISAT-number: 40015

Assessment panel

Raoul van Aalst, chair
Cees Ronda, expert
Jeroen Keijzers, expert
John Bolte, expert
Astrid Hornman, student-member
Titia Buising, secretary

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Summary

On 30 January 2025, the master's programme Smart Systems Engineering of Hanze University of Applied Sciences was assessed. The panel's overall assessment is positive. The programme educates professional engineers to design, develop, and manage data-driven products and services in technical environments where the generation, management, analysis and application of (potentially large) data streams from sensors play a central role.

Intended learning outcomes

The intended learning outcomes of the SSE master programme are clearly formulated and correspond with the master's level and the professional requirements. The learning outcomes align with the Dublin Descriptors and focus on the full engineering cycle, applied research, and system-level thinking. They also include competences in data interpretation, system design, and professional skills such as communication and collaboration in intercultural and multidisciplinary teams.

The programme draws on input from the Professional Board, alumni, and the field through collaborative projects and the final thesis phase. The renewed and expanded Professional Board contributes to the programme's responsiveness to developments in the field. The panel appreciates the link with industry and the integration of real-world constraints and sustainability into the learning goals.

The panel notes that the programme has adequately responded to the recommendation from the previous accreditation to improve its visibility and academic positioning by strengthening research output and international cooperation.

The panel concludes that the programme meets this standard.

Teaching-learning environment

The content of the programme enables students to achieve the intended learning outcomes. The curriculum is well designed with the courses and the projects. The small-scale character of the programme allows for interactive contact between students and lecturers. Students' guidance and coaching is adequate and matches the small-scall character of the programme. The legal enrolment criteria are applicable to the programme.

On a more general level, the panel noticed that within the programme and the studied theses, the use of sensors is focussed more on classification and less on control. The panel is of the opinion that even in a specific application, sensors can be utilised in multiple and different ways other than the intended way and that this in general leads to additional value of the solutions. In addition, the panel challenges the programme to think more 'out of the box' and include, for example, data reduction in sensor systems, software sensor systems, virtual sensing and sensing without sensors.

The Professorship of Sensors and Smart Systems is well connected to and involved in the programme. Lecturers greatly value the combination of research and teaching.

The international character of the programme is reflected in the content and set-up of the programme, in the international staff involved, the international students and the international character of the field. Lecturers are experienced in English-language teaching to students from diverse backgrounds. The site visit showed that both staff and students have good command of English. The small, dedicated team of lecturers is committed and very competent. Moreover, sufficient lecturers are available to execute the programme. The panel is impressed by the number of lecturers holding a PhD.

The panel thus concludes that the programme meets this standard.

Student assessment

The programme has an adequate assessment system in place, aligned with Hanze University's assessment policy. The system focuses on development-oriented testing and includes both formative and summative elements. Effective measures are taken to guarantee the validity, reliability and transparency of the assessments. These include using rubrics, the four-eye principle, written feedback for students and calibration between lecturers. Group work also entails an individual assessment.

The examination board and assessment committee safeguard the quality of the assessments and the end level of the programme. In doing so, the assessment committee systematically screens the assessments, including the final level.

The panel thus concludes that the programme meets this standard.

Achieved learning outcomes

In the final semester, students complete a graduation project in collaboration with a company or the professorship. The project demonstrates the student's capability to conduct applied research and design innovative smart systems. The programme has an adequate graduation procedure in place. In assessing students final work three examiners and the company supervisor are involved, the latter in an advisory role. The panel appreciates the involvement of the professional skills lecturer in the assessment of the thesis.

Based on the fifteen studied theses, the panel concludes that the level reflected in these theses is adequate and that students achieve the required master's level. The studied theses are relevant for the companies involved. And the research component is clearly visible in the studied theses. Students also receive substantial feedback on their thesis. Students and alumni, the panel met with, feel very well prepared for their career in industry or research.
The panel notes that the studied theses are quite lengthy, and that the assessment form is also quite extensive. Lecturers involved are aware of this and discuss other options. The panel supports the programme in its exploration of alternative forms such as a paper.

The panel is of the opinion that the programme acted appropriately on the recommendation of the previous accreditation.

The panel thus concludes that the programme meets this standard.

Recommendations

The panel concludes that the programme meets all standards. The suggestions mentioned in the remainder of the report are noncommittal in nature.

All standards of the NVAO framework have been positively assessed. On this basis, the panel provides a positive recommendation regarding the accreditation of the master's programme Smart Systems Engineering of Hanze University of Applied Sciences.

On behalf of the entire site visit panel,
Utrecht, April 2025

Raoul van Aalst
Chair

Titia Buising
Secretary

Introduction

Profile

The master programme Smart Systems Engineering is part of the School of Engineering of Hanze University of Applied Sciences (Hanze). The School of Engineering also offers bachelor's programmes in Electrical Engineering, Industrial Product Design, Mechanical Engineering and Industrial Engineering, the associate degree programmes in Project Management and Mechatronics in the Smart Industry and the master's programmes European Master in Renewable Energy, European Master in Sustainable Energy System Management and Energy for Society.

The school aims for graduates to be 'future ready engineers': graduates that can devise innovative solutions to unfamiliar situations and complex problems. The school works closely with 'ENTRANCE, Centre of expertise Energy', the knowledge centre 'Biobased Economy' and the knowledge centre 'Noorderruimte'.

The master programme Smart Systems Engineering is an international and English taught programme, with students and lecturers from all over the world. In 2021, the programme was redesigned from 70 EC to 90 EC.

The programme focuses on the development of smart systems that provide the core intelligence of innovative technology in many different sectors and as such create impact in the fields of digital transformation, digital health care, circular economy and the energy transition. The programme is closely connected to the Hanze professorship Sensors & Smart Systems.

The assessment

The Hanze has commissioned AeQui to carry out the current assessment. For this purpose, AeQui, in collaboration with the programme, has assembled an independent and knowledgeable panel. A preparatory meeting with representatives of the programme has taken place.

The assessment was conducted based on the Accreditation Framework for Higher Education in the Netherlands, according to the programme outlined in Appendix 2. The institution has a positive institutional audit decision, and therefore four standards were assessed. The open consultation hour was not used.

Recommendations for further development were made during the previous accreditation. The programme has acted in response (see Appendix 3). The panel has integrated this follow-up into its considerations for the current assessment.

The panel conducted the assessment independently; the panel received the necessary information to arrive at a judgement. At the end of the assessment, the programme was informed of the findings and conclusions. This report was sent in draft to the programme; the programme's responses have been incorporated into this final report.

At the initiative of the programme, a development meeting will take place in 2025. The results of this development meeting will not affect the assessment presented in this report.

Intended learning outcomes

Standard 1: 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.

Findings

The programme notes that smart systems are the connecting layer between the virtual world and the real world. Smart systems have the capability to make sense of data and adapt or influence the real world as a result. All devices connected to the Internet of Things contain sensors that collect data, interact with the environment and communicate over a network. These sensor units are increasingly miniaturised and can be realised with advances in low-power electronics design, even printed in biodegradable materials and low power battery technologies. The programme also remarks that the key characteristics of a smart system are its communication, learning, reasoning, perception and control capability, the embedded knowledge, and its self-organisation and context awareness. The merging of machine learning with advanced electronics launches a new era of smart systems, offering unprecedented capabilities and efficiencies.

The programme focuses on the application of a wide range of innovative technologies between operational and information technology (OT/IT) ranging from (the programming of) hardware to the analysis and feedback of data output to build more efficient systems. The programme educates students to become professional engineers, capable of conceiving, designing and managing end-to-end products and user level services in technical environments where the generation, management, analysis and application of (potentially large) data streams from sensors play a central role. Graduates have the professional skills to carry projects beyond the proof-of-concept phase into prototypes and user applications. Graduates can also advise clients on conceptual solutions and on optimal ways to design and analyse complex systems and data flows.

Graduates have advanced technical knowledge of sensor technology with systems overview and a problem-oriented approach that allows them to take a user/service perspective. In addition, graduates have the competences to design architectures for big-data sensor systems and data-centric sensor applications, including the modelling of complex data flows and analysis algorithms. In doing so, graduates are aware of real-world limitations and constraints, both physical, societal and regulatory. Graduates also have the professional skills to work in intercultural and multidisciplinary teams, to interact with customers, colleagues and partners in the value chain. Graduates generally work in organisations with an emphasis on high-tech, in the engineering and technical industry or research. Moreover, graduates work in organisations that have a high dependence on smart systems such as healthcare.

The basis for the programme learning outcomes is formed by sensor technologies, (embedded) programming and data analysis, extended with professional skills and system design competences. Students are expected to deliver professional products (aligned with the professional field). The programme formulated six programme learning outcomes:

1. Giving meaning to sensor data.
2. Building intelligent architecture.

3. Creating reliable services.
4. Professional skills.
5. Performing applied research for systems design.
6. Contributing to sustainable innovation.

The programme learning outcomes are aligned with the Dublin Descriptors.

Connection to professional field

Input from the professional field is gathered through the Professional Board and the connection with the professorship Sensors & Smart Systems. In addition, lecturers gain input from the professional field in the second semester project and the final research projects in the third semester. The Professional Board was recently revived and expanded with several alumni. The programme aims for the professional board to offer a wide perspective on the developments in the field. The programme is also connected to companies in the Innovatiecluster Drachten, a group of over 20 high-tech companies including Philips. Together a Robotics workgroup is organised where companies pitch robotics projects for students.

Representatives of the professional field the panel met with, value their connection to the programme and ideas and input from the students. The programme and its lecturers are very accessible and open to discussion. It was noted that close contact with professional practice is essential to ensure the topicality of the programme. The programme's location at the Techhub enhances collaboration with the professional field.

Recommendation previous accreditation

The previous panel recommended to strengthen the visibility and positioning of the programme by intensifying the dissemination of research papers and results and attending and organising conferences. Regarding this, the programme notes that currently all lecturers are involved in research with the professorship Sensors and Smart Systems and that the research output of lecturers has greatly increased. The programme also strengthened its research network through collaborations with universities in Portugal, Brazil, Germany, France, the universities of Nijmegen, Twente, Eindhoven and Groningen.

Considerations

Based on the interviews and the examination of underlying documentation, the panel concludes that the intended learning outcomes tie in with (inter)national requirements for the field of smart systems engineering. In addition, the intended learning outcomes are in line with Dublin Descriptors. The panel is of the opinion that the intended learning outcomes are clear and well formulated.

The professional field is involved in the programme. The panel invites the programme to organise more critical and structured peer discourse and to involve other peers than alumni. The panel also challenges the programme to stay ahead of developments in the professional field. Connection to broader research programmes and projects and applying for European funding can contribute to this. Making graduation projects part of larger research projects can also contribute to this and will strengthen the connection with knowledge development within Hanze.

The panel is of the opinion that the programme acted appropriately on the recommendation of the previous accreditation. Taking these considerations into account, the panel assesses that the programme meets this standard.

Teaching-learning environment

Standard 2: The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

The programme comprises three semesters. The first two semesters both consist of five courses and a project. All courses comprise 5 EC. In the projects students work together as a group to find a suitable solution for a given multidisciplinary problem.

The first semester provides students with the knowledge and tools required to model and design complex smart systems for big data applications and digital signal processing. After an introduction into smart systems engineering, students learn to integrate data coming from multiple, complex sensors and how to interpret these data correctly. Students also learn how to apply data analysis algorithms through courses like Applied Machine Learning. Students work on various projects, where they can demonstrate what they have learned within a practical setting. The first semester also includes courses such as Sustainable Research Skills, which focuses on the ability to reflect on the sustainability of developed systems.
In the first semester project student groups programme robots. In this project students learn for example how to collect and use data. Students work on their own personal goals and are assessed accordingly.

The second semester focuses on the design of a smart system as a whole. In the Products and Services Design course students are involved in the full design process of a smart system related to an application. In the Sensor Application Specialisation course, students explore various sensor applications in their chosen field. Students also engage in a project where they work with innovative health, energy and/ or smart industry related companies or research institutes like Philips or the University Medical Centre in Groningen (UMCG). The second semester also provides students with the knowledge and skills to conduct research at a master level. The Sustainable Research Skills course addresses research skills and ethics in engineering. Students also follow workshops on academic writing.
The second semester project is executed for an external organisation. The content of the project depends on the question or problem that is brought in by the external organisation. In this project students work through the research cycle and write a paper. The site visit learned that in this project, students meet with their client on a weekly basis.

In addition, students commented during the site visit that ethical aspects and topic such as sustainability are addressed and discussed in the programme.

The third semester encompasses a six-month research project within the domain of the 'Groningen colours': Energy, Health and Smart Industry. This results in the master thesis. This is further elaborated on in standard 4.

Students the panel met with, value the applied character of the programme, the combination of theory and practice and the prominence of machine learning, AI and data in the programme. Moreover, students value working together in groups with peers from different backgrounds. The programme also addresses their critical thinking skills. Students feel very well prepared for their future career in which they can solve real world engineering problems,

implement smart solutions and have an innovative role.

Learning environment

The educational concept is based on four ways of learning: conceptual learning, learning by training, learning of professional skills and integral learning. Conceptual learning allows for students to broaden and deepen their knowledge. This includes fundamental knowledge and applied knowledge. Learning by training applies to acquiring and practicing practical skills and methods for working. Professional learning addresses the development of professional skills such as critical thinking, personal qualities, professional attitude and interpersonal skills. And integral learning focuses on integrating knowledge, skills and professional attitude in a professional situation. The latter type of learning takes place in the third semester, during the research project and the master thesis.

The small-scale of the programme allows for close connections with students. Activities such as the introduction week add to this connection. All students are coached by a dedicated mentor, who monitors their professional development. The mentor is also the first point of reference when personal issues arise. If needed, extra support is available from the International Student Office, facilities regarding study planning and psychological wellbeing or other Hanze facilities.

During the third semester, students are mainly guided by their company supervisor. The manual guides company supervisors in assessing the student's professional attitude and behaviour. Students are visited at least two times by their Hanze supervisor in this period. During those visits or meetings, the graduation project is discussed with the student and the company supervisor. Students are in general content with the guidance in the programme, the panel learned during the site visit. If needed, students can always contact their supervisor for additional coaching. Students commented that in (final) research projects at the professorship there is often more contact with the supervisor.

The programme is offered in the Techhub in Assen. Here, the programme shares lab facilities with the professorship of Sensors and Smart Systems, local tech companies and vocational learning. The Techhub consists of an electronics lab, a chemistry lab, a room with 3D printers and laser cutters (for mechanical work), an open space where students can work and classroom that is always available to students. Students can also use the Hanze lab facilities in Groningen, such as the Makerspace.

The self-evaluation report notes that attending classes in Assen is a challenge for most students since foreign students are not compensated for public transport costs.

Intake

The legal enrolment criteria apply to the programme. Candidates have to submit an enrolment video that is used to assess their motivation and level of English proficiency.
The programme has an annual intake of approximately 20 students. The programme attracts students from all over the world, from for example the Netherlands, Indonesia, Bulgaria, Iran, Nigeria, India, Vietnam and Spain.

Staff

The team consists of twelve members (1,4 fte). All lecturers hold a master's degree, a didactical qualification and an examination qualification. The majority also holds a PhD relevant to the field or the specific topic of teaching. The composition of the staff reflects the international

character of the field, with staff from the Netherlands, Kenia, Portugal, Spain, England, Brazil, Iran and Lebanon.

The lecturers' appointments vary from 0,02 fte to 0,35 fte. It was noted during the site visit in this regard that the involvement of lecturers varies per period, making it workable. Lecturers also noted that the open atmosphere allows for an open discussion about workload and appointments. Lecturers value the ties between their research and teaching.

The site visit also learned that the team meets every two weeks and that the team decides on changes to the programme. Lecturers stay up to date with their knowledge through their involvement in research and their contacts with the field.

Students the panel met with during the site visit value the feedback from their lecturers as well as their approachability and their teaching skills.

As mentioned before, the programme is closely connected to the professorship Sensors & Smart Systems. Lecturers are also involved as researcher in the professorship. And currently three researchers are working on their didactical qualification, to prepare them to participate in the programme. In addition, several lecturers are in a PhD track as junior researchers.

During the site visit, it was made clear that the close connection of the master programme to the professorship is part of Hanze policy. This implies that the topics researched in a professorship are closely linked to a master's programme and that lecturers/researchers can bring their research experience directly into their courses.

The board of studies advises management on the quality of the programme. The site visit made clear that feedback is usually acted upon in a timely manner. In addition, students feel heard, and their feedback is taken seriously. For example, the programme added deep learning based on student feedback.

Considerations

The panel concludes that the content of the programme enables students to achieve the intended learning outcomes. The curriculum is well designed with the courses and the projects.

On a more general level, the panel notes that within the programme and the studied theses, the use of sensors is focussed more on classification and less on control. The panel is of the opinion that even in a specific application, sensors can be utilised in multiple and different ways other than the intended way. In addition, the panel challenges the programme to think more 'outside the box' and include, for example, data reduction in sensor systems, software defined sensor systems, virtual sensing (f.e. which sensor readings are expected, which are found and what does this mean?) and sensing without sensors (f.e. using information of satellite images to 'sense' where buildings are and where land is in weather predictions). The panel also believes it is important to consider upgradability of the sensor systems (f.e. by over the air updates) already in the design phase.

The small-scale character of the programme allows for interactive contact between students and lecturers. Students' guidance and coaching is adequate and matches the small-scall character of the programme. Students can easily contact their lecturers for extra feedback and coaching. In addition, if needed, extra support regarding study planning and psychological wellbeing is available. The panel also concludes

that the legal enrolment criteria are applicable to the programme.

The Professorship of Sensors and Smart Systems is well connected to and involved in the programme. Lecturers greatly value the combination of research and teaching.

The international character of the programme is reflected in the international profile of the staff involved, the international students attending and the international character of the field of study and research. The panel therefore concludes that the international name of the programme is more than appropriate. The panel also agrees to the fact that the programme is entirely taught in English. In addition, the panel establishes that the lecturers involved are experienced in English-language teaching to students from diverse disciplinary and cultural backgrounds. The meetings during the site visit showed that both staff and students have good command of English.

The small, dedicated team of lecturers is committed and very competent. Moreover, sufficient lecturers are available to execute the programme. The panel also noted that the lecturers' appointments are quite small; this fragmentation can make the team vulnerable.
The panel is impressed by the number of lecturers holding a PhD. The panel already noted that the staff involved has a good command of the English language.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Student assessment

Standard 3: The programme has an adequate system of student assessment in place.

Findings

The programme adheres to both the Hanze and the school's assessment policy. This policy aligns with the Hanze's learning policy, that focuses on 'learning for understanding'. This implies the assessment of knowledge in the context of skills. The programme translated this into its vision on assessment, focusing on development-oriented testing. The programme notes that development-oriented testing allows for a positive and supportive learning environment that aligns with professional practice. This contributes to a growth mindset and the development of lifelong learning.

All courses are assessed by means of a summative assignment and in de majority of courses by two examiners. All assignments are assessed by means of a rubric. The rubrics are evaluated and adjusted during regular team meetings.

During the site visit it was made clear that in most courses students are assessed individually. In projects, students are assessed as a group and the grades are tailored to students' individual contributions. During weekly coaching meetings in projects, lecturers can observe each student's contribution quickly and intervene as needed. It also became clear that formative assessments, such as weekly presentations, are held in some courses.

Students the panel met with value the feedback from their lecturers. Students can also work through the rubric with their lecturers and discuss the feedback.

A school wide working group for development-oriented testing is involved in updating the vision and policy around testing and in promoting the testing expertise of teachers through an ongoing learning programme. This involves various activities, such as lectures, workshops and trainings, and the establishment of a learning community around testing.

Examination board and assessment committee

The institution-wide examination board is responsible for assuring the quality of the programme by supervising the content, method and level of the examinations. The examination board is charged with determining whether students have achieved the intended learning outcomes (exit level) described in the Teaching and Examination Regulations. The board yearly appoints assessors and examiners. To guarantee the quality of examinations, the board has drawn up criteria for examiners. For example, at least one of the two graduation examiners must be in possession of a PhD.

The examination board delegated some of its tasks to the institution-wide assessment committee. This includes screening parts of the curriculum, examinations or procedures, including screening of the final level. The screening is based on the programme learning outcomes, examination material and the assessment forms. The results and improvement actions from the screening are reported to the examination board, which reports to the management team. All members of the Assessment Committee have a Basic Teaching Qualification Assessment and Examination (BKE), and two of them are in possession of a Senior Qualification Assessment and Examination (SKE).

Lecturers and representatives of the examination board or assessment committee engage in assessment calibration sessions and discuss

interpretations of assessment criteria to ensure that assessments are valid and reliable. These sessions are planned annually after graduation so that improvements can be put in the manuals for the next cohort.

During the site visit, the panel met with representatives of the examination board and assessment committee. It was noted that external validation of the final level is difficult because of the NDA's under which most theses are written. On the use of generative AI, it was commented that this is allowed as long as students are transparent about this and aware of the limitations. Students also learn how to use generative AI.

Recommendation previous accreditation

The previous panel recommended to use external assessors for final level assessment, to expand the number of assessors. In respond to this, the programme has added several internal assessors for the final assessment in recent years. Therefore, the need for more assessors has become less relevant. The programme currently considers external assessors for collaborational purposes. The company supervisor is present in the final assessment and has an (advisory) role in the assessment.

Considerations

The panel is of the opinion that the programme has an adequate assessment system in place. Effective measures are taken to guarantee the validity, reliability and transparency of the assessments. These include using rubrics, the four-eye principle, written feedback for students and calibration between lecturers.

The panel values that in group work, the programme provides students with an individual assessment. This can however be made more explicit in the rubric.

Since students achieve some intended learning outcomes at end level in other courses than the thesis, the panel is of the opinion that these intended learning outcomes should not be included in the assessment form for the thesis.

The examination board and assessment committee safeguard the quality of the assessments and the end level of the programme. In doing so, the assessment committee systematically screens the assessments, including the final level. The panel recommends that the programme organises regular peer review of the final level.

The panel is of the opinion that the programme acted appropriately on the recommendation of the previous accreditation.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Achieved learning outcomes

Standard 4: The programme demonstrates that the intended learning outcomes are achieved.

Findings

In the third semester, the graduation phase, students show that they are ready for their role as a high-level engineer in smart systems engineering. The programme notes that a high-level engineer is always innovative. Innovation can be something new, or it can be something already existing in a new context. 'High-level' is about knowledge and thinking, 'engineer' is about tools.

The graduation phase of the programme consists of:

- the master thesis project (30 EC);
- the Data Centric Architecture course (5 EC) and;
- the Products & Services design course (5 EC).

The courses focus on the engineering skills required from entry-level competent professionals. Both courses are assessed by means of an assignment. In the assessment two examiners are involved.

In the third semester, students work on a six-month research project (master thesis project) within the domain of the 'Groningen colours', being Energy, Health and Smart Industry. The project is executed for an external organisation and should apply a significant amount knowledge from applied machine learning, adaptive filtering, or complex, multidisciplinary model-based reasoning. The project is about smart systems involving data processing: the data required for the project is already present or the smart system that processes the data already exists at least at prototype stage.

Students start with the master thesis project by drawing up a project proposal that is assessed by the graduation coordinator and graduation committee (six-eye principle). The research project results in a master thesis. The assessment of the master thesis project consists of the end report, the final presentation and the assessment of the professional skills.

At the end of this phase students' hand in a first draft to their supervisors (Hanze and company). Both provide feedback on the draft report. Based on that, students prepare the final report, which is graded by the Hanze supervisor and the second assessor. No other changes are made to the report. When both teachers agree that the report is sufficient, students can plan their final presentation. The final report is presented to the Hanze supervisor, the second assessor, a professional skills lecturer and the company supervisor in a final presentation held at school, at the company or online. The final assessment of is done by the supervisor, second assessor and professional skills teacher. The company supervisor has an advisory role.

During the site visit it was made clear that students can also engage in a research project at the professorship. Most students however opt for a research project for an external organisation.

The programme notes that more and more students are offered a job by the company where they conclude their graduation. Alumni are involved in the professional board and also deliver graduation assignments for students. Two alumni are currently pursuing a PhD position within the professorship of Sensors and Smart Systems.

Recommendation previous accreditation
The previous panel noted that the studied theses were not always obvious to solving an engineering design problem. In addition, the panel suggested that students could be more critical in accepting and approaching their research assignments. In respond to this, the programme now critically assesses the feasibility of each research project in the proposal phase.

Considerations
The panel concludes that the programme has an adequate graduation procedure in place. In assessing students final work three examiners and the company supervisor are involved, the latter in an advisory role. The panel values the involvement of the professional skills lecturer. This aligns with the programmes ambition to deliver graduates that also have the professional skills to excel in interaction with customers, colleagues and partners in the value chain.

To assess whether students achieve the required end-level and the intended learning outcomes, the panel studied 15 theses. Based on this, the panel concludes that the level reflected in these files is adequate and that students achieve the required master's level. The studied theses are relevant for the companies involved. And the research component is clearly visible in the studied theses. Students also receive substantial feedback on their thesis. Students and alumni, the panel met with feel very well prepared for their career in industry or research.

Ethical aspects and relevant topics such as sustainability could be incorporated more into the thesis. Students seem to address this as an afterthought in their thesis as opposed to a consideration in their design and methodology.

The panel noticed that in some of the studied theses, students elaborate extensively on (the usual state of the art) literature studied rather than on the implications of the reviewed literature. This also makes the thesis very lengthy. The site visit learned that this is recognised by lecturers and that alternative forms such as a paper are under discussion. The panel supports the programme in exploring this further and to choose a format that supports the intended audience of the thesis, being the professional field or the scientific field. If needed, additional information can be included in a process report for the supervisor and the student's discretion.

The panel is of the opinion that the assessment form is quite extensive, which does not make it easier for students to get a high grade. This is also discussed by the team, the panel learned during the site visit.

The panel is of the opinion that the programme acted appropriately on the recommendation of the previous accreditation.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Attachment 1: assessment panel

drs. Raoul van Aalst, chair
Independent management consultant, philosopher and researcher

dr. John Bolte, member
Associate professor Smart Sensor Systems, The Hague University of Applied Sciences

ir. Jeroen Keijzers, member
Lecturer Master Digital Technology Engineering, Fontys University of Applied Sciences

Prof. dr. Cees Ronda, member
Professor Physics, Zhejiang University, China

Astrid Hornman MSc, student-member
Student M BME University of Twente

The panel was supported by drs. Titia Buising, certified secretary.

All panel members have completed and signed a statement of independence and impartiality, and these have been submitted to NVAO.

Attachment 2: site visit program

30 January 2025

Time	Topic
09:00 - 09:45	Welcome and introduction SSE and meeting management
09:45 - 11:00	Lab Tour and presentations
11:00 - 11:15	Break
11:15 - 12:15	Learning environment & assessment - Teachers
12:15 - 13:00	Lunch
13:00 - 14:00	Learning environment & assessment - Students & Alumni
14:00 - 14:15	Break
14:15 - 15:15	Quality Assurance & Assessment, TIE, EIE & Board of Studies
15:15 - 15:30	Break
15:30 - 16:00	Professional Board
16:00 - 17:15	Internal consultation panel
17:15 - 17:45	Panel feedback

Attachment 3: Recommendations from previous assessment

Recommendation	Action
In the rapidly evolving domain of sensor technology the panel for the sake of knowledge management and benchmarking would consider it desirable to enhance the programme's network perspective, both nationally and internationally. This is the more at stake, when taking into account the international unique position of the Master. Both Hanze and other parties may benefit substantially from this networking. For this reason, too, the panel suggested under Standard 3 to engage in its assessment system assessors from other universities. Also, European consortia may pave the road to European funding, as is already the case with the European Master in Renewable Energy.	The Master Smart Systems is set up as a professional master, which means that applied research and the connection to the professional field are its focus. The expansion of the curriculum allowed the programme to set up more projects with industrial partners and build a stronger network. Especially within the Smart System project in the second semester, students work on problems applied to the professional field and they are supervised and assisted by industrial experts. Analysis of the graduation topics and graduation companies showed that the application shifted towards industry. The Professional Board was expanded to reflect this.
Intensify the dissemination of research papers and research results, also by attending or organising conferences and seminars. Consider participating in summer schools. Strengthen your visibility and positioning in the national and international field.	The research network has been strengthened through collaborations of the lecturer-researchers with universities in Portugal, Brasil, Germany, France, the universities of Nijmegen, Twente, Eindhoven and the University of Groningen and University Medical Centre Groningen. Students participate via the second semester project and the graduation project in these collaborations. Various student projects were disseminated via research papers and presentations at international conferences.

Attachment 4: reviewed documents

- Self-evaluation report
- The professional masterstandard 2019
- Strategisch Jaarplan Hanzehogeschool 2021-2026 Betrokken en Wendbaar
- Huishoudelijk reglement Examencommissie 2023-2024
- Jaarplan Instituut voor Engineering 2024 + 2025
- Leden commissies 2023-2024
- Meerjaren-Personeelsplan (MPP) Engineering 2021-2026
- Curriculum tabel 24-25.
- Dublin descriptors
- Product Learning Outcomes
- Visie op toetsing Hanze 2024
- Teaching and Examination Regulations Master SSE 23-24
- Jaarverslag Examen- en Toetscommissie 2022-2023
- Jaarverslag Examencommissie Engineering 2023-2024
- Master SSE Graduation Rules and Regulations 2024-2025
- Addition to The second Wave
- KIA-ST-Bijlage-A-Kennis-en-innovatievragen
- Health 40 how virtualization and big data are revolutionizing 2017
- Towards Characterisation of smart systems
- Integrating machine learning
- Overview personnel_SSE
- Reinforcement learning for colaborative robots
- International conference on optimalisation, learning algorithms and applications
- Sensors of smart systems professorship Heinrich wortche
- Toetsbeleid SIEN
- Handreiking toetsing O&O
- Several assessments and rubrics
- TNO advies Hanzehogeschool Sensor System Engineering 2014
- Hobeon Auditreport SSE
- Graduation work of 15 students (including the manual and assessment forms)

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