Industrial Engineering and Management
University of Twente

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Project code P2127

Contents

Summary

Standard 1. Intended learning outcomes

The profile and aims of the BSc and MSc Industrial Engineering and Management (IEM) are fitting for academic bachelor's and master's programme in Industrial Engineering. The programmes have relevant and strong aims, and are embedded in an attractive context with small-scale, interactive education and many connections to the professional field. They offer students the opportunity to specialize in the application areas of production and logistics, health care technology and financial engineering. The goals of both programmes have been well-translated into two coherent sets of intended learning outcomes that are aligned with the requirements of the academic and professional fields. The panel appreciates the initiatives to further align the programmes with major societal challenges and transitions, but believes this effort could be strengthened and made more explicit. It recommends expanding the network of the programmes in the direction of societal stakeholders, and increasing attention paid to ethics and sustainability of new technologies, as well as their role in societal transitions, in the programmes' aims.

Standard 2. Teaching-learning environment

The curricula of both programmes are coherent and well-structured, and cover all intended learning outcomes. The bachelor's IEM offers a strong basis in IEM, with excellent opportunities for integration through the project-led educational approach. The master's IEM has an open curriculum, allowing opportunities for specializing and broadening in a well-structured proposition of tracks, research orientation and specialization packages. Both programmes have many opportunities for interdisciplinary, challenge-based learning (both in the courses and in the externally executed thesis projects), which the panel considers to be a strength of the programmes. Both programmes are offered in English, which the panel considers to be well-motivated and implemented. The panel recommends both programmes to increase attention to ethics and sustainability in the curricula, either through the learning lines (bachelor's) or as cross-cutting themes through the tracks (master's). It also suggests using the challenge-based learning-oriented courses in the master's IEM to introduce challenges related to societal transitions in the curriculum.

The programmes are embedded in a small-scale, interactive environment, with very short lines of communication between staff and students. This results in close guidance and support throughout the programmes, which contributes to student learning and well-being, as well as continuous development of the curricula. The curricula are feasible, with extra attention being paid to support during the thesis trajectory. The teaching staff is well-qualified, and is dedicated to the specific educational approach of the programme. The panel advises to keep investing in teacher professionalization, and to carefully monitor any future growth to ensure that the unique nature of the programmes can be preserved.

Standard 3. Student assessment

The system of assessment of the IEM programmes promotes valid, reliable and transparent assessment, with considerable attention to feedback to enhance student learning. There are several checks and balances in place to safeguard the quality of assessment and the exit level of students, including monitoring the balance between individual and group assessment and calibration among thesis examiners. The Examination Board fulfils all of its duties in a proactive way. Thesis assessment is insightful and transparent, with two examiners involved with each thesis and attention paid to qualitative feedback. The thesis assessment procedure could be further improved by ensuring that an external examiner is involved for each thesis, also in the case of two supervisors, and by including the individual forms of each examiner in the assessment file. Furthermore, the panel advised paying extra attention in thesis assessment to writing, lay-out and academic reflection.

Standard 4. Achieved learning outcomes

The panel concludes that the selected theses show that the intended learning outcomes of both programmes are achieved. The topics are relevant and cover a variety of real-life cases of external organizations. The panel recommends particularly the MSc IEM to challenge students to reflect on the generalization of their results and the academic contribution of their work. The programmes prepare students for relevant MSc programmes (BSc) and relevant positions in the academic and professional field (MSc).

Score table

The panel assesses the programmes as follows:

BSc Industrial Engineering and Management	
Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

MSc Industrial Engineering and Management	
Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

Prof. dr. J. (Nico) Vandaele, chair

Peter Hildering MSc, secretary

Date: 13 February 2023

Introduction

Procedure

Assessment

On 17 and 18 November 2022, the programmes Industrial Engineering and Management of the University of Twente were assessed by an independent peer review panel as part of the cluster assessment Industrial Engineering and Management. The assessment cluster consisted of 11 programmes, offered by the University of Groningen, Eindhoven University of Technology, the University of Twente and Delft University of Technology. The assessment followed the procedure and standards of the NVAO Assessment Framework for the Higher Education Accreditation System of the Netherlands (September 2018).

Quality assurance agency Academion coordinated the assessment upon request of the cluster Industrial Engineering and Management. Peter Hildering acted as coordinator and secretary in the cluster assessment. He has been certified and registered by the NVAO.

Preparation

Academion composed the peer review panel in cooperation with the institutions and taking into account the expertise and independence of the members as well as consistency within the cluster. On 20 July 2022 the NVAO approved the composition of the panel. The coordinator instructed the panel chair on his role in the site visit according to the Panel chair profile (NVAO 2016). The full panel was also informed on the assessment frameworks, the working method and the planning of the site visits and reports.

The programmes composed a site visit schedule in consultation with the coordinator (see appendix 3). The programmes selected representative partners for the various interviews. They also determined that the development dialogue would be organized in the form of thematic sessions during the site visit. A separate development report was made based on these sessions.

The programmes provided the secretary with a list of graduates over the period 2019-2021. In consultation with the secretary, the panel chair selected 15 theses per programme. He took the diversity of final grades and examiners into account, as well as the various tracks. Before the site visit, Academion received the relevant documentation from the programmes, consisting of an extensive set of current documentation pertaining to the four standards of examination that, together with a cover letter and SWOT analysis, served as self-evaluation report. This included a comprehensive analysis of the programmes' strengths and weaknesses, and a separate and independent student chapter along with the required appendices. Before and during the site visit, the panel studied the additional documents provided by the programmes. An overview of these materials can be found in appendix 4.

The panel members studied the information and sent their findings to the secretary. The secretary collected the panel's questions and remarks in a document and shared this with the panel members. In a preliminary meeting on 3 November 2022, the panel discussed the initial findings on the self-evaluation reports and the theses, as well as the division of tasks during the site visit.

Site visit

During the site visit, the panel interviewed various programme representatives (see appendix 3). The panel also offered students and staff members an opportunity for confidential discussion during a consultation

hour. No consultation was requested. The panel used the final part of the site visit to discuss its findings in an internal meeting. Afterwards, the panel chair publicly presented the preliminary findings.

Report

The secretary wrote a draft report based on the panel's findings and submitted it to a colleague at Academion for peer assessment. Subsequently, the secretary sent the report to the panel for feedback. After processing this feedback, the secretary sent the draft report to the programmes in order to have it checked for factual irregularities. The secretary discussed the ensuing comments with the panel chair and changes were implemented accordingly. The panel then finalised the report, and the coordinator sent it to the University of Twente.

Panel

The following panel members were involved in the cluster assessment:

- Prof. dr. J. (Nico) Vandaele, KU Leuven – chair
- Prof. dr. A. (Allan) Larsen, Technical University of Denmark – vice-chair
- Prof. dr. E.M.M. (Emmo) Meijer
- Dr. Ir. J.C. (Jaap) Schouten
- Prof. em. dr. ir. J.P.L. (Joos) Vandewalle, KU Leuven
- Prof. dr. H.J. (Erik-Jan) Hultink, Delft University of Technology
- Prof. dr. ir. G.H. (Gerrit) van Bruggen, Erasmus University Rotterdam
- Prof. dr. R.E.C.M. (Rob) van der Heijden, Radboud University Nijmegen
- Prof. dr. I.F.A. (Iris) Vis, University of Groningen
- Prof. dr. M.C.E. (Rietje) van Dam-Mieras
- Prof. dr. P.D. (Patricia) Wolf, University of Southern Denmark
- Dr. J.C. (Christine) Teelken, Vrije Universiteit Amsterdam
- L.P.F. (Lynette) Haksel BSc, Eindhoven University of Technology – student member
- I. (Ilse) Overvelde BSc, University of Groningen – student member

The panel assessing the Industrial Engineering and Management programmes at the University of Twente consisted of the following members:

- Prof. dr. J. (Nico) Vandaele, KU Leuven – chair
- Prof. dr. A. (Allan) Larsen, Technical University of Denmark
- Prof. dr. R.E.C.M. (Rob) van der Heijden, Radboud University Nijmegen
- Prof. dr. I.F.A. (Iris) Vis, University of Groningen
- L.P.F. (Lynette) Haksel BSc – student member

Information on the programmes

Name of the institution:	University of Twente
Status of the institution:	Publicly funded institution
Result institutional quality assurance assessment:	Positive

Programme name	Industrial Engineering and Management Science
CROHO number:	56994
Level:	bachelor
Orientation:	academic
Number of credits:	180 EC
Specialisations or tracks:	-
Location:	Enschede
Educational minor:	Applicable
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO:	01-05-2023

Programme name	Industrial Engineering and Management
CROHO number:	60029
Level:	master
Orientation:	academic
Number of credits:	120 EC
Specialisations or tracks:	Production and Logistics Management Healthcare Technology and Management Financial Engineering and Management
Location:	Enschede
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO:	01-05-2023

Description of the assessment

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.

Findings

Mission and profile
The bachelor's and master's programmes Industrial Engineering Management (IEM) are organized by the Department of High-tech Business and Entrepreneurship (HBE) at the Faculty of Behavioural, Management and Social Sciences (BMS) of the University of Twente (UT). The programmes aim to educate engineers that can combine expertise in technology, human behaviour and business processes to help organizations function more effectively. Students are taught a hands-on approach, applying academic knowledge and skills in practice. Emphasis is placed on professional skills, teamwork and interdisciplinary collaboration.

The *BSc IEM* teaches students to develop, analyze and optimize processes and management in organizations. Relevant domains that students get acquainted with are Production and Logistics Management, Financial Engineering and Management, Information and Technology Management and Business Administration. In addition, they learn quantitative techniques (applied mathematics, such as operations research, statistics and probability theory) as well as ethics and professional and academic skills. Over the course of the programme, students learn to integrate all these elements in designing solutions for organizational challenges, improving processes and productivity, raising product quality, and quantifying risks. The *Twente Educational Model* (TEM) is instrumental in this. TEM is characterized by project-led education, organized in thematic modules that cover an entire 10-week period. Modules consist of interrelated courses and projects, where students directly apply their new knowledge and skills. Students take several modules together with students from other BSc programmes, underlining the multidisciplinary character of the programme.

The *MSc IEM* aims to educate students to become highly qualified industrial engineers and managers. The focus is on improving operational processes with multiple, sometimes conflicting objectives. Students learn to use modelling and quantitative analysis grounded in an understanding of the technology that is used in the process. Also attention is paid to human behaviour and the environment in which the organization is situated. Students are prepared for various fields in which to apply their IEM knowledge and skills, and learn to translate practical domain problems towards scientific questions and vice versa. The various fields are grouped in three specializations:

- *Production and Logistics Management (PLM)* covers the design and management of processes related to logistics and the supply chain. Students learn to analyze the structure of logistic chains and to apply quantitative optimization, notably Operations Research, techniques to solve problems in production and logistics for industry, service organization or the public sector.
- *Health Care Technology and Management (HCTM)* focuses on analyzing and optimizing processes in the health care sector. The specialization trains students to use quantitative and qualitative methods to support health care management in optimizing health care delivery to patients, for instance through new health care technology and efficient planning of health care processes.

- *Financial Engineering & Management (FEM)* teaches students quantitative instruments for risk management in the financial sector, allowing them to analyze and manage financial risks using financial products and modifying business processes.

The panel studied the profile and goals of both programmes. It concludes that both programmes have a strong profile with a clear position in the field of IEM, focusing on interdisciplinary collaboration to improve organizations through a combined focus on technology, human behaviour and business processes. In doing this, the programmes focus on relevant application areas, notably related to production and logistics, health care technology and financial engineering, with the MSc IEM offering these three directions as specializations. The programmes have many ties to external organizations that contribute to the programme, for instance by bringing real-life cases into courses or supervising external projects. According to the panel, this positioning, as well as the interactive, small-scale setting is an important strength of the programmes that strongly resonates with its mission and aims.

During the site visit, the panel spoke with various representatives about the role of the programmes in tackling major societal challenges, and the alignment of the goals and content of the IEM programmes with this role. The panel learnt that there are various initiatives in this direction, and that both programmes, particularly the MSc IEM, are exploring ways to create further opportunities to work on major societal challenges in an interdisciplinary approach. The panel applauds this, and thinks that IEM graduates could have an important role in guiding organizations through the upcoming major societal transformations. It recommends expanding the network of the programmes by including societal stakeholders, both in its work field committee (see below) and through informal connections.

Intended learning outcomes

The intended learning outcomes (ILOs) of both programmes are divided into professional academic qualifications, and general academic qualifications. The professional academic qualifications describe the specific IEM knowledge and skills that students are expected to master, whereas the general academic qualifications contain the relevant academic and personal skills of students on an academic bachelor's or master's level. The full sets of ILOs are included in appendix 1. The programmes benchmark their ILOs against the Domain-Specific Framework of Reference (DSFR) to keep these aligned with the general expectations for Industrial Engineering programmes. To keep the aims and content aligned with the expectations of the professional field, the programmes regularly consult with their work field committee. This committee consists of members from the professional field of the programmes, and regularly contributes ideas about their curricula and learning outcomes.

The panel studied the ILOs of both programmes and concluded that they form a well-structured overview of the main goals of each programme translated into knowledge and skills to be acquired by students. The programmes have worked on reformulating the ILOs of both programmes to better distinguish between the BSc and MSc IEM, based on the recommendation of the previous accreditation panel. The panel appreciates this, and concludes that the distinction between bachelor's and master's level is clearly visible in the current ILOs. Furthermore, the learning outcomes clearly reflect an academic orientation, as well as the general knowledge, skills and attitudes described in the DSFR for IEM, demonstrating that the programmes meet the expectations of the discipline. The work field committee provides an excellent benchmark for the expectations of the professional field, and safeguards that the goals of the programmes remain aligned with that of future employers of graduates.

Regarding the content of the ILOs, the panel thinks that attention to ethics and sustainability could be more prominent. Ethics is currently related to research integrity, but could be expanded to include ethical

considerations of new technologies in relation to public values and public acceptance. In the same vein, technology could also be considered more explicitly in its relation to the rapidly intensifying societal debate on circularity and sustainability. This is particularly relevant for the MSc IEM, which studies complex challenges with conflicting stakeholder needs. The panel recommends increasing attention paid to these elements in the goals and curricula of the programmes.

Considerations

The profile and aims of the BSc and MSc IEM are fitting for academic bachelor's and master's programme in Industrial Engineering. The programmes have relevant and strong aims, and are embedded in an attractive context with small-scale, interactive education and many connections to the professional field. They offer students the opportunity to specialize in the application areas of production and logistics, health care technology and financial engineering. The goals of both programmes have been well-translated into two coherent sets of intended learning outcomes that are aligned with the requirements of the academic and professional fields. The panel appreciates the initiatives to further align the programmes with major societal challenges and transitions, but believes this effort could be strengthened and made more explicit. It recommends expanding the network of the programmes in the direction of societal stakeholders, and increasing attention paid to ethics and sustainability of new technologies, as well as their role in societal transitions, in the programmes' aims.

Conclusion

The panel concludes that both programmes meet standard 1.

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.

Findings

BSc IEM: Curriculum and teaching methods

The curriculum of the BSc IEM (see appendix 2) is structured using the principles of the Twente Educational Model (TEM). This model is characterized by the integration of courses in thematic 10-week modules of 15 EC each. Modules are designed alongside overarching themes such as Supply Chain Management, Finance for Engineers and Consumer Products. Within each theme, multiple business, engineering, quantitative methods and skills study units are integrated in a coherent package, alongside a capstone group project. This group project presents students with a specific, open-ended challenge that requires skills and knowledge from each of the study units, supplemented by independently gained knowledge and skills by the students. These projects are often offered in a multidisciplinary project setting. Five modules are shared with other bachelor's programmes, including Business and IT, Industrial Design Engineering, Mechanical Engineering, Applied Mathematics and Civil Engineering, requiring students to work on their projects in multidisciplinary teams. The full curriculum consists of eight mandatory modules (120 EC), two modules reserved for a minor with a free choice of subject (30 EC), and two modules dedicated to the preparation and execution of the BSc thesis (30 EC).

The programme distinguishes three learning lines within the mandatory modules: *Domain Knowledge* (with subdomains Production and Logistics Management, Financial Engineering and Management, Information and Technology Management and Business Administration), *Quantitative Techniques* (Mathematics and Statistics & Probability) and *Professional and Academic Development* (Research Methodology, Skills, and

Ethics & Philosophy). The Quantitative Techniques learning line is partly shared with other engineering programmes. The theory is similar for all programmes, but each study unit contains a case assignment tailored to IEM. Statistics and probability is fully tailor-made for IEM, and aligns with the other study units of the modules where statistics and probability are applied. Professional and Academic Development contains education in research methodology, skills, ethics and philosophy. The skills are both aimed at professional development (e.g. presenting, team roles, project management, work field orientation) and academic development (e.g. feedback skills, time management, reflection skills). Ethics and Philosophy is offered by the Reflection on Science, Ethics and Society education team and tailor-made for IEM.

The third year is devoted to broadening (minor) and integration (BSc thesis). In the minor modules space, students choose a 30 EC minor programme aimed at broadening their perspectives. This can be one of the many minor programmes offered by the UT, teacher training, studying abroad or at another Dutch university, or following a bridging programme for a non-IEM master's programme. In the graduation project and its preparatory project plan, students integrate domain knowledge, quantitative techniques and professional and academic skills obtained throughout the programme. The BSc project is primarily executed in an organization outside the university. The project results in a written report and oral presentation at a student colloquium.

The panel studied the curriculum as well as the content of a number of modules, and concludes that the BSc IEM has a strong and coherent curriculum. The curriculum covers all intended learning outcomes, and offers a strong basis in Industrial Engineering and Management. The TEM model provides an excellent context for integration of knowledge in capstone projects, and has deliberate opportunities for interdisciplinary learning in the modules shared with other programmes. The panel also welcomes the opportunity for students to follow a semester abroad during the elective modules, an addition to the programme that was made based on the recommendations of the previous accreditation panel.

The learning lines provide structure and overview to the curriculum, and safeguard that the relevant domain knowledge and techniques, as well as academic and professional skills, are sufficiently covered throughout the curriculum. In line with its recommendation under standard 1, the panel advises to give ethics and sustainability a larger role in these learning lines, using this structure to ensure that these elements are sufficiently incorporated in the modules.

MSc IEM: Curriculum and teaching methods
The curriculum of the MSc IEM (see appendix 2) is composed of mandatory core study units (10 EC), specialization-specific core courses (30 EC), elective space (45 EC), thesis preparation (5 EC) and the MSc thesis (30 EC). At the start of the programme, students choose between the PLM, HCTM or FEM specialization (see standard 1). They follow a set of six core courses within this specialization. In PLM, students can further specialize by choosing between four research orientations (Service Logistics and Maintenance Management, Supply Chain and Transportation Management, Manufacturing Logistics, and Operations Management in Healthcare) during the first block of their study. Each orientation represents a scientific research area, and covers 15 EC of the specialization-specific courses. Regardless of their specialization, all IEM students follow the two courses IEM Research Orientation and Data Science. The teaching methods often feature challenge-based learning in the shape of group work on real-life cases, allowing students to practice their interdisciplinary problem-solving skills.

The elective space of the programme can be used to either follow a selection of recommended deepening electives within the specialization, or (after approval by the Examination Board) any other relevant technical courses from the UT or another Dutch or international research university. Students can also use their

elective space to opt for a second specialization, following a specific 30 EC package from one of the other two IEM specializations, or selected specialization packages from other master's programmes such as Civil Engineering and Management, Business and IT, Business Administration, Mechanical Engineering and Industrial Design Engineering. During the MSc thesis, students work in an external organization, investigating a real-life issue or problem within that organization using the scientific and professional knowledge and skills they acquired throughout the programme. In the preceding course Master Thesis Preparation, students compose a project plan, including a research question and plan for execution.

The panel studied the structure and content of the curriculum of the master's IEM, as well as a number of courses. It concludes that the curriculum incorporates all intended learning outcomes and is well-structured. It appreciates the semi-open structure of the curriculum, with many opportunities for broadening and specialization through the three tracks and the electives, without losing coherence and focus. This is also very much appreciated by students, who welcome the options for choosing their own route through the programme, guided by the research orientations and pre-composed specialization packages. The real-life cases that are brought into the programme as well as the MSc thesis offer ample opportunities for students to practice their hands-on approach for solving complex challenges with multiple stakeholders, which the panel considers to be a very strong element of the curriculum. Students interested in interdisciplinary working can further deepen their skills by choosing elective courses with project work and following courses in other programmes. In line with its recommendations under standard 1, the panel recommends safeguarding that the complexity of sustainable development and the variety of ethical aspects related to major societal challenges, are sufficiently covered throughout all tracks. This could for instance take the shape of cross-cutting themes on sustainability and ethics through the tracks. Challenge-based learning could be a good opportunity for bringing challenges originating from societal transitions into the curriculum.

Language and internationalization
Both programmes are offered in English. According to the programmes, English is the dominant language in the field, both in academia and increasingly in the professional field where graduates of the programme can be expected to work. All IEM teachers are required to take a UT English Proficiency Assessment before they can teach in the programmes. The university offers optional courses to improve the staff's language proficiency when necessary. To promote intercultural learning in an international classroom, the programmes take care to mix Dutch and international students in project groups, allowing students to learn from a diversity of backgrounds.

The panel considers the choice for the use of English to be well motivated. Many of the companies at which graduates of the programmes can be expected to work operate in an international environment. An English language programme prepares students for this internationally oriented field. Students are positive on the quality of the education in English, and there is sufficient attention to the language skills of the teaching staff. The panel appreciates the choice to deliberately mix project groups, and thinks that this contributes to learning through an international classroom.

Guidance and feasibility
The IEM programmes prides itself on an educational environment with a personal approach: down-to-earth, with easily approachable staff, personal attention, lean procedures and co-production between staff and students. Student inflow varies between 100-150 students per year for the BSc, and 75-100 for the MSc. The panel verified during the site visit that this is indeed a strong element of the programme. It understood from both students that they have very short lines of communication with the teaching staff and programme management, with whom they interact on a first-name basis. Staff and students are located in the same building, where student facilities such as the rooms of the study association Stress are situated in a

prominent central location, further promoting informal contact. Students are often involved in the organization of activities on a programme or faculty level, which the programmes see as an important extra-curricular element of education. The panel applauds the programmes for their supportive learning community. It also understood that this community was also instrumental in keeping students engaged during the COVID-19 lockdowns, using virtual meetings and extra support for student well-being.

Next to these informal interaction with students, the programme management and the study association organize course evaluations in the form of panel meetings during each module/quarter, in addition to the anonymous written course evaluations after the quarter. All students are invited to participate in a round-table discussion to evaluate their courses and modules. The input of these meetings is used to improve education for the next academic year. The panel thinks that this is a very fruitful approach that fits the small-scale character of the programmes, and understood that these evaluations often result in helpful and nuanced feedback for further development of courses and modules.

The programmes pay particular attention to student guidance during the bachelor's and master's thesis, which are often executed at an external organization. Students can acquire an assignment, internal and external supervisor through the programme's network of organizations. Alternatively, students can acquire their own project, and submit their assignment to the proposed supervisor for approval. During the execution of the thesis, they are supervised by a pair of supervisors. The external supervisor is responsible for daily supervision within the organization, and the internal supervisor is an academic specialist on the topic from within the programme, and responsible for the academic content and assessment of the project. In some cases, often with strongly multidisciplinary research topics, there are two internal supervisors. While working on their thesis, students are part of a thesis group, where they can share and discuss their experiences and questions with other students, work together on shared assignments throughout the preparatory period, and ask for peer feedback. The groups are often organized in such a way that students can share experiences with students working at the same or a similar organization.

The panel approves of the guidance during the thesis trajectory, and thinks that the thesis groups are a good mechanism for this. It learnt during the site visit that international students sometimes have difficulty finding a suitable external projects. Many organizations, particularly in health care, require Dutch-language proficiency. The programmes help these students by compiling a list of known organizations that are open to English-language internships. The panel approves of this additional support, and advises to keep investing in this, especially regarding the rise in international students in the past years.

The panel learnt during the site visit that students consider the curricula to be feasible, with no major hurdles that prevent a nominal study duration. Some MSc students that came from the BSc IEM reported that they felt that the step from bachelor's to master's was quite steep, resulting in a high study load in the first semester of the first MSc year. After discussing this with students and teaching staff, the panel concludes that this mainly results from the more interdisciplinary and integrated approach that the master's programme uses compared to the bachelor's, which presents students with a challenge at the start. After getting used to this, most students report that the later courses are more manageable. The panel advises the programme to invest in managing expectations for prospective MSc students, so that they know what to expect in the first part of the programme, which might help them to feel less overwhelmed.

Students entering the MSc from a university of applied sciences (hbo) need to complete a premaster programme before being admitted. This is a programme of 30 EC that repairs deficiencies on mathematics, statistics, academic skills. For students from an academic social sciences BSc or a monodisciplinary engineering degree, the master's programme decides on a case-by-case basis whether students can be

admitted and what parts of the premaster programme they need to follow. The panel concludes that the premaster is well-designed and provides students with a sufficient basis for participating in the MSc programme.

Teaching staff
The programme is mainly offered by the teaching staff of the Department of HBE, with the exception of the Mathematics and Ethics & Philosophy courses in the BSc, which are organized by the UT teaching staff from these disciplines. Almost all teaching staff members are active researchers. 88% of the teaching staff of the BSc and 100% of the MSc have a PhD. Teaching assistants (often higher-year BSc or MSc students IEM) are employed under supervision of tenured staff to assist in tutorials and projects in the bachelor's. Regarding professionalization of teachers, the programmes require all new teaching staff to obtain the University Teaching Qualification (UTQ) certificate within three years of appointment. At the moment, 76% of the BSc and 86% of the MSc teaching staff has obtained an UTQ, with the remainder in the process of obtaining it.

The panel concludes that the teaching staff is well-qualified for teaching in the programme, both in terms of research background and didactic qualities. According to the panel, the interactive and small-scale project-oriented approach used in the programmes requires specific didactic qualities. It was happy to learn that the programmes offer several opportunities to support this with additional courses and training beyond the UTQ. As this is generally done on a voluntary basis by teaching staff members, the panel advises to investigate whether such professionalization activities can be further integrated into formal requirements and recognition for staff teaching in the programme.

Teaching in the IEM programmes is rewarding, yet time-intensive for the teaching staff. The teaching staff as well as the programme management realize that this specific didactic approach is an integral aspect of both programmes. With the current student numbers, this approach is feasible, but there is a natural limit to the number of students the programmes can accommodate, and this limit is not significantly higher than the current inflow of 200 BSc and MSc students per year. The panel endorses this, and thinks that the programmes should approach any future growth carefully to avoid losing it unique nature.

Considerations
The curricula of both programmes are coherent and well-structured, and cover all intended learning outcomes. The bachelor's IEM offers a strong basis in IEM, with an excellent opportunities for integration through the project-led educational approach (TEM). The master's IEM has an open curriculum, allowing opportunities for specializing and broadening in a well-structured proposition of tracks, research orientation and specialization packages. Both programmes have many opportunities for interdisciplinary, challenge-based learning (both in the courses and in the externally executed thesis projects), which the panel considers to be a strength of the programmes. Both programmes are offered in English, which the panel considers to be well-motivated and implemented. The panel recommends both programmes to increase attention to ethics and sustainability in the curricula, either through the learning lines (bachelor's) or as cross-cutting themes through the tracks (master's). It also suggests using the challenge-based learning-oriented courses in the master's IEM to introduce challenges related to societal transitions in the curriculum.

The programmes are embedded in a small-scale, interactive environment, with very short lines of communication between staff and students. This results in close guidance and support throughout the programmes, which contributes to student learning and well-being, as well as continuous development of the curricula. The curricula are feasible, with extra attention being paid to support during the thesis trajectory. The teaching staff is well-qualified, and is dedicated to the specific educational approach of the

programme. The panel advises to keep investing in teacher professionalization, and to carefully monitor any future growth to ensure that the unique nature of the programmes can be preserved.

Conclusion

The panel concludes that both programmes meet standard 2.

Standard 3. Student assessment

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

Findings

Assessment system

The assessment policy of the IEM programmes is based on the principle that assessment is an activity to enhance student learning, with feedback as the most important catalyst. The programmes aim to present students with a differentiated spectrum of tests and assignments, corresponding with the learning goals of the associated course as well as the programme's overall ILOs. For the modules in the BSc IEM, the module coordinator is responsible for assessment within the entire module. He or she cooperates with the lecturers in the module components to design the various tests and assignments in the course in order to achieve a balanced planning, alignment with the module learning goals and sufficient variation in assessment forms. In the MSc IEM, the coordinating lecturer of a course is responsible for designing the assessment.

As project work plays an important role in the IEM programmes, specific attention is paid to the balance between individual and group assessment. Each module and course should combine individual and group assessment forms, and at least 50% of the grades within both programmes should be based on individual assessment. All tests and exams are peer reviewed before implementation. In addition, the lecturers engage in peer screening of full courses and modules, where they provide each other feedback.

The panel studied the system of assessment in the programmes and concludes that this is well-structured. It understood that there is ample room for feedback to students on assignments and exams, contributing to student learning. It appreciates the module-wide coordination of assessment in the modules in the BSc IEM, as well as the quality assurance mechanisms in place for designing and screening assessment quality. The balance between group and individual assessment is carefully monitored, safeguarding that all intended learning outcomes are reliably assessed for all individual students.

Thesis assessment

The BSc and MSc theses are assessed independently by the first examiner, who is usually also the internal supervisor, and the second examiner. The role of second examiner is taken either by a second internal supervisor (in the case of a multidisciplinary research topic), or by an unrelated other scientific staff member of the programme. The external, daily supervisor at the external organization where the student executed his or her thesis has an advisory role in evaluating the process and daily function of the student. Before a thesis can be graded, the first examiner determines whether a draft of the thesis offers sufficient ground to be graded with a satisfactory grade in a 'green light meeting'. After being given the green light, students can participate in the public defence of the thesis at a student colloquium. The final grade of the thesis consists of the quality of the written thesis, the oral presentation and defence at the colloquium, and the performance in professional practice, and is decided through consensus by the examiners after the defence.

As part of its preparation for the site visit, the panel studied the final work of 15 students from each programme, including the accompanying assessment forms. It found the assessment forms as well as the rubrics to be insightful and transparent, with sufficient attention to qualitative feedback. Using two assessors that separately evaluate the theses before the defence adds to the validity and reliability of the assessment. Regarding the role of the second examiner, the panel thinks that all theses should have a second examiner not involved in supervision. Currently this is not the case for co-supervised theses, where both examiners are also supervisors. It recommends investigating ways to implement this, for instance by adding a third independent examiner for co-supervised theses, or having only one of the co-supervisors act as formal examiner.

The panel noted that the assessment file only included the joint assessment completed by both examiners after the defence. It recommends also storing the separate forms to further improve the transparency of the assessment process, even though students would only receive the joint assessment form. Several assessment forms that the panel reviewed did not provide further written explanation of the grading, whereas some contained hand-written comments, that were in some cases hard to read. The panel understood that even though the form is in a digital format, some examiners print it, fill it in by hand and scan it afterwards. The panel recommends enforcing the digital use of the form as well as a brief explanation of the main argumentation for the grading.

Some of the theses that the panel studied could be improved regarding reflection on academic contribution as well as writing and layout (see standard 4). The panel advises the programme to consider adding this explicitly to thesis assessment. Even if elements such as formatting and lay-out are not separately graded, the programmes could consider setting a threshold that all theses should meet and help students through supervision and feedback to achieve this.

Examination Board
The IEM programmes share an Examination Board with the bachelor's and master's Business Administration. This Examination Board Management Sciences is responsible for safeguarding the quality of assessment in the programmes. The Board monitors quality of assessment by studying the programme assessment plans, the rules and guidelines of assessment, a sample of exams and tests, a sample of BSc and MSc theses and their assessment forms. An additional thesis check is performed by the examiners in the programmes themselves through the thesis carrousel. During the thesis carrousel, teaching staff members re-grade a number of completed theses from a colleague, and compare their ways of grading. This serves as calibration between examiners, as well as a quality check on the thesis.

Furthermore, the independent educational experts at the Centre of Expertise in Learning and Teaching (CELT) of the UT do a full screening of one bachelor's module and one master's course per year. They discuss their results with the examiners and programme management, and report to the Examination Board. To discuss their findings and provide recommendations, the Board meets four times a year with the management of each programme.

The panel interviewed the Examination Board and studied a number of its reports, and concludes that the Board fulfils all of its duties in a proactive way. It has several mechanisms in place to monitor the quality of assessment of individual courses, the overall programme and the exit level of students. The thesis carrousel in particular is an efficient tool for thesis quality monitoring and for internal calibration of grading culture and processes.

Considerations

The system of assessment of the IEM programmes promotes valid, reliable and transparent assessment, with considerable attention to feedback to enhance student learning. There are several checks and balances in place to safeguard the quality of assessment and the exit level of students, including monitoring the balance between individual and group assessment and calibration among thesis examiners. The Examination Board fulfils all of its duties in a proactive way. Thesis assessment is insightful and transparent, with two examiners involved with each thesis and attention paid to qualitative feedback. The thesis assessment procedure could be further improved by ensuring that an external examiner is involved for each thesis, also in the case of two supervisors, and by including the individual forms of each examiner in the assessment file. Furthermore, the panel advised paying extra attention in thesis assessment to writing, lay-out and academic reflection.

Conclusion

The panel concludes that both programmes meet standard 3.

Standard 4. Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings

Thesis quality

Prior to the site visit, the panel studied 15 BSc theses, and 15 MSc theses. The panel took care that all tracks of the MSc programmes were sufficiently covered in the selection. It concludes that thesis quality in both programmes is good. The topics cover relevant, real-life cases of the external organizations where the theses were executed, and make appropriate use of scientific literature and (quantitative) research methods in investigating the cases.

For both programmes, the panel found that the theses focus primarily on the added value for the organization and the solution to the investigated case. Attention paid to generalization of results and the reflection on the contribution of the work to scientific literature was often limited in scope. The panel recommends training students to further explore this in the theses. In particular in the master's programme, students could be stimulated to take a helicopter view, reflecting on how robust solutions are in other contexts and how they relate to broader academic debates. Furthermore, the panel found that in some cases, theses could be improved in terms of lay-out, formatting and writing. It recommends including these elements in thesis assessment and supervision (see standard 3). Notwithstanding these recommendations, the panel found the theses to be very relevant and interesting, and concludes that they convincingly show that graduates achieve the intended learning outcomes of their programme.

Alumni

According to a recent alumni survey, graduates of the BSc IEM usually continue with a related master's programme either at the UT or elsewhere. Approximately 10-15% of BSc graduates decides to enter the professional field. BSc graduates continuing with the MSc IEM felt, after an acclimatization period (see standard 2), well prepared for the programme. The MSc graduates generally find a suitable position in industry, in societal organizations or in academia. The BSc and MSc alumni that the panel interviewed during the site visit were very satisfied with their education, and found that particularly the many interactions with external organizations during their programme prepared them well for their future career.

Considerations

The panel concludes that the selected theses show that the intended learning outcomes of both programmes are achieved. The topics are relevant and cover a variety of real-life cases of external organizations. The panel recommends particularly the MSc IEM to challenge students to reflect on the generalization of their results and the academic contribution of their work. The programmes prepare students for relevant MSc programmes (BSc) and relevant positions in the academic and professional field (MSc).

Conclusion

The panel concludes that both programmes meet standard 4.

General conclusion

The panel's assessment of the BSc Industrial Engineering and Management is positive.
The panel's assessment of the MSc Industrial Engineering and Management is positive.

Development points

1. Invest in the alignment of the programmes with major societal challenges and transitions. This includes expanding the network of the programme in the direction of societal stakeholders, further development of challenge-based education and increasing attention in the programmes to complex issues of ethics and sustainability related to existing and new technologies, as well as their role in societal transitions.

2. Carefully monitor any future growth to ensure that the unique small-scale and interactive nature of the programmes as well as the proven informal culture can be preserved.

3. Improve thesis assessment by ensuring that an external examiner is involved for each thesis, also in the case of two supervisors, and including the individual forms of each examiner in the assessment file.

4. Formulate a threshold for quality of writing, lay-out and formatting in each thesis. Help students achieve this through supervision and feedback, and provide support to the staff involved in this.

5. Pay extra attention to academic reflection and generalization of results in the theses, particularly for the master's IEM.

Appendix 1. Intended learning outcomes

BSc Industrial Engineering and Management

	Professional Academic Qualifications BSc
	The graduate is able to identify, comprehend, assess, correctly apply, and integrate existing scientific knowledge that can be used for analysing problems and designing solutions, in the domains of: • Production and logistics; • Information systems; • Finance and accounting; • Other fields in business administration (law; marketing; human resources; entrepreneurship); • Mathematics, statistics, empirical research methods.
A1	*The student has a global overview of the **structure of research and design processes.*** The student is able to: • Identify the various steps in performed research and design • Properly break up own research and design activities into subprocesses These processes are intertwined: Research is needed for producing knowledge that is used for designing solutions in a specific context. Such knowledge is produced in a purposeful and methodical way (using scientific research methods). It may or may not be generalizable knowledge
A2	*The student has an overview of quantitative and qualitative **empirical research methods.*** The student is able to: • Analyse performed research as to the methodological aspects • Select an appropriate method and explain this choice for research to be performed • Apply this method in relatively simple cases
A3	*The student has an overview of quantitative **modelling techniques** for operational processes, specifically in the domains of* • Operations research models • Information systems models • Finance and accounting models The student is able to: • Analyse the results of modelling activities • Select an appropriate modelling technique and explain this choice • Apply this technique in relatively simple cases.
A4	*The student is able to **integrate** existing knowledge, modelling techniques, and research results for designing, validating, and selecting solutions in relatively simple cases.* This is challenging, because existing knowledge may not fully apply to a specific situation, models are always stylized, empirical research always has limitations, and some aspects have been left out of scope from the beginning anyway
A5	*The student has an overview of **implementation methods and processes**.* The student is able to: • (critically) Analyse ongoing or finished implementation processes • Plan globally an implementation process in a relatively simple case
A6	*The student has an overview of **evaluation methods and techniques**.* The student is able to: • Analyse the results of performed evaluations • Select appropriate evaluation methods and explain this choice • Carry out an evaluation in relatively simple cases
A7	*In order to be able to meet these competencies, the graduate must have mastered the following disciplines:* • Mathematics and statistics - [2] (see Legend) • Finance and accounting - [2] (see Legend) • Production and logistics - [2] (see Legend) • Information systems - [2] (see Legend) • Law, organization theory, marketing - [1] (see Legend)

	General Academic Qualifications BSc
B1	*The student is able to **work autonomously and is self-reliant*** The student: • Is able to select and use appropriate time management techniques • Is able to select and apply appropriate principles of project management • Can perform complex assignments without detailed briefs and within given boundaries
B2	*The student is able to work in **multidisciplinary teams*** The student: • Can organize and structure meetings and has basic knowledge of decision-making techniques • Can adopt different roles within a team • Can reflect on the functioning of himself and others • Is able to give and receive effective feedback
B3	*The student is able to **communicate effectively,** in oral and written form, with various stakeholders* The student: • Can deliver a strong, valid, and scientific line of argumentation in a concise manner and an acceptable amount of time • Can explain various concepts and present data • Can give a presentation aimed at knowledge transfer with use of appropriate audio-visual means • Can design, conduct, and report an interview
B4	*The student is able to conduct a **bibliographic search** and knows how to reference correctly* The student: • Can systematically search for and select relevant scientific literature for projects and reports • Is able to properly use quotation and paraphrases • Is able to compile a relevant reference list in APA-style
B5	*The student is able to recognise and reflect on **ethical and societal** aspects in the IEM domain* The student: • Can identify and address General Data Protection Regulation and confidentiality issues • Can describe ethical implications of using research methods and technologies
B6	*The student is able to reflect on and direct **personal and professional behaviour and development*** The student: • Is able to analyse their own strengths and weaknesses and compose and execute a personal development plan • Is able to balance study and other activities with effective time management
B7	*Has enough basic knowledge and competencies to follow a broad range of MSc programmes that are adjacent to the IEM domain.*

Level	Legend
[1]	Knowledge of the basic concepts and principles
[2]	Application in relatively simple and monodisciplinary cases
[3]	Application in relatively simple interdisciplinary cases

	Professional Academic Qualifications MSc
	The graduate is able to quickly identify, thoroughly comprehend, critically assess, correctly apply, and creatively integrate existing scientific knowledge that can be used for analysing problems and designing solutions, in one of the domains of: • Production and logistics; • Finance and accounting; • Health care
A1	*The student has a thorough overview of the **structure of research and design** processes.* The student is able to: • Identify the various steps in performed research and design • Properly break up own research and design activities into sub-processes These processes are intertwined: Research is needed for producing knowledge that is used for designing solutions in a specific context. Such knowledge is produced in a purposeful and methodical way (using scientific research methods). It may or may not be generalizable knowledge.
A2	*The student has an overview of quantitative and qualitative **empirical research methods**.* The student is able to: • Critically analyse performed research as to the methodological aspects • Select an appropriate method and justify this choice for research to be performed • Apply this method in relatively complex cases
A3	*The student has a thorough overview of **quantitative modelling techniques** for operational processes in this domain.* The student is able to: • Select appropriate modelling techniques and justify this choice • Apply these techniques in relatively complex cases • Critically analyse the results of modelling activities
A4	*The student is able to **integrate** existing knowledge, modelling techniques, and research results for designing, validating, and selecting solutions in relatively complex cases.* This is challenging, because existing knowledge may not fully apply to a specific situation, models are always stylized, empirical research always has limitations, and some aspects have been left out of scope from the beginning anyway.
A5	*The student has an overview of **implementation methods and processes.*** The student is able to: • Critically analyse ongoing or finished implementation processes • Plan globally an implementation process in a relatively complex case
A6	*The student has an overview of **evaluation methods and techniques**.* The student is able to: • Critically analyse the results of performed evaluations • Select appropriate evaluation methods and justify this choice • Carry out an evaluation in relatively complex cases
A7	*In order to be able to meet these competencies, the graduate must have **mastered** a set of **core disciplines** in the specialization domain.*
A8	*The student is able to **contribute** to the development of the academic profession by identifying generic consequences and implications from professional cases (for example, general presentations, write papers about design solutions).*
	General Academic Qualifications MSc
B1	*The student is able to **work autonomously and is self-reliant*** The student: • Is able to work on complex assignments and conduct research projects without clear boundaries • Can apply effective time management and is self-reinforcing
B2	*The student is able to work in **multidisciplinary teams*** The student:
	• Can form a team to work with based on what is required for the project or assignment • Understands decision-making techniques and how to effectively organise meetings • Can effectively make use of a supervisor and organise feedback
B3	*The student is able to **communicate properly** (in oral and written form) with various stakeholders and from different backgrounds* The student: • Can write an academic text, based on clear questions or hypotheses. • Is capable of designing, conducting and digesting interviews and other means of oral input and can identify argumentation fallacies and the like • Is able to organise the preconditions for co-production of knowledge and interaction • Can balance appropriate body language, content, and the use of audio-visual means on the basis of a good understanding of the audience
B4	*The student is able to conduct a **bibliographic search** and knows how to reference correctly* The student: • Can select and judge relevant scientific literature for projects and exams and has a pro-active attitude regarding acquiring and updating knowledge • Is able to properly use quotation and paraphrases and compile a relevant reference lists in APA-style
B5	*The student is able to reflect on **ethical and societal** aspects of the IEM domain and work field* The student: • Can reflect on his behaviour in a professional context • Can detect General Data Protection Regulation and confidentiality issues and analyse ethical implications of using research methods and technologies
B6	*The student is able to reflect on and direct **personal and professional behaviour and development*** The student: • The student is able to manage and concretize his own learning process in the context of "lifelong learning" • Can create an innovative learning portfolio by selecting and describing learning and development goals he wants to pursue
B7	*Has sufficient knowledge and competencies to pursue a PhD or PDEng, and work in the IEM domain.*

Appendix 2. Programme curriculum

BSc Industrial Engineering and Management

B1					
Module 1 – 202000390 Introduction to IEM		**Q1**	**Module 2 – 202000395 Operations Management**		**Q2**
Study Units:		*EC*	*Study Units:*		*EC*
202001193	Intro to Mathematics + Calculus 1A	4	202001200	Calculus 1B	3
202100391	Probability	3	202000396	Operations Research	3
202000392	VBA Programming	2	202000397	Operations Strategy	3
202000393	Project and Core IEM Topics	4	202000398	Project Operations Management	4
202100394	Professional and Academic Development M1	2	202000399	Professional and Academic Development M2	2
Module 3 – 202000400 Business Intelligence and IT		**Q3**	**Module 4 – 202000405 Supply Chain Management**		**Q4**
Study Units:		*EC*	*Study Units:*		*EC*
202100283	Statistics and Probability	3	202001222	Calculus 2	3
202000402	Business Intelligence and Databases	4.5	202000406	Statistics	3
202000403	Business Process Management	4.5	202000407	Demand Supply Planning and Inventory Management	3
202000404	Professional and Academic Development M3	3	202000408	Sourcing, Supply Network Design and Transport	2.5
			202000409	Business Game	3.5

B2					
Module 5 – 202000410 Finance for Engineers		**Q1**	**Module 6 – 202000415 Consumer Products**		**Q2**
Study Units:		*EC*	*Study Units:*		*EC*
202000411	Accounting and Finance	3.5	202000416	Technical Product Modelling 1	2.5
202000412	Option Pricing	2.5	202000181	Production 1	2.5
202000413	Project Finance for Engineers	6	202000418	Sustainable Supply Chains for Consumer Products	2
202000414	Professional and Academic Development M5	3	202000417	Project Consumer Products	8
Module 7 – 202000420 From Product Design to Online Business		**Q3**	**Module 8 – 202000424 Modelling and Analysis of Stochastic Processes**		**Q4**
Study Units:		*EC*	*Study Units:*		*EC*
202001207	Linear Algebra	3	202000425	Stochastic Models	5
202000421	Product Design to Online Business Theory	4	202000426	Project Stochastic Models	1.5
202000422	Project PDOB	6	202000427	Simulation and Heuristics	3
202000423	Professional and Academic Development M7	2	202000428	Project Simulation and Heuristics	3.5
			202000429	Multidisciplinary Project	2

B3					
Module 9 - Minor		**Q1**	**Module 10 - Minor**		**Q2**
Free choice		*EC*	***Free choice***		*EC*
	Minor or study abroad	15		*Minor or study abroad*	15
Module 11 – 202000430 Bachelor Thesis Preparation		**Q3**	**Module 12 – 202000433 Bachelor Thesis IEM**		**Q4**
Study Units:		*EC*	*Study Units:*		*EC*
202000431	Project Plan	10	202000434	BSc Research Assignment IEM	15
202000432	Professional and Academic Development M11	5			

MSc Industrial Engineering and Management Programme 2020-2021

MSc IEM Structure		EC
Mandatory IEM		45
Mandatory per Specialisation		15
Mandatory per Orientation		15
(*Recommended*) Electives		45
Total EC's		120
QRT	Quartile	

Specialisations		Orientations
PLM	Production and Logistics Management	Service Logistics and Maintenance Management
		Supply Chain and Transportation Management
		Manufacturing Logistics
		Operations Management in Healthcare
HCTM	Health Care Technology and Management	Health Care Technology and Management
FEM	Financial Engineering and Management	Financial Engineering and Management

All courses are 5 EC (except the Master Thesis). Course content can be found in the Course Catalogue, see: Course Catalogue

	Programme IEM / Specialisations	Qrt	PLM (EC)	HCTM (EC)	FEM (EC)
201700020	IEM research orientation	1+3	5	5	5
201400174	Data Science	2+3	5	5	5
202001464	Thesis Preparation	--	5	5	5
194100060	Thesis	--	30	30	30
201800003	Operations Research Techniques 1	1+3	5	5	
201800004	Operations Research Techniques 2	4	5	5	
191820210	Simulation	1	5	5	
191506103	Statistics & Probability	1			5
191860651	Micro Economics	1			5
201300060	Mathematical Finance	2			5
	Mandatory per Orientation: ≥ three courses		15	15	15
	(*recommended*) Electives		45	45	45
	Total		**120**	**120**	**120**

Important notifications

Electives: free choice of courses only from ***engineering*** MSc programmes.

Exceptions:

Stochastic Models for Operations Management (191530881) is:
- **not allowed** for students with an UT IEM-BSc background;
  mandatory for PLM and HCTM students who did a pre master;
- **possibly mandatory** for **international students** in case of a deficiency.

Consult the specialisation coordinator to check what applies to your situation.

Statistics & Probability (191506103) may be mandatory for **international students**.
Consult the specialisation coordinator to check what applies to your situation.

Stochastic Models in Production Logistics (191531830) is not allowed, the related course Applied Queueing Models 201800171 is allowed.

Design of Production and Inventory Systems (191124720) is not allowed.

Courses from **non-technical** programmes that are listed in this overview are allowed.

*See the **Additional Specialisations** for more options to personalise your study programme.*

IEM Orientations

Course Code	Service Logistics and Maintenance Management	Q	Course code	Supply Chain and Transportation Management	Q	Course code	Manufacturing Logistics	Q	Course code	Operations Management in Healthcare	Q	Course Code	Health Care Technology and Management	Q	Course Code	Financial Engineering and Management	Q
Mandatory per specialisation																	
201700020	IEM research orientation	1+3	201700020	IEM research orientation	1+3	201700020	IEM research orientation	1+3	201700020	IEM research orientation	1+3	201700020	IEM research orientation	1+3	201700020	IEM research orientation	1+3
201400174	Data Science	2+3	201400174	Data Science	2+3	201400174	Data Science	2+3	201400174	Data Science	2+3	201400174	Data Science	2+3	201400174	Data Science	2+3
202001464	Thesis Preparation	--	202001464	Thesis Preparation	--	202001464	Thesis Preparation	--	202001464	Thesis Preparation	--	202001464	Thesis Preparation	--	202001464	Thesis Preparation	--
194100060	Thesis	--	194100060	Thesis	--	194100060	Thesis	--	194100060	Thesis	--	194100060	Thesis	--	194100060	Thesis	--
201800003	Operations Research Techniques 1	1+3	201800003	Operations Research Techniques 1	1+3	201800003	Operations Research Techniques 1	1+3	201800003	Operations Research Techniques 1	1+3	201800003	Operations Research Techniques 1	1+3	191506103	Statistics & Probability	1
201800004	Operations Research Techniques 2	4	201800004	Operations Research Techniques 2	4	201800004	Operations Research Techniques 2	4	201800004	Operations Research Techniques 2	4	201800004	Operations Research Techniques 2	4	191860651	Micro Economics	1
191820210	Simulation	1	191820210	Simulation	1	191820210	Simulation	1	191820210	Simulation	1	191820210	Simulation	1	201300060	Mathematical Finance	2
Mandatory per orientation																	
201800008	After-Sales Service Logistics	2	201800010	Transportation and Logistics Management	3	201800007	Planning & Scheduling	4	201800007	Planning & Scheduling	4	201700196	Adv. Sim. for Health Economic Analysis	3	191515101	Introduction to Risk Theory	2
191852630	Reliability Eng. & Maintenance Mngt.	3	201800009	Advanced Inventory Management	2	201800009	Advanced Inventory Management	2	191506103	Statistics & Probability	1	201700197	Decision Making in HC	4	191860181	Risk Management	3
201800009	Advanced Inventory Management	2	201800008	After-Sales Service Logistics	2	191820120	Warehousing	4	194121020	Optimization of Healthcare Processes	3	201800005	Applied Statistical Learning	1	201300062	Structured Products	3
Recommended electives per orientation																	
201800007	Planning & Scheduling	4	201800007	Planning & Scheduling	4	201800010	Transportation and Logistics Management	3	191820120	Warehousing	4	194121020	Optimization of Healthcare Processes	3	201000202	Management control for Fin. Institutions	4
201200146	Maintenance Engineering & Management	1	191820120	Warehousing	4	191820160	Purchasing Management	1	194122030	New Production Concepts	4	191506103	Statistics & Probability	1	201100162	Applied Financial Engineering	4
191506103	Statistics & Probability	1	201800065	Traffic Management	3	194121020	Optimization of Healthcare Processes	3	201700196	Adv. Sim. for Health Economic Analysis	3	201600032	Quality Management in Healthcare	2	201200138	Special Topics in Financial Engineering	2
191820120	Warehousing	4	201800064	Traffic Operations	1	194122030	New production Concepts	4	201600025	Finance and Healthcare Purchasing	2	191820120	Warehousing	4	201400244	Cost Management and Engineering	2
Interesting Example Electives per orientation																	
201800010	Transportation and Logistics Management	3	191581420	Optimization Modelling	3	191506103	Statistics & Probability	1	201700197	Decision Making in HC	4	201700089	Sustainable Business Development	1	191521800	Game Theory	1
191820160	Purchasing Management	1	194122030	New production Concepts	4	201700294	Engineering Project Management	4	201800005	Applied Statistical Learning	1	201400244	Cost Management and Engineering	2	192340101	Implementation of IT in Organizations	3
194121020	Optimization of Healthcare Processes	3	191820160	Purchasing Management	1	201700089	Sustainable Business Development	1	201700089	Circular Sust. Business Dev.	1	192340101	Implementation of IT in Organizations	3	201500510	Pioneers of Applied Mathematics	4
194122030	New production Concepts	4	194121020	Optimization of Healthcare Processes	3	201400244	Cost Management and Engineering	2	192340101	Implementation of IT in Organizations	3	201600015	Strategic Technology Mgmt. & Inn	3	191571090	Time Series Analysis	4
201700089	Circular Sust. Business Dev.	1	192340101	Implementation of IT in Organizations	3	192340101	Implementation of IT in Organizations	3	201600015	Strategic Technology Mgmt. & Inn	3	192360501	E-Health Strategy	4	201700294	Engineering Project Management	4
201400244	Cost Management and Engineering	2	201600015	Strategic Technology Mgmt. & Inn	3	201600015	Strategic Technology Mgmt. & Inn	3	192360501	E-Health Strategy	4	201800007	Planning and Scheduling	4	201600015	Strategic Technology Mgmt. & Inn	3
191571090	Time Series Analysis	4				191581420	Optimization Modelling	3	201600032	Quality Management in Healthcare	2	201600025	Finance and Healthcare purchasing	2	201700089	Circular Sust. Business Dev.	1
201700294	Engineering Project Management	4				191571090	Time Series Analysis	4	191571090	Time Series Analysis	4						

Appendix 3. Programme of the site visit

17 November 2022

11.00 – 11.15	Welcome
11.15 – 12.30	Preparatory panel meeting
12.30 – 13.30	Interview Programme Management
13.45 – 14.30	B-IEM students
14.45 – 15.30	M-IEM students
15.30 – 16.00	Break
16.00 – 17.00	Lecturers
17.15 – 18.00	Examination Board

18 November 2022

9.00 – 9.30	Preparatory panel meeting
9.30 – 10.30	Thematic session: Theme 1
10.30 – 11.30	Thematic session: Theme 2
11.15 – 11.45	Guided tour
11.45 – 13.00	Panel discussion and lunch
13.00 – 13.45	Concluding discussion with Programme Management
13.45 – 15.00	Composing the final verdict
15.00 – 16.00	Oral feedback and drinks

Appendix 4. Materials

Prior to the site visit, the panel studied 15 theses per programme. Information on the theses is available from Academion upon request. The panel also studied other materials, which included:

- SWOT analysis
- Student chapter
- Report previous accreditation 2016
- Intended learning outcomes BSc and MSc
- Domain Specific Framework of Reference
- Schematic overview of the curriculum
- Study guide BSc and MSc
- Overview final qualifications and assessment BSc and MSc
- Programme committee yearly report 2021
- Manuals of mandatory B-IEM modules
- Rules and Regulations of the Examination Board
- Annual Reports of the Examination Board
- Education and Examination Regulations (EER)
- Programme Specific Appendix to the EER for BSc and MSc
- Assessment Policy B-IEM & M-IEM
- Examiners BSc and MSc theses
- Assessment Criteria and Assessment Rubric BSc and MSc Thesis
- Report Thesis Carrousel 2022