

Evaluation report

Ghent University
Faculty of Engineering and Architecture
FEA, UGent

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For your information:

- * The CTI evaluation reports are written in unjustified layout, in order to facilitate the reading for people suffering from dyslexia.
- ** A glossary explaining the main abbreviations is published on the last page of this report.

Name of the institution: Ghent University - Faculty of Engineering and Architecture
 Acronym: FEA, UGent
 Country: Belgium
 Institution's head office: Ghent

CTI accreditation application, campaign: 2021-2022
“Admission par l’Etat” and EUR-ACE® Label

I. Scope of the evaluation procedure

Following bachelor’s programmes have been evaluated but are not eligible for admission by the French state or for the Eur-Ace® label:

Application category	Programme	Pathway
Bachelor's	Bachelor of Science in Engineering: Architecture	Initial engineering training under student status
Bachelor's	Bachelor of Science in Engineering, presenting 7 main tracks: - Civil Engineering - Chemical Engineering and Materials Science - Engineering Physics - Electrical Engineering - Electromechanical Engineering - Computer Science Engineering - Biomedical Engineering	Initial engineering training under student status

Accreditation application of the institution for the renewal or the first admission by the French state and the EUR-ACE® Label for the following programmes:

Application category	Programme	Pathway
Renewal Admission par l’Etat (RAD)	Master of Science in Engineering: Architecture	Initial engineering training under student status
Renewal Admission par l’Etat (RAD)	Master of Science in Biomedical Engineering <i>(Joint programme with VUB - Vrije Universiteit Brussel - Faculty of engineering sciences)</i>	Initial engineering training under student status
Renewal Admission par l’Etat (RAD)	Master of Science in Civil Engineering	Initial engineering training under student status
Renewal Admission par l’Etat (RAD)	Master of Science in Computer Science Engineering	Initial engineering training under student status
Renewal Admission par l’Etat (RAD)	Master of Science in Electrical Engineering	Initial engineering training under student status
Renewal Admission par l’Etat (RAD)	Master of Science in Electromechanical Engineering	Initial engineering training under student status

Renewal Admission par l'Etat (RAD)	Master of Science in Industrial Engineering & Operations Research	Initial engineering training under student status
Renewal Admission par l'Etat (RAD)	Master of Science in Sustainable Materials Engineering	Initial engineering training under student status
Renewal Admission par l'Etat (RAD)	Master of Science in Photonics <i>(Evaluated at VUB, refer to the VUB evaluation report)</i>	Initial engineering training under student status
New Admission par l'Etat (NAD)	Master of Science in Bioinformatics – Engineering track	Initial engineering training under student status
New Admission par l'Etat (NAD)	Master of Science in Chemical Engineering	Initial engineering training under student status
New Admission par l'Etat (NAD)	Master of Science in Engineering Physics	Initial engineering training under student status
New Admission par l'Etat (NAD)	Master of Science in Fire Safety Engineering (MSFSE)	Initial engineering training under student status

Accreditation application of the institution for the EUR-ACE® label for the following programmes, which are not eligible for admission by the French state:

Application category	Programme	Pathway
Renewal EUR-ACE® label (REU)	International Master of Science in Fire Safety Engineering (IMFSE)	Initial engineering training under student status
Renewal EUR-ACE® label (REU)	International Master in Textile Engineering	Initial engineering training under student status
Renewal EUR-ACE® label (REU)	European Master in Nuclear Fusion and Engineering Physics	Initial engineering training under student status
Renewal EUR-ACE® label (REU)	Advanced Master of Science in Nuclear Engineering <i>(Evaluated at KULeuven, refer to the KULeuven evaluation report)</i>	Initial engineering training under student status
Renewal EUR-ACE® label (REU)	European Master of Science in Photonics <i>(Evaluated at VUB, refer to the VUB evaluation report)</i>	Initial engineering training under student status

II. Presentation of the faculty

The engineering faculties of three Flemish universities (VUB, UGent, KU Leuven) applied for the renewal of a CTI evaluation with the aim to have their master's programmes recognised in France via the "Admission par l'Etat" procedure and at the European level through the Eur-Ace® Label. These degrees are awarded after the completion of a 5-year programme involving a 3-year general science and technology undergraduate degree (bachelor's), followed by a 2-year specialisation resulting in the master's degree.

Ghent University is a major university in Belgium, offering courses to nearly 50 000 students under 11 different faculties, that cover the full spectrum of academic disciplines. It distinguishes itself as a socially committed and pluralistic university that is open to all students, regardless of their ideologies, political opinions or cultural or social background, and scores highly in international rankings, i.e. 11th in the Shanghai ranking for sciences and technology.

The Faculty of Engineering and Architecture (FEA) is one of these 11 faculties. The range of engineering specialisations has gradually increased to cover the demands of industry and society. The overall number of students at FEA in 2020 was 4 676: 2 592 for engineering programmes, 1 935 for engineering technology programmes, 149 guest and exchange students.

The FEA aspires to train highly skilled engineers able to adapt quickly to global technological and economic changes and contribute to the long-term socioeconomic development of Flanders and Belgium. Doctoral and postdoctoral researchers advise students during their master's studies, bringing them into close contact with current research practices and results.

The FEA staff are involved in cutting edge research and ERC and Methusalem grants are rather common. Start-ups and spin-offs are well-developed and a longstanding tradition at Ghent University.

Engineering Programmes

The FEA offers a 5-year integrated programme structured according to the Bologna Process, with a 3-year bachelor's degree followed by a 2-year master's programme. The faculty currently proposes 2 Bachelor's of Science in Engineering programmes (BSc) and 17 master's programmes leading to a Master of Science in Engineering (MSc). Bachelor students can start some courses of the master's programme before validating the bachelor's degree. The average duration to get the bachelor's degree is 3 years.

The bachelor's programmes validate 180 credits.

The BSc in Engineering: Architecture aims to develop the ability of students to position themselves as designers with regard to the wide range of fields of knowledge (social, historical, technical, artistic). The number of graduates is increasing, from 78 in the 2018-2019 academic year to 93 in the academic year 2020-2021; the average rate of female students is 50%.

An average of 50% of the students validate the degree within 3 years.

The BSc in Engineering proposes 7 main study fields, with 670 students enrolled in 2021-2022 for the second and third bachelor's years in total: Civil Engineering (73), Chemical Engineering and Materials Science (60), Engineering Physics (65), Electrical Engineering (56), Electromechanical Engineering (177), Computer Science Engineering (132), Biomedical Engineering (107). Additionally, in the first year of the bachelor's programme (common year) 372 students were enrolled in 2021-2022.

The main subject “Biomedical Engineering“ was introduced in 2019-2020 following the recommendation of the CTI, to fit the expectations of the redesign of the programme. After 2 years the number of graduates is 35. Most of the bachelor’s programmes are directly linked to the field of a master’s degree, but some master’s don’t have a bachelor’s course directly connected to their fields. Only minor changes have been operated since the previous evaluation procedure. The programmes aim to train students in basic sciences and basic engineering sciences, with a large spectrum of disciplines. Research and innovation are part of the objectives, especially through project work.

The Master of Science in Engineering programmes, validate 120 credits and aim to develop a core of 7 competencies and associated learning outcomes, as well as 3 or 4 specific competencies and associated learning outcomes dedicated to the specific fields of each master’s. All programmes, except Architecture, are taught in English.

The number of graduates is rather stable or has a regular increase depending on the programmes, except for some of them where the number of students stay very low, which could threaten their existence in the long term.

MSc in Engineering: Architecture:

The objectives of the Master of Science in Architecture are to train academic engineer-architects who have the required intellectual and technical competences to be able to discuss and work with all partners involved in the design and construction processes and manage their combined actions around a shared project. The number of graduates has increased from 62 in 2018-2019 to 81 in 2020-2021.

The average rate of female students is of 50%. The total number of PhD students is 18.

MSc in Biomedical Engineering

This is a joint programme between UGent and VUB, Ugent being the leading institution. The programme operates in autonomy since the end of the CEMACUBE Erasmus Mundus International Master’s. Four specialisations are proposed: Neuro-engineering, Biomechanics and Biomaterials, Sensors and Medical Devices, and Radiation Physics.

The number of graduates is increasing, from 25 in 2018-2019 to 29 in 2020-2021. The average rate of female students is of 50%. The total number of PhD students from FEA is 19.

MSc in Chemical Engineering

The programme aims at training graduates who master the fundamental chemical engineering principles and are capable to innovate and become chemical engineers in charge of R&D, design, construction, management or maintenance of equipment or plants in industry mainly chemical (but also 10% in biotech) or in public R&D laboratories. Since the last CTI procedure, the curriculum has integrated the technological innovations coming from different fields (for example artificial intelligence, big data).

The number of graduates is decreasing, from 31 in 2018-2019 to 19 in 2020-2021. The average rate of female students is about 15%. The total number of PhD students from FEA is 26.

MSc in Civil Engineering

The programme aims to train broadly educated civil engineers in the field of civil and structural engineering. Three specialisations are proposed: construction design, dredging and offshore engineering (it does not include a separate course on dams but navigation dams, weir, energy dissipating structures and small hydropower devices are included in mandatory courses) as well as operation management.

The number of graduates is decreasing, from 57 in 2018-2019 to 39 in 2020-2021. The average rate of female students is also decreasing, from 18% to 10%. The total number of PhD students from FEA is 16.

MSc in Computer Science Engineering.

The programme aims to train engineers to build complex information processing systems, covering the development cycle from design and conception to implementation. It is well balanced between computer science topics, including recent technologies (machine learning, information security, IoT, parallel systems), physical layers, modelling courses, and research and design project. Since the last evaluation, 2 majors were proposed: “Artificial intelligence” and “Embedded systems”. The number of graduates is increasing: from 51 in 2018-2019 to 66 in 2020-2021. The average rate of female students is increasing but stays very low at 10%. The total number of PhD students from FEA is 50.

MSc in Electrical Engineering

The programme aims to train engineers capable of building complex electronic and communication systems in an efficient and methodical manner, within a broad field of applications, ranging from the conception and analysis right up to the design, implementation, testing and management of such systems. Two main subjects are proposed: Electronic Circuit and Systems (ECS) and Communication and Information Technology (CIT).

The number of graduates is stable, with 23 students in 2020-2021. The average rate of female students has been decreasing from 20% in 2018-2019 to 4% in 2020-2021. The total number of PhD students from FEA is 40.

MSc in Electromechanical Engineering

The programme aims to train engineers in various disciplines around the themes of motion, force and energy. The world of electromechanical engineering encompasses development, design, manufacturing, testing and control of tools, machines, vehicles, and other electrical and mechanical systems, as well as research on these topics.

The number of graduates is stable, 66 in 2018-2019 and 61 in 2020-2021. The average rate of female students stays very low between 7% and 12% depending on the academic year. The total number of PhD students from FEA is 51.

MSc in Engineering Physics

The programme aims to give a wide knowledge in different fields relevant to physics: nanoscale materials, nanoelectronic devices, thin films, electronic and photonics, quantum optics, plasma and fusion technologies. In this respect, the programme develops both the pragmatic reasoning as well as the manipulation of complex systems. Since the last evaluation, the students have to choose 5 amongst 8 key topics that have been defined from the European roadmap on physics.

The number of graduates is increasing, from 14 in 2018-2019 to 22 in 2020-2021. The rate of female students is low, between 12% and 16%. The total number of PhD students from FEA is 31.

MSc in Fire Safety Engineering (MSFSE)

The two programmes Master of Science in Fire and Safety Engineering (MSFSE) and International Master of Science in Fire and Safety Engineering (IMFSE) aim at providing “a top-notch education for graduates to emerge as leading experts in the field of “Fire Safety Engineering.” During the IMFSE, students spend the second semester at Lund University (Sweden). Even if the MSFSE programme attracts many students from overseas, mobility is not systematic as it is the case in the IMFSE programme.

The MSFSE programme started in 2015 and was not previously evaluated.

The number of graduates for MSFSE is very low and the trend is for decreasing, from 12 in 2018-2019 to 9 in 2020-2021. The rate of female students is low, between 12% and 16%. The total number of PhD students from FEA is 4.

International MSc in Fire Safety Engineering (IMFSE)

The number of graduates for IMFSE is relatively stable, from 15 in 2018-2019 to 22 in 2020-2021. The rate of female students is good, more than 25%. The total number of PhD students is mutualised with MFSE (see above).

MSc in Industrial Engineering & Operations Research

The programme aims to train engineers in supply chain and production management for various industries. Two major options are proposed: “Manufacturing & Supply Chain” and “Transport & Mobility” as well as two minor options: “Artificial Intelligence” since 2020-21 or “Automotive Production Engineering”.

The number of graduates is decreasing from 31 in 2018-2019 to 20 in 2020-2021. The average rate of female students is 20%. The total number of PhD students from FEA is 8.

MSc in Sustainable Materials Engineering

The programme aims to give a wide knowledge in different materials, especially metals, polymer and textiles, and, to a small extent, composites and ceramics. It goes from their extraction or production towards their use and recycling. There are two majors in the programme: “Metal science and engineering” and “Polymer and fiber engineering”.

The number of graduates is stable, 15 in 2019-2020 and 12 in 2020-2021. The rate of female students ranges from 25% to 30%. 28 graduates continue their studies towards a PhD.

MSc in Bioinformatics, Engineering track

The Engineering track aims at “training bioinformatics software engineers and computer scientists who can develop on an independent basis new algorithms and complex software implementations to improve current techniques or to respond to new developments in the domain of bioinformatics and systems biology.”

The number of graduates is very low, 3 in 2019-2020 and 4 in 2020-2021. The average rate of female students is not significant for so few students: 0% in 2019-2020, 50% in 2020-2021. One graduate enrolls for a PhD.

International Master in Textile Engineering

The educational project meets a significant mix of scientific, technical, industrial and organisational skills from one or more professional sectors and from society. The target job market is national and international and aims at a wide textile-based industrial target. The textile industry is very global and international.

The number of graduates is very low, no students in 2020-2021, 2 to 4 students in the previous academic year. The average rate of female students is not significant for so few students: 100% in 2018-2019 and 50% in 2019-2020. The number of PhD students is not significant.

European Master in Nuclear Fusion and Engineering Physics

The number of graduates is very low, 1 student in 2020-2021, 4 to 8 students in the previous academic year. The average rate of female students is not significant for so few students. The number of PhD students is not significant.

Other MSc in Engineering are delivered jointly with VUB and KU Leuven and were evaluated with the VUB or KU Leuven programmes.

In addition to the Master of Science in Engineering programmes, FEA also propose Master of Science in Engineering Technology programmes, and the UGain (UGent academy for Engineers) founded in collaboration with the Faculty of Biosciences offers a wide variety of courses to provide training on selected specialised topics to the graduate engineers active in industry or research institutes.

Resources

The faculty is well endowed with all the means required to deliver the different programmes.

The teaching staff for all the programmes of the faculty, delivering 804 courses, represents a total of 1 351 FTE (Full time equivalent) including PS (Professorial Staff), AAS (Assistant Academic Staff), OAS (Other Academic Staff), they are internal resources of the faculty. In addition, 60 visiting professors, representing 11 FTE (Full time equivalent), provide expertise and teach one or two courses each.

Considering the overall number of students as 4 676, the ratio of PS per 100 students is 4,10 and the ratio (AAS+OAS) per 100 students is 23,4.

The teaching facilities for education benefit from “state of the art” research laboratories.

The financial resources allocated to FEA for education is coming from different sources:

- Source 1: the government budget to pay salaries, buildings and all infrastructure costs;
- Source 2: the government budget to support research, innovation and entrepreneurship,
- Source 3: contracts from different public funding sources;
- Source 4: research contracts with industry.

The total budget is increasing, from 89 M€ in 2018 to 121,3 M€ in 2020. The budget from source 1 is stable, 39 M€ in 2020, versus 36,4 M€ in 2018. The main increase of the budget is from the sources 2,3 and 4, this highlights the importance of research at FEA.

The faculty premises are spread over different buildings and campuses. A first step is to move progressively to the Ardoyen Technology campus. For the architecture programmes, a thorough renovation of a faculty building is planned.

The institution’s evolution

Most of the CTI guidelines for improvement have been considered by the faculty. Nevertheless, all the started actions didn’t provide the expected results, but the trend is satisfactory and the faculty convinced the expert panel of their willingness to pursue the necessary efforts.

The following subjects still need to be improved: multidisciplinary, international mobility, internship in industry and their duration, inclusion of sustainability in the different fields of the studies.

The strategic plan of the faculty is aligned with the one of the university, and focusses on 3 main objectives: active learning, diversity and talent development, sustainability. Besides these objectives, the restructuration of the different buildings and the construction of facilities for students, are proper answers to some major concerns raised.

III. Follow-up of previous CTI guidelines for improvement

Guidelines for the faculty

Previous guidelines for improvement CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Improve the capabilities of faculty management teams to conduct multidisciplinary actions and coordinate cross-cutting initiatives	Under implementation
Pursue the excellent work done to prepare the SER and define a precise action plan driven by a broad vision of the faculty's future	Implemented
Put into action the university mission statement concerning interactions with alumni	Under implementation
Develop the sharing of good practices and encourage programmes to share initiatives	Implemented
Work at the university level to develop common marketing and student selection tools	Implemented

Guidelines for the master's programmes

Previous guidelines for improvement - MSc Engineering: Architecture CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
One may say that the tendency for the students of Ghent University is to be more architect-engineers than engineer-architects	Implemented
Ties with Sint Lucas should be developed	To pursue
Staff should be concerned with internationalisation	To pursue

Previous guidelines for improvement - MSc in Civil Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
An effort should be made to increase the number of students participating in internships.	Under implementation
It may be useful to select certain universities for more intensive cooperation, in order to be able to select the best students and decrease the likelihood of dropout.	Under implementation
The student workload remains high along with drop-out rates in the bachelor's programme, like other bachelor's programmes	Under implementation

Previous guidelines for improvement - MSc in Electrical Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
The programme management team seems conservative in terms of teaching methods and openness to soft skills and preparation for the job market (other than research).	Implemented
The issues of the global energy transition and of the post carbon economy should be addressed.	Implemented
The attractiveness of the master's programme must be addressed, in connection with a strategic analysis of the future of the programme to be carried out with all the stakeholders	Under implementation

Previous guidelines for improvement - MSc in Biomedical Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
The forthcoming objective to have students participate in mandatory internships is to be encouraged	Under implementation
<u>The visibility of the Biomed programme needs to be improved:</u> The creation of a dedicated stream at the Bachelor's level currently discussed within the Steering Committee would certainly contribute	Implemented
<u>The visibility of the Biomed programme needs to be improved:</u> Student initiatives to promote the programme in secondary schools deserves support	To pursue
<u>The visibility of the Biomed programme needs to be improved:</u> Initiatives to increase visibility within industry, to better understand industry needs, have to be strengthened	Implemented
<u>The visibility of the Biomed programme needs to be improved:</u> The programme has been adapting quickly over the years since its creation less than 10 years ago The Strategic Vision will define the Programme signature to be promoted with various stakeholders (hospitals, companies, students, etc.) in the future	Implemented
International visibility (beyond the International Master partners) and foreign recruitment deserve to be improved as part of a reinforced FEA policy in this area	Implemented

Previous guidelines for improvement - MSc in Electromechanical Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Since the courses are taught in English, a first step towards internationalisation strategy could be implemented to develop international mobility, attract good international students and allow them to succeed in this master's programme.	Under implementation
Define the competences and focus the programme more on engineering	Implemented
Define specific profiles	Implemented

Previous guidelines for improvement - MSc in Engineering Physics CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Since the courses are taught in English, a first step towards internationalisation strategy could be implemented to develop international mobility, attract good international students and allow them to succeed in this master's programme.	Under implementation
Define the competences and focus the programme more on engineering	Implemented
Define specific profiles	Implemented

Previous guidelines for improvement – MSc in Industrial Engineering and operations research CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Difficulties for foreign students because this master's programme has a high scientific level	Under implementation
Necessity to make this master's programme better known and understood by companies for its scientific specificity	Under implementation

Previous guidelines for improvement - MSc in Computer Science Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Some students are very clear in their choice of career, others want the very broad programme, and others have no idea what to do. It may be appropriate to guide students in their career choices and help them to choose the elective courses they will need to have the skills required for their future professional careers	Implemented
Develop the internationalisation of the programme.	Implemented

Previous guidelines for improvement - MSc in Sustainable Materials Engineering CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
The "sustainability" aspect needs to be more developed in the compulsory subjects and should be better highlighted in the curriculum description.	Implemented
More coherence between the different courses and between the 2 majors would be beneficial for the attractiveness of the master.	Implemented
According to the Learning Outcomes/Courses table, the learning outcomes are well distributed over the different courses: it is important to evaluate all the learning outcomes.	Under implementation
The projects are appreciated by the students; they could be developed, especially by making them more interdisciplinary or associating students from different disciplines.	To pursue
Management, Economics and Social courses are not compulsory, which is a pity for this field of activity.	Under implementation
International exchanges are not sufficient even if Erasmus+ mobility is encouraged. An effort should be made to attract foreign students.	Under implementation
The strategy concerning the Textile major of this master's programme needs to be more clearly defined with respect to the International Master in Textile Engineering	Implemented
The number of students is too low. All the efforts need to be pursued to attract more students	Implemented
"Sustainability" has been added to the master's name, but to attract students, this concept has to be more developed in the curriculum.	Implemented
The objective to pursue industrial internships is to be encouraged. There are very good industrial placements	Under implementation

Guidelines for MSc not eligible for admission by the French state

Previous guidelines for improvement - MSc in Engineering Physics CTI's decision recommendation n° 2016/09-10	Evaluation by the expert panel
Re-examine the fundamentals of the programme, giving it a more competence-based approach and a deeper relevance to engineering (in the content and in the teaching methods)	Under implementation
The students benefit from the broader education in engineering provided by the Bachelor of Engineering physics, with in particular the "project track", which provides efficient training to the "problem solving" approach	Implemented

The common core of basic physics constitutes one third of the curriculum, the rest being elective courses. This “à la carte” organization does enable specific graduate profiles to be defined. One may question why clusters of elective specialised courses overlap with the programmes of other master’s programmes	Implemented
The lack of defined graduate profiles -beyond scientific excellence- does not favour communication to the public and employers on the benefits of this programme	Implemented
There is little place left for soft skills in the curriculum and they are not a priority for teachers	Implemented

Previous guidelines for improvement - MSc in Chemical Engineering CTI’s decision recommendation n° 2016/09-10	Evaluation by the expert panel
Establish an ambitious vision for the future of the Chemical Engineering Master and clarify the student recruitment strategy	Under implementation
Actively promote the programme both in Belgium and abroad and further develop outbound mobility	Implemented
Increase the awareness of process safety throughout this programme	Implemented
Include a hands-on execution phase for the business project	Implemented

Guidelines for one master’s programme regarding the EUR-ACE® Label

Previous guidelines for improvement – European MSc in Nuclear Fusion and Engineering Physics CTI’s decision recommendation n° 2016/09-10 for EUR-ACE® Label	Evaluation by the expert panel
The programme follows the Erasmus Mundus framework, with sequences of courses in the different universities and common training periods. Exchanges and internships need to be developed	Under implementation
The wording “Engineering physics” in its title is somewhat misleading. The curriculum is that of a high-level research-based master’s programme in a specialised field of physics	Implemented
Attention to soft skills in the programme seems not equally shared in the consortium	Under implementation

Most of the guidelines for improvement have been taken into account. Nevertheless, all the actions didn’t provide the expected results, but the trend is satisfying and the faculty convinced the expert panel of their willingness to pursue the necessary efforts.

The following main subjects still to need to be improved: multidisciplinary, international mobility, internship policy, sustainability.

IV. Description, analysis and evaluation by the expert panel

Mission and organisation of the faculty

The FEA (Faculty of Engineering and architecture) is part of the Ghent University, which operates in social and pluralistic fields of knowledge, with very strong links with research centres, partly shared with other Flemish Universities, VUB and KU Leuven. The university gives substantial freedom to the faculty to own their vision and mission, using the defined guidelines.

The university has defined 5 strategic objectives for education and FEA has chosen 3 of them for its own strategic plan: active learning, diversity and talent development, sustainability.

The faculty defines its mission as: “train excellent engineers and architects, ready to apply their skills for the benefits of society, so they provide solid foundation in mathematics and sciences, specializations in a specific engineering discipline, focus on creativity, innovative thinking and research drive, strong project focus and active learning experience”.

The FEA (Faculty of Engineering and Architecture) of UGent university proposes the 15 master's programmes described above, on the scope of this evaluation report. The programmes delivered jointly with other universities (VUB or KU Leuven) are evaluated in the corresponding evaluation procedures. All master's programmes are taught in English except the Master in Engineering: Architecture, which is taught in Dutch.

The bachelor's programmes last 3 years and prepare for the master's programmes, which have a duration of 2 years. One bachelor's programme, the Bachelor of Science in Engineering: Architecture prepares for the MSc in Engineering: Architecture. A second bachelor, the Bachelor of Science in Engineering presents 7 main fields of study: Civil Engineering, Chemical Engineering and Materials Science, Engineering Physics, Electrical Engineering, Electromechanical Engineering, Computer Science Engineering, Biomedical Engineering. The main subject Biomedical Engineering was introduced in the 2019-2020 to follow the recommendation of the CTI. The main subjects of the Bachelor of Engineering are aligned with the field of the master's programmes.

The field of education of the master's programmes stays very broad, with specialisations in selected domains corresponding to the field of excellence of FEA's research so that students acquire the knowledge in the latest developments in science and technology. All masters' programmes are managed by the respective programme coordinator, who is responsible for the strategy of the programme construction and development. The Study Programme Committee (SPC) and the faculty's management team are working together, supported by the Industry Advisory Board and have the willingness to adapt or redesign some programmes to rationalize the curriculum and to better fit the industry expectations.

The total number of students at the FEA for the engineering programmes is 2 592.

The potential of research at Ghent University is very attractive, the faculty is welcoming 553 PhD-students: post-graduates from FEA and other universities, including foreign students.

The FEA is one of the 11 faculties of Ghent University and is managed by a dean, who is elected for 4 years. The faculty followed the CTI guideline for improvement and implemented a “Faculty Management Team” (FMT), grouping the vice-dean of education, the vice-dean of research and the vice-dean of human resources. This evolution is considered to be very helpful when needing to reach a consensus and to inspire the discussion on new topics. The Academic Strategic Advisory Board (ASAB) and the Industrial Strategic Advisory Board (ISAB) provide relevant advice from their fields to the Faculty Management Team. The Faculty Council (FC) discusses and approves

proposals of the FMT and other committees. The faculty is structured in 10 departments. The Educational Quality Control Unit (EQCU) handles a key role in steering the content and the evolutions of the different programmes, as well as quality control. They get advice from the SPC (Study Programme Committee) steering every programme. Industry representatives attend the SPC. In the decentralised vision of the management, the programme coordinator, chairing the SPC, gets a large scope of responsibilities, committed in the quality and consistence of his programme.

The faculty develops new marketing tools, to improve communication, for example virtual tours, "Engineer of the year", Instagram for students abroad, etc. The websites of FEA and UGent, are available in Dutch, as well as in English, and are thus accessible for foreign students. The information on the different programmes, research, educational facilities, event communications and student life, is very extensive. The syllabus is detailed.

Students consider that the communication from the university could be improved; clearly the pandemic situation heightens this. The communication between the students and the lecturers is mainly good at course level, more than at a programme wide level. The communication from the university during the COVID sanitary crisis seemed to be confusing for the students.

The data provided on human resources headcount and full time equivalent staff (FTE) are at the faculty level.

The staff for all the programmes of the faculty, delivering 804 courses, represent quite valuable ratios to ensure the quality of the studies.

The PhD students are also involved in some courses; this involvement represents on average 15% of their workload. Most of the teacher staff members have a very strong experience in the course topics, based on their research expertise. They collaborate with other departments of the FEA and other Flemish universities' research centres.

The faculty is also hiring new lecturers and takes care of their integration.

The faculty has developed an ambitious HR plan compliant with the strategy of the university. The SPC, EQCU, and HR Committee encourage regular improvement on learning methods and the course contents.

Whenever the teaching staff complain on a too heavy workload due to administrative tasks, they expect that the processes will be simplified, so they could better focus on their courses, and research activities.

The CTI expert panel could assess the high level of the teaching staff and their involvement in research fields and industrial expectations as well, and the satisfaction of the HR development plan. Students appreciate the support of the teaching team for clear understanding of the course objectives and for decision making on curriculum options and elective courses.

The educational facilities of the bachelor's and the master's programmes are at a very high level of technology, due to the very strong links with research laboratories. The available space and equipment for classrooms are consistent with the expectations of the educational mission according to the objectives of the different programmes. Every year the faculty invests in new educational infrastructures (details are provided in the SER).

The sanitary crisis led the university and the faculty to invest in active learning methods and the required infrastructure through 2 main projects: ACTIVO and APPOLO, just starting in 2022.

The total floor space occupied by FEA is of 75.322 m² for education and research facilities. The objectives are to deliver engineering programmes on a single campus (except for architecture) at Ardoyen Technology campus. Currently 50% of the total floor space of FEA is on this campus. Architecture programmes will stay at the Architecture School in the city centre. The main issue is that for some master's programmes the courses are split through different locations and the

communications across these locations are not facilitated by public transportation services. Students complain about this situation, as they often have to move from one site to another during the same day or half-day and the connectivity to the different platforms are not really harmonized.

The curriculum of the master's programmes at UGent are very demanding, so taking care of the conditions for students to attend courses have to be monitored.

The financial resources allocated to FEA for education is coming from different sources as specified above.

The faculty gets all the means to support their development strategy and implements the relevant governance, for steering the content and the quality of the programmes, as well as for prospective and day to day operations. The transversal approach through the different fields of the programmes could be improved to fit a multi-system approach in the industry and to strengthen the identity of the faculty.

Analysis summary - Mission and organisation

Strengths:

- Involvement of all stakeholders;
- Good cohesion across all internal stakeholders;
- Funding for research facilities;
- Willingness to re-design some programmes to fit industry expectations;
- Investment in pedagogical methods during the sanitary crisis;
- Human resources improvement plan for teaching staff.

Weaknesses:

- Limited organisation for steering the international strategy;
- The distribution of teaching facilities amongst several campuses is not considered in the organisation of the curriculum;
- Communication with students at faculty and university level;
- Lack of cross fertilization between most of the programmes.

Risks:

- Increase of the administrative procedures.

Opportunities:

- New building for Architecture Engineering (renovation planned until 2025);
- Ghent perceived as an attractive and innovative city;
- Campus renovation to enhance student facilities.

Quality and continuous improvement approach

The FEA quality assurance policy has been reviewed since 2015, evolving from a model aiming to controlling educational practice to a continuous improvement approach.

The university gives general objectives, and the FEA develops its own strategy and defines its quality assurance policy. But the FEA also participates in the university strategy, at its level.

Both study programme committees and the faculty cooperate with the university level.

The director of studies chairs the Educational Quality Control Unit (EQCU) composed of academic staff, student representatives, administrative and technical staff, in charge of the programmes content evolution and quality monitoring.

The quality is managed at different levels:

- The Educational Policy Department of UGent University: annual quality meeting;
- The Education Quality Board which guarantees the quality culture and efficiency level of each study programme.

At programme level, SPC are guided by specific objectives on a yearly basis, following the university's recommendations. The university has defined an incentive plan on additional budget allowance to foster the completion of the objectives. Depending on the requirements of the period, 2 to 5 human resources are assigned to the follow-up of the quality indicator's objectives.

The course evaluation, considered as mandatory, gets a 60% response rate, but the feedback to the students is too long, because only a part of the courses is treated each year. This could affect the response rate in the future.

The very low response rate of the employment survey - 10% on average - is not very meaningful but doesn't seem to be a problem.

There is a culture of quality spread through the different levels of the organisation, at both university and faculty levels. However, improvement is necessary, especially on the evaluation processes and day-to-day inconveniences for students.

Analysis summary - Quality and continuous improvement approach

Strengths:

- Quality management is under the control of the university;
- Quality is monitored at the relevant level;
- Existence of an incentive policy to foster the quality objectives' completion.

Weaknesses:

- Low response rate on employment surveys;
- Feedback to students is too long, because only a part of the courses is treated each year.

Risks:

- No specific risks identified.

Opportunities:

- No specific opportunities identified.

Outreach and partnerships

The faculty actively seeks advice and support from industry in the conception and in the delivery of its programmes through:

- The involvement of the Industrial Strategic Advisory Board at the faculty level, and the incorporation of advisors from industry in the SPC;
- The integration of industrial experience in the programme through 60 visiting professors;
- The strong encouragement to take one or more industrial internships during the engineering education;
- The inclusion of industrially oriented cases in many courses of the programmes;
- The possibility for master's dissertations to be defined and carried out in cooperation with industry.

Only one third of the students realise an internship during their curriculum.

Conclusion: The representatives of industry provide efficient support to the FEA through good advice. Internships could be more developed.

The strategy of the Faculty of Engineering and Architecture (FEA) aims to train graduates to be able to face scientific, technological and economical challenges contributing to socio-economic development. Within the University of Ghent, in line with this strategy, research is a strong marker of FEA, which is structured into 10 departments whose research themes cover all the fields of the MSc in engineering, addressed by around fifty research teams. Each master's programme is linked to one or more research departments.

The research activity covers fundamental aspects and addresses societal issues as well. Results of research work developed with the industry contribute to innovation.

Research quality indicators identify in particular the success of researchers in calls for projects of the European Research Council (ERC) programmes of excellence: 10 ERC grantees and 9 ERC Proof of Concepts or of the Flemish excellence programmes Methusalem and Odysseus.

The FEA financially supports nearly 250 researchers and is able to support 1,100 researchers (including PhD and scholarship holders) with funding from competitive research projects. About a hundred doctoral students graduate each year.

The links between training at master's level and research are based on several aspects:

- The members of the research staff are all involved in the training programmes;
- The research themes are well in line with the master's programmes and support good interactions;
- The training claims a strong emphasis on problem solving and innovative thinking throughout the programmes, culminating in integration into research groups during the master's thesis. Project-oriented learning starts early on (first trimester of the first year);
- The faculty has state-of-the-art research facilities which are used for educational purposes. Part of the practical work for engineering students takes place in the laboratories.

To further stimulate this transfer of knowledge, UGent has created a dedicated funding mechanism, the IOF (Industrial Research Fund), focusing specifically on projects with a strong valorisation drive. The IOF has created "business development centres" that group complementary research departments (across faculties) by application area or domain of expertise.

A lot of actions are undertaken to promote international exchanges (for example courses are taught in English) but, besides the current sanitary crisis, the volume of incoming students stays low, on average 14% of the overall students, 32% of them being women. This point is mentioned in the self-assessment of the FEA, the efforts have to be pursued.

The Faculty of Engineering and Architecture at UGent is currently taking an active part in three Erasmus Mundus programmes (Master of Textile Engineering, Master of Nuclear Fusion and Engineering Physics, Master in Fire Safety Engineering). These programmes got renewed by the European Commission after a very competitive process.

However, most of the master's programmes do not have an international visibility and are not very welcoming to foreign students. The international strategy seems to be addressed at the master's programme level and mainly on the initiative of the programme coordinators, and not at faculty level. There should be some objectives set and managed by the FEA on the relevant partnerships to develop and on the number of incoming and outgoing students.

The CTI expert panel observed a positive trend to improve co-operation across Flemish universities; At the programme level, the Master of Science in Biomedical Engineering and the European Master of Science in Photonics as well as the Master of Science in Photonics are organised in co-operation with VUB, while the Master of Science in Nuclear Engineering is organised with KU Leuven and VUB. Those initiatives are of great value for Flemish students in engineering.

National and regional networks in the field of research are also well developed. FEA is involved in several Strategic Research Centres of the Flemish Region, having a specific interest in the field of master's programmes.

FEA can also take benefits from different Flemish organisations and programmes dedicated to funding research or support development of research, innovation and entrepreneurship projects. Partnerships in the neighbouring part of France are also developed with FEA, either through Interreg (with Ensait Roubaix) or through double degrees with Lille University in Electromechanical Engineering.

The expert panel considers that at the level of Flanders as well at the level of the "Greater Region", co-operations of high level exist in Research, Innovation and Education.

FEA is open to enlarge those collaborations, relying on the level of English language of the staff and even French language for part of them.

Analysis summary - Outreach and Partnerships

Strengths:

- Industrial partners play an active role in the improvement of the master's programmes;
- Competitive Erasmus Mundus programmes ensure international attractiveness;
- Strategic partnerships with regional research institutes;
- Cooperation across Flemish universities for 4 master's programmes.

Weaknesses:

- International strategy at programme level
- International mobility unevenly spread across the programmes.

Risks:

- Viability of the Erasmus Mundus programmes when the European Commission financing is over.

Opportunities:

- Strategic research centre funded by the government.

Educational process regarding all programmes

The master's programmes are well balanced and appreciated by students, and the FEA has considered most of the previous guidelines for improvement of CTI. The model of education is the T-shaped one, to guarantee the openness of all graduates, no matter which programme they come from. This model is appreciated by employers.

The master's programmes are organised in continuity with the bachelor's programmes. The 5 years of studies represent in fact not a real 3+2 year programme but much more a 2+3 year programme (except for those master's programmes that do not have a specific related bachelor's degree).

Professionals are involved in the faculty and the programmes at various levels; they can suggest their expectations for education on the Strategic Advisory Board.

There is a well-defined process for programme evolution.

The lack of interdisciplinary activities observed in most master's programmes could be taken into consideration by the EQCU (Education Quality Control Unit). The SPC (Study Program Committee), one for each programme, composed of teaching staff, students and representatives from industry, is in charge of designing and updating the curriculum. The proposal defined by each SPC is discussed and validated or rejected by the EQCU and then by the Faculty Council and University Board.

Since 2005, a competence model has been implemented at UGent, which includes Generic Competences as well as Specific Competencies for each engineering discipline. The learning outcomes of each programme and each course are detailed in the online "study guide" which is up to date.

The link between each of the course units and the targeted skills is formally established, as well as expected outcomes, evaluation methods and teaching methods. This is however not the case for elective subjects and the internships.

All the competencies expected in the CTI's guidelines and criteria are globally met, but the methods to assess soft skills could be refined. The expert panel thinks that now FEA could go further indicating which level of each learning outcome is expected in each module.

The Bologna process is carefully applied in the programmes and its description is available to all students. The programmes are built on a very similar pattern: apart from compulsory core courses there is project work (25-33 ECTS), a set of elective courses (some of which could be compulsory) and the thesis work concluded by the master's dissertation (24 ECTS). The work for the master's dissertation is considered as an individual research project, even when the subject is given by a company.

Several master's programmes offer specialisation tracks and all programmes include a large choice of elective courses in order to provide the students with a "in-depth and broad" type of education.

The in-depth aspect of education can be achieved through electives in scientific courses, while the broadness is achieved thanks to courses in soft skills (language, business operations for example). Soft skills are also acquired with a very active student life (numerous active associations in link with the alumni).

Cross fertilization is limited to sharing some "classical" courses in scientific domains that are close to each other. The development of projects as well as the thesis subjects, could be a good method to develop cross fertilization between academic fields.

However, in order to ensure that all students acquire the same level of knowledge in particular in soft skills, it may be necessary to make some courses in humanities compulsory.

The regulations are clear and available for all students.

Currently, internships are not compulsory, but optional through elective courses, and validate 3 credits for a 4-5 week duration and 6 credits for longer durations. Before the sanitary crisis, the average rate of graduates carrying out an internship was 35%. Most employers are satisfied when

they get internship students, but they consider the duration too short and less valuable for them, as it prevents them from a pre-recruitment facility.

There are two concerns regarding the current approach to internships. They are optional, and as such not considered as being an important element in the engineering education. Another issue is that the only allotted time to carry out internships is during the summer vacation.

The faculty implemented some evolutions starting during the academic year 2022-2023: the allotted number of credits is 6 which is aligned with the workload (200h); flexibility has been introduced with the possibility to carry out internships during the academic semesters; more emphasis is put on internship reports, follow-up and quality control.

It would be interesting to take stock of the implementation of these measures and their impact, for students as well as for employers.

The master's thesis (24 ECTS) is the corner stone for developing research skills. The subject of the master's thesis is the student's personal choice and can also take place in industry. The master's dissertation is the final step in the learning process and is regarded as the opportunity for acquiring many of the profession's specific, intellectual, and scientific skills.

The laboratories are at a state of the art level in their field, and effectively support education.

Assistant teachers are the supervisors of projects; this creates a strong link with research.

An entrepreneurial track exists through the "Dare to venture" programme but is not compulsory.

Most of the time, students do not set up their own companies just after graduation but some years later.

About 25% of master's students are involved in an international training (semester or full-year exchanges, internships, summer schools). Exchanges between incoming and outgoing students are balanced (47 master's students going out of UGent for a semester or a year abroad, and 54 master's students coming in).

The annual success rate for credit validation is quite similar between foreign and local students. Students should be more encouraged to go on international mobility. For the incoming flow of international students, FEA regrets that the existing regulation at UGent does not allow them to recruit foreign students at a better level.

The international aspects of the studies still need to be improved: programme coordinators could benefit from the international network of researchers, in order to develop relevant contacts for students.

Sustainability is a strong point in the objectives of UGent, but it seems that there is a misfit between what students expect to learn on the subject and the approach put in place by FEA; this should certainly be a subject of discussion.

Professional Ethics is not mandatory, which is a pity in some fields such as Civil Engineering or Computer Science.

The sanitary crisis between 2020-2022 was a very strong incentive to implement on-line teaching methods and to develop active learning methodology. Some staff members are dedicated to assist teachers in setting up new courses with active teaching methods ("Activo" project).

Project work was introduced early at the bachelor's level with a 2-step (and two semesters) project called MMM ("Modelling, Making, Measuring") and investigates the results from a sustainable, entrepreneurial and ethical point of view. Although the expected project outcomes were linked to sustainability issues, from the students' view point they don't achieve these objectives.

Pedagogy by projects is developed in all master's courses, with more or less effectiveness. It would be nice for the faculty to think about the workload induced by the project teaching and learning methodology, especially when other types of more traditional teaching are conducted in parallel.

All master's curricula end up with the writing up of a master's thesis on themes linked with research conducted in the laboratories of the faculty or with partners of the programmes.

Globally, the teaching methods are adapted to the competence based approach.

Student life is an important part at Ghent University. There is a high number of active student associations. Two main student organisations exist, one for the engineering fields (VTK) and one for Architecture Engineering (DLK). Some of them act as a bridge between students and the administrative staff. Industry is also sponsoring student's activities, brochures, exhibits, and events.

Students are represented in the councils with a voting right. According to them, their voice is usually heard. Up to now, the university didn't integrate any student engagement into the academic regulations. However, there is an election of a student of the year and an entrepreneur-student of the year.

According to the students, there is a lack of facilities dedicated to them, although essential ones such as sports facilities, student restaurants and a medical service are already available. This will be solved with the future construction of a new building that will have dedicated spaces for the students. Campus accessibility is also a matter of discussion. Some solutions and projects on this issue are already discussed between the university and the city of Ghent.

The faculty is monitoring the study efficiency per programme through 2 criteria: the rate of students validating the credits every year and the duration of studies to get the degree. It then compares them to the FEA and Ghent University results.

Background diversity at bachelor's entry level and the possibility of continuing the studies within the master's programme create difficulties in the concrete follow-up of students. The nominal time to finish the BSc and MSc is 5 years. However, it takes 6 or more years for half of the students.

Remediation for incoming bachelor and international students are provided at both faculty and university level. Students are very well monitored and various forms of tutoring and monitoring are possible, some of them based on the recommendations of the student associations.

Very diverse assessment methods exist: written exams, thesis write-ups, project reports and presentations and lab work. The evaluation methods are reviewed yearly by the suitable Study Programme Committee. The sanitary crisis was an opportunity to improve some of them.

All students get feedback (although in some programmes the process may be long). Students are also assessing the different courses within the programmes. Although this feedback is compulsory, the rate of response from the students adds up to an average of 60%.

Academic regulations present the necessary conditions to award the degrees. The awarded degree and the diploma supplement (in compliance with the Bologna process) are in line with laws and regulations.

Analysis summary – Educational process regarding all master's programmes

Strengths:

- Students are involved and enthusiastic about their programmes;
- Strong contribution of research to the educational programmes;
- Programmes are appreciated and recognized by industry;
- Decisions have been taken to redesign some programmes;
- The sanitary crisis led to improved pedagogical methods;
- The teaching staff is strongly involved and very close to the students;
- Very dynamic student associations (VTK, DLK);
- Good balance between industrial practice and academic theory;
- Study Programme Committees including representatives from industry;
- Well-balanced programmes in terms of teaching methods;
- Dedicated staff to support the teaching staff to implement active learning.

Weaknesses:

- Lack of cross fertilization between most of the programmes;
- The course organisation does not consider the multi campus factor;
- Lack of international students with the appropriate scientific level;
- Notions of sustainability and professional ethics need to be reinforced and clarified;
- Lack of staff to ensure a personalised follow-up of foreign students.

Risks:

- Student work overload in the first semester for some programmes.

Opportunities:

- Competence based approach to be refined with the expected level for each learning outcome;
- Have a reflexion on the period of the internships to be able to extend them.

Educational process regarding the different programmes

Bachelor of Science in Engineering: Architecture

Architecture has a very strong positioning in UGent as it has its place in the name of the faculty.

This programme is organized to provide a balanced education between basic sciences, architectural design and engineering courses. Since the last CTI evaluation procedure, the overall structure of the programme has remained largely the same. However, a reinforcement of the staff has been operated with investments in academic positions in the fields of theory and history of architecture and architectural design. These recruitments address the 2016 guideline for improvement of the CTI to reinforce the engineering approach of the future graduates.

There is no admission selection, according to the current statutory policy, and this is generally the main cause for drop-out numbers. Admission at the entry level is relatively stable in the last 6 years (139 newly enrolled students in 2020-2021). The student numbers show a slight increase during the 3 last academic years; they are correlated to an increase of the number of graduates. The gender figures remain globally balanced. There seems to be however a slight increase in the duration of the studies (from 3 to 4 years).

The programme is defined as an educational project developed jointly with all internal and external stakeholders. The Department of Architecture and Urban planning has proposed an action plan. Collaboration and involvement of professionals from architecture offices in the teaching seems to be efficient for continuously adapting the programme. Students are usually involved in the discussions and appreciate the good contacts with the teaching staff, as well as the opportunity to give feedback on lectures.

Bachelorkrant is an important initiative which defines the objectives of the programme and helps the students to have an overview on the projects over the next 3 years.

The challenges are clearly identified (staff, student diversity, infrastructures and the evolution of the professional skills of architects) and action plans are defined accordingly.

The programme is built around the sequence of three design studios (Architectural design): this approach is the backbone of the educational programme. Students are supposed to integrate and apply competences acquired in other courses in the studios. Monitoring of these studios is co-led (from 2021-2022) by a staff member with practical background and another one more involved in theoretical courses. Skills in humanities and social sciences such as economy or sociology are

only slightly developed in the curriculum. Internships are not considered at this stage (bachelor's degree).

The overall structure of the programme remained largely the same since the last CTI evaluation. The programme globally consists of 17% basic sciences, 23% (structural and building) engineering, 57% courses specific to architecture and 2 elective courses: anthropology, entrepreneurship and sustainability and LCA (Life Cycle assessment) of Materials and Structure seem to be the most popular.

A large part of the teaching activities is devoted to seminars and practice. This part is clearly presented to the students, notably through the *Bachelorkrant* where the projects are presented for the 3rd year bachelor's programme. Students greatly appreciate the diversity of the topics. A comparative analysis of the programmes in terms of the proportions between core subjects, engineering sciences and architecture, was carried out with the two other Flemish universities offering the same training: the programme is considered by the programme coordinators as situated half-way between the other 2. The programme offers a good balance between design, basic sciences (engineering and architectural sciences), but less on basic science and soft skills.

Students are allowed to start a course at master's level prior to having acquired all bachelor credits. In consequence, the bachelor curriculum is part of the 5 years curriculum for the master's programme, thus complicated to monitor. *Jokerweek* is a very good initiative to mix students and teachers on a common project.

Three design studios are proposed during the bachelor's degree. These projects based on "real topics" are managed by a team of professors from the basic and applied areas of study. Seminars are proposed to students and help them connect with companies and offices.

A follow-up on site is organised every 2 weeks to put students into contact with real life. There is a risk in increasing the number of students in the studio, as the rate of students supervised by the teachers has a limit.

Research activities, innovation and entrepreneurship training

Contact with research is provided through participation to exhibitions, lectures with teachers involved in research activities, lectures given by PhD researchers and specific projects (*Bamboo project*).

Training for an international multicultural context

An increasing diversity is noted in the profile of the students enrolling for the bachelor's degree. This diversity has been considered in the challenges and in the action plan developed by the department.

ERASMUS+ destinations are selected on the base of excellence. *Excursions @home* lecture series help the student to come into contact with invited foreign guests who virtually present a site or building. This initiative will be extended after the COVID period.

Sustainable development, social responsibility and ethics

Only one elective course has been added on sustainability. Architecture history and engineering will also include some topics concerning ethics and social evolution.

Educational engineering

The Covid crisis has induced some concerns about the teaching environment. Online courses will definitively be maintained (notably digital design) as offering a more efficient way of teaching. Innovative teaching techniques are encouraged, developed, and shared: projects, studios and group activities help the students to become autonomous and responsible. They are regularly evaluated.

Student monitoring / failure management and employment

The students are well monitored and supported by the university. The only pathway for further studies consists in starting the master's curriculum in engineering: architecture. The analysis of duration to succeed at the bachelor's degree shows that only 50% of the students succeed after 3 years and 82% after 4 years. But there is no data to detail the difficulties met during the courses.

Assessment of results

The curriculum details the validation per unit, but there are no rules concerning the validation of a semester or the academic year.

Analysis summary – BSc in Engineering: Architecture

Strengths:

- Willingness to challenge the programme continuously;
- Recruitment of new teaching staff members in relevant areas of proficiency as recommended by the CTI;
- Evaluation of lectures and the quality system: on-going and appreciated by students;
- Good balance between design, basic sciences, the courses of engineering and of architectural sciences;
- Integration of sustainable development from the beginning of the curriculum;
- Open-mindedness in the communication with all students.

Weaknesses:

- The identity of the programme is not clearly and specifically defined compared to similar programmes in other Flemish universities;
- Lack of humanities and social sciences (economy, sociology, etc.) in the programme;
- Lack of data and statistics on the failure of students (after the 1st year of Bachelor).

Risks:

- Increasing number of students in studios becomes difficult for the teaching staff, the rate of students to supervise comes to a limit;
- Increase of the effective duration of the studies (from 3 to 4 years).

Opportunities:

- Transfer to Technicum in 2026: this will help to work in a more efficient environment;
- Collaboration with other departments: artificial intelligence seems to be an opportunity for developing new skills for the engineer-architect.

Bachelor of Science in Engineering

The Bachelor of Science in Engineering proposes 7 main subjects: Biomedical engineering (107 students), Chemical Engineering and Materials Science (60 students), Civil engineering (73 students), Computer Science Engineering (132 students), Electrical engineering (56 students), Electromechanical engineering (177 students), Engineering Physics (65 students). A total of 670 students are enrolled in the current year (2021-2022) and will choose the main subject when entering term 3. The above mentioned subjects qualify for further studies in Belgium or abroad. A positioning test is organized at the admission stage for all students to evaluate the students' level, but the results have no influence on the admission which is granted without selection.

The original bachelor's programme, with a structure of six different degrees, was revised and transformed into one single programme, containing seven main subjects. This includes an additional discipline that has been added since the academic year 2019-2020: Biomedical Engineering (third year). The seven bachelor subjects result in the same BSc degree with the mention of the elected major. These BSc studies in different fields prepare students for the corresponding follow-up MSc studies.

The programme design is based on the expertise of the faculty staff members, who are closely connected to the various research laboratories (covering the specialisation field of each main subject). All programmes are designed to include the basics of the main subject as well as more general topics. They are designed to ensure a good connection to the related master's programme. The programme-specific competencies are endorsed by all relevant stakeholders and the governance committee.

Curriculum: programme outcomes and learning

Each programme is described accurately with clear goals and different learning outcomes which are related to different engineering skills and competences. Most competences are common to all Engineering BSc programmes, while specific courses have been tailored towards the specialisation of each BSc. All bachelor's programmes are constructed around a project line proposed each year. In the second year (term 4), the engineering project is specific to the major and aims to acquire related experimental and soft skills. In the last year, projects of a more transverse nature are possible but not compulsory. Since 2019-2020, the first year of the programme offers a project course focusing on societal issues (sustainability, entrepreneurship and ethics) as well as *Sustainable Business Operation*. These projects are mandatory, although the generic list of competences do not reflect the extended focus on sustainability.

The curriculum highlights a very strong and high-quality content and gives basic competencies for scientific research, thanks to the excellent relationship with the researchers of the different departments. The alumni and companies mentioned that the learning outcomes are in line with expectations of industry and/or the research area.

All programmes consist of 180 ECTS. Various teaching methods are implemented (hybrid lectures, seminars, projects...) and the competencies are evaluated in different ways (written exams, reports, skills tests). The virtual educational method has emerged more clearly during the sanitary crisis (flipped classroom organisation, online teaching and virtual platforms for exercises). The *Apollo 8* project will emphasize these new teaching methods while other e-learning courses are under development (MOOC).

Worth mentioning is the introduction of new courses that give an interdisciplinary perspective on broad issues related to sustainability and ethics during the first term of the bachelor's programme. However, the programme could go deeper into soft skills and sustainability to develop students'

awareness on the societal impact of computer science, new industrial revolution (i.e., Industry 4.0), objectives of the energy and ecological transition, international treaty on climate change, etc.

The interdisciplinarity across different bachelor's programmes could be developed through projects and research topics. This could further the mixing of students from different bachelor's specialisations to work together.

The connection between bachelor's and master's programmes is less evident in some bachelor's programmes (lack of introducing AI in the bachelor's programme in computer science). It is worth mentioning that some of these programmes are benchmarked in a common European Benchmark Framework.

Programme implementation

A competence coverage matrix catalogue is available online and contains the major information about the main subjects, competences, related evaluations and, furthermore, a clear description of each course.

The stimulation of student-entrepreneurship by different means is valuable (cross-course projects, encouragement of internships and student jobs, contests).

The project line has been strengthened significantly with two major projects: sustainability with the introduction of courses such as Sustainable Business Operations and Sustainability, Entrepreneurship and Ethics. The concept of sustainability is interwoven in different programmes but the strategy in how these aspects are included in the programme remains unclear.

Training for an international multicultural context

Since the bachelor's degree is viewed as the first step towards a master's degree, the international dimension is not really considered. Specifically, an inbound mobility cannot be offered due to the language requirements in Dutch. Nevertheless, students are well exposed to English as a second language during the six terms of their BSc education, which facilitates their integration into the master's degree or into an international master's.

An internship is not compulsory although students are encouraged to do an internship in industrial companies.

Analysis summary – BSc in Engineering

Strengths:

- Good balance and consistency between theory and practice;
- Strong involvement and enthusiasm of the teaching staff in their mission and interactions with the students;
- The feedback system is well appreciated by the students;
- Dutch and English languages;
- Valuable stimulation of student-entrepreneurship;
- Specific programme *VIRGO*, to attract more students from minorities.

Weakness:

- Lack of international experience.

Risks:

- N/A.

Opportunities:

- Increase the number of women amongst the teaching staff in the bachelor's programme, to offer more opportunities for female professors to chair bachelor's programmes or main subjects;
- The project MMM can be used to strengthen the discovery of scientific fields and social fields;
- The *Apollo 8* project which is looking into possibilities and options to include virtual assignments and virtual courses;
- Refine the strategy to strengthen the sustainability track.

Master of Science in Engineering: Architecture

The objective of the Master of Science in Architecture is to train academic engineer-architects who have the required intellectual and technical competences to be able to discuss and work with all partners involved in the design and construction processes and organise their combined action around a shared project.

The programme consists of two academic years; most of the students enrolled in this master's programme are graduates from the Bachelor of Architecture and have the essential background to attend this main subject.

The programme is divided into two main options (Urban Design and Architecture – UDA, and Architectural Design and Building Technology – ADBT). These two options are well structured and balanced between technical and professional practices: three main blocks are built to cover the two options, including shared courses between the two options and a design studio. Moreover, the programme includes applied research activities.

The number of students enrolled for this master's programme has increased from 181 in 2019-2020 to 228 in 2020-2021 and 233 in 2021-2022. Moreover, 64% of the students completed the master's degree in 2 years and 94% in 3 years.

Curriculum: programme outcomes and learning outcomes

The objective of the programme curriculum is to acquire a list of competences and associated learning outcomes such as: technical installations in buildings and calculation methods in architectural engineering, introduction of courses and seminars regarding sustainable architecture and urbanism and ethics, history and theory of architecture and urbanism, project development and project management (design studios), social and cultural aspects of architecture-urbanism, links between education and research. There is also an ethics course on architectural practice.

There is a majority of professional architects involved in the programme. Since the academic year 2021-2022, two members of the teaching staff, one from the practical field and the other from the theoretical courses, are in charge of the studios.

The language of instruction in the master's programme is Dutch, whereas all students are exposed to the English language which will facilitate their integration in international exchanges and international offices.

Each teaching unit is also defined in terms of learning outcomes with the allocation of ECTS credits when validated.

During secondary studies in Belgium, no subject addresses architecture, which justifies the continuity of the programme in 5 years and the initiation to architecture from the first year of the

bachelor's programme. There is no compulsory internship during the 2 years of the curriculum, but there is a mandatory two-year internship after the completion of the studies, in order to access the profession.

Research activities, innovation and entrepreneurship training

There is a strong link between the training programme and research. Each "full time" teacher is active in research. These research subjects will be the common thread of the reform of the current programme. Research seminars are an important core element of the curriculum.

Training for an international and multicultural context

Currently the international influx is insufficient, despite the fact that the procedures for mobility are well detailed. Efforts are concentrating on ensuring the high quality of the programme in Dutch. However, the international dimension of this programme is in progress and collaborations exist with European universities (University Gustave Eiffel, Politecnico Milano, TNO Eindhoven, Vienna Polytech).

International guest speakers and international researchers contribute to the exposure of students to an international experience.

Sustainable development, social responsibility and ethics

Sustainable development, social responsibility and professional ethics are present in different courses, seminars, studios, and are also related to current research. These subjects will be the common thread of the reform of the current programme.

Educational engineering

The clear focus on design including historical, cultural and societal aspects, gives this programme a distinctive image in the academic ecosystem. An important part of the programme is delivered by professionals from the architecture-construction sector.

Teaching provided during the programme uses different methods, including lectures, research seminars, tutorials, practical work, studios, individual and group activities. Student self-training is another one of these methods. All these activities provide a significant workload and there is a follow-up for students who have difficulties.

Student life

The department considers that student life is a fundamental element in the education. The *Joker* week and the student association "De Koe" contribute largely to this, without forgetting the city-trips.

Student monitoring & failure management

The faculty cultivates a general atmosphere of openness in order to identify any reported problem situations (there is a follow-up of students confronted with difficulties). The department checks the results obtained by the students and provides personalised guidance if necessary.

Architecture is strongly positioned at Ghent University and the experts have particularly appreciated the enthusiasm of the teaching staff and students.

The experts consider that the degree of Master of Science in Engineering: Architecture of UGent meets the CTI criteria.

Analysis summary – MSc in Engineering Architecture

Strengths:

- Very enthusiastic teaching staff, working as a team;
- Good and pleasant interactions between students and staff;
- Clear focus on design, from the first year – including historical, cultural and social aspects – gives this degree a distinctive feature;
- Large contribution of professional architects in the education programme;
- The *Joker* week is one of the top elements of the curriculum;
- Important library specialised in architecture;
- Both Dutch and English languages;
- The annual study trip abroad;
- Dynamics of the student circle “de KOE” (setting up of a radio station during the sanitary crisis).

Weaknesses:

- Courses and seminars regarding sustainable architecture and urbanism and ethics, can be developed;
- Difficult mobility from Ghent to the Ardoyen campus;
- Quality of the studio rooms, limited places for storage and limited accessibility;
- Non-existing studio for the realisation of models;
- Lack of the diversity of the students’ profile;
- Insufficient international incoming and outgoing mobility.

Risks:

- The growing number of students;
- Limited career paths for “full time” staff.

Opportunities:

- The generation shift of the staff (6 new positions) is clearly used to refocus and rejuvenate the curriculum;
- Moving to a new renovated building;
- The reshaping of the programme from the academic year 2024-2025 on;
- Promoting the Fablab;
- Gender balance.

Master of Science in Biomedical Engineering

The MSc in Biomedical Engineering (BME) is a joint programme between UGent and VUB. UGent is the leading institution. The programme operates in autonomy since the end of the CEMACUBE Erasmus Mundus International Master. Four specialisations are proposed: Neuro-engineering, Biomechanics and Biomaterials, Sensors and Medical Devices and Radiation Physics. As a multidisciplinary programme, it has strong links with industry in the field and with local hospitals, to reinforce exposure to work with patients, clinicians and doctors as well as the many stakeholders of the biomedical and health care industries. There are 4 hospitals within the Ghent area where the students work on a hospital project.

Thanks to the setting up of the BSc BME at UGent in 2019-2020, curriculum changes have been handled fruitfully. Close interactions and synergy with faculty, students, and teaching staff have been maintained, apart from more formal FEA quality assurance processes and quality monitoring tools. There is a dynamic and smooth co-ordination between the UGent and VUB programme leaders, as well as a good collaboration with the dean of the UGent Faculty of Medicine. According to the previous CTI guidelines for improvement, the visibility of the programme has been clearly enhanced locally thanks to the new BSc BME at UGent in 2019-2020. Close links with industry and local hospitals allowed to strengthen the understanding of the needs of the profession and to align the courses accordingly (e.g. the recent introduction of the course in Medical Equipment, Safety and Regulations).

Curriculum: programme outcomes and learning outcomes

The programme and learning outcomes are formalised according to the FEA methodology, with core outcomes linked to the common FEA MSc profile, extended to specific BME outcomes: basic knowledge, scientific and professional competencies, cooperation & communication, social competences and medical radiation physics.

The 120 ECTS programme structure is very clear and well organised in semesters of 12 weeks each. 66 ECTS are compulsory courses, more in the first year. Since 2016, 30 ECTS of electives reinforce the flexibility of the learning topics and the student latitude in their choices. The volume of electives increases over the semesters. The master's thesis at the end of the curriculum allocates 24 ECTS.

General BME courses (3 to 6 ECTS each) at UGent are on Artificial Organs, Medical Equipment, Safety and Regulations, Clinical Study Design and Biostatistics, and Leadership in Health Care. At VUB, students study Health Information and Decision Support Systems. Other courses are for specialising in Medical Imaging (joint), Biomaterials and Tissue Engineering (joint), Neuro-Engineering Science (UGent), Micro- and Nanotechnologies for Medical Device Design and Fabrication (joint), Biomedical Robotics and Assistive Technologies (VUB). The Data Analytics in Healthcare and Connected Care course is operated in parallel between the two sites, as for the 1st year Biomedical Product Development projects and 2nd year Hospital project.

6 ECTS of elective subjects have to be taken in the 1st year. Then, some other electives are accessible among Modelling in Medicine and Biomedical Engineering, Bio electromagnetism, Manufacturing Planning and Control, Ethics Engineering and Society, Artificial Intelligence, Wave Physics in Living Matter, and Scientific and Clinical Applications of Magnetic Nanoparticles. Then, there are up to 5 to 9 different electives per specialisation (3 to 6 ECTS each).

Overall, the diversity and choices of electives make the programme very open, even if the BME engineering profile may not be fully addressed in all student pathways.

Programme implementation

Some extra-curricular activities with industry are organised via the active BEAM student association. Students are offered visits of big companies and can attend exhibitions (e.g. MEDICA trade fair). The *UGent Industry Days* are very well organised and much appreciated by BME students for connecting with industry and recruiters of the sector.

The number of students graduating with an internship is increasing, from 34% in 2018-2019 to 45% in 2020-2021 (UGent: 41%; VUB: 53%). The opportunity to conduct a MSc thesis in hospitals as interns is to be envisioned.

The encouragements for more integrated internships in the curriculum have been heard and could be reinforced for the next period with more flexibility in industry periods during academic semesters rather than during summer periods only.

Research activities, innovation and entrepreneurship training

The BME meets the standards of a state-of-the-art research-based education. A research subgroup creates interactions between all the departments involved in the BME MSc. Visiting professors are in charge of BME courses and some professors have research experiences in Hospitals (e.g. via sabbatical research leaves). Several lecturers of BME courses are involved in spin-off companies (e.g. Epilog, XEOS, Molecubes, MedTech Flanders). The BME ecosystem is a means to accelerate medical technology and medical device innovations in Ghent.

Training for an international multicultural context

This BME MSc is fully taught in English (B2 level required) and benefits from good rates of international incoming students from all over the world. The student association "BEAM" organizes a semester welcome and international student evening. There are several Erasmus+ exchanges with Italian universities. Despite the end of the CEMACUBE programme, some opportunities of collaboration with the Czech TU remain. Other partnerships with Irish, Spanish or Canadian universities are considered for 2022-2023.

At an international level, the communication strategy is to find echoes in order to meet up to 30% of international students as a target for the UGent site on a regular basis.

Sustainable development, social responsibility and ethics

Students develop awareness of the ethical and socio-economic aspects of the profession and can enhance their skills related to the quality of life in society. The sustainability and social responsibility skills could be reinforced and interwoven all along the programme with a transdisciplinary perspective, and thus find echoes in several courses, projects, thesis work or internships. Ethical and safety aspects could be reinforced accordingly.

Educational engineering

There is a good balance of course models, with big projects for systemic perspectives. Around 50% of the core and elective face to face courses rely on lectures, along with hands-on practical courses. Of the 120 ECTS credits, 41 are dedicated to project-oriented courses: Biomedical Product Development project in semester 1, Computational project and Biomedical Product Development in semester 2, Hospital project in semester 3, and master's thesis in semester 4. The Hospital project (5 credits around 150h) is noteworthy and followed by the students in a real hospital (in teams of 2 to 3 at UGent and individually at VUB). It reinforces the students' capabilities to communicate with clinicians and hospital staff, to better understand the systemic complexity of hospital business processes and develop relationship skills.

Assessment of results / Student monitoring / failure management

Expectancies regarding transversal and soft skills are non-homogeneous in the assessment criteria of courses all along the curricula to align with the global programme outcomes and graduate engineering profile. For soft skills, there is a structured development and assessment of presentation skills (oral, written) with intermediate and detailed feedback. Peer feedbacks in work groups and interactive discussions and debates are now in place for several courses, including project-based models. A more formal analysis of soft skills is conducted during the M2 Hospital project, which includes presentation skills and reflection with industry representatives. As such, formative assessment prevails.

The specialisation (Neuro-engineering, Biomechanics and Biomaterials, Sensors and Medical Devices, and Radiation Physics) is mentioned on the diploma supplement.

On average, about 70% of students graduate in 2 years, 30% in 3 years, most of whom are international students. There is a very positive atmosphere between students & academic staff. Students' voices are well heard, and courses can be adapted reactively. Occurring problems are tackled quickly. Guidance for incoming foreign students has been reinforced, especially for the

intercultural dimensions thanks to the BEAM association, and also for the administrative dimensions of this joint degree between the two institutions (e.g. "administrations" guidelines). Preparatory courses can be taken, which may come from the BME BSc courses.

Student selection and admission

The BME MSc benefits from its local source of admissions thanks to the newly created BSc, a dedicated degree, which ensures a very good visibility to this MSc. Overall, in 2021 the number of international students is high (45%, 33/74), but there's an imbalance between UGent (25%, 11/44) and VUB (76%, 22/30). 30 to 50% of international students is seen as a good target for the future on the UGent site. The origin of students is worldwide and non-limited to the EU. There is a very good student gender balance and international student integration. This reflects a general greater female participation in Biomedical studies.

The programme could be very attractive in the near future due to its multidisciplinary nature and high demand of the sector.

Graduate Employment

Graduate employability is exemplary in several dimensions. At a European and international level, alumni are working in large companies as global business managers, in spin-off companies, and working for public service commissions, BioMed departments in hospitals, or engaged in PhD postgraduate studies in the field. Around 50% of the UGent BioMed PhD students are from the BME MSc.

The graduate employment analysis relies on the UGent FEA processes.

The UGent BME MSc is a very attractive programme, fully aligned with the industrial needs of the medical sector. It meets the UGent educational vision of "creative knowledge development". It has clear R&D links as a good combination of technical, engineering, and research skills for a sector in high demand. The programme co-ordination is flexible and reactive.

Analysis summary – MSc in Biomedical Engineering

Strengths:

- High local visibility via the newly created and related BSc degree;
- Reactive quality improvements in line with external recommendations (e.g. CTI guidelines for improvement from the 2016 evaluation procedure);
- Flexibility, dynamism and engagement of the staff to manage programme updates;
- Adequate mix between classical teaching and project-based learning methods;
- Multidisciplinary programme with the *Hospital project* in M2 involving stakeholders in the field;
- Good student gender balance (close to 50/50) and international student integration;
- Positive atmosphere between students & academic staff;
- Workspaces for the courses on a hospital site.

Weaknesses:

- N/A.

Risks:

- Discrepancy between international students' rates from VUB and UGent;
- A fast-evolving Biomed domain which could request a too large skill spectrum;
- A growth of incoming students and international students which could impact the existing flexibility and familiar atmosphere due to small student numbers with the same cultural background.

Opportunities:

- Strengthen bridges between programme leaders, BEAM and alumni associations to revive the BME community;
- Longer term internships apart from short summer periods (e.g. part-time semester model);
- Clarify the Hospital project learning outcomes to mature it: as an example, UGent's transferable project learning model, including agile project management methods;
- New building under construction.

Master of Science in Chemical Engineering

The programme aims at training graduates who master the fundamental chemical engineering principles and are capable to innovate and to become chemical engineers in charge of R&D, design, construction, management or maintenance of equipment or plants in industry (mainly refining and chemical industry, but also 10% in biotech) or in public R&D laboratories.

Since the last CTI procedure, an ambitious and appropriate vision is being developed towards "modern" and sustainable chemical engineering. This vision is in compliance with the required skills recently defined by the European Society of Chemical Engineering to tackle the current social and environmental needs and to integrate technological innovations coming from different fields (e.g. artificial intelligence, big data). The programme design and implementation benefit from the strong research expertise of the team within the Centre for Sustainable Chemistry.

In 2021-2022 the programme enrolled 64 students (in the 2 years) an increase of 52% with respect to 2019-2020. 20 to 25 students per year are typically enrolled in M1. The number of graduates is on average 20/year in the 2 last years, with an extremely low proportion of women for this speciality (16% in 2021). The current target is to maintain the number of enrolled students in M1 and increase the number of graduates to 35. This target seems reasonable (based on the excellent employment rate), and achievable (based on the current increase of the student numbers and on the recruitment of new faculty staff).

This master's programme is primarily tailored to fit the needs of the chemical and petrochemical industry, although it could certainly fit the needs of the fine chemicals and the pharmaceutical industry. It is well aligned with the demand of local employers, who seem to appreciate it for the depth and the breadth of scientific and technical knowledge it provides. Employers also very much appreciate the organisational skills, adaptability, critical thinking, ability to think outside the box, along with the communication and multilingual skills that students acquire during their training. It is noteworthy that 30% of the research budget comes from industry.

The Study Programme Committee is active, and 4 representatives from industry are taking part in it. However, the management approach used to revise the programme and the curriculum could be improved periodically. Indeed, ownership for the new vision is not fully taken by the whole staff including the co-ordinators and explained clearly-enough.

Curriculum: programme outcomes and learning outcomes

Strong skills are developed both in basic sciences and in the applied science and technique of the speciality. By comparison with other programmes in chemical engineering, emphasis is given to distillation, reaction kinetics and reaction engineering, hydrodynamics and process control, in relation with the research activities and the industrial partnerships of the teaching staff.

All soft skills associated with the scientific mandatory course units are clearly identified and described, as well as their evaluation method. Therefore, each mandatory "scientific" course unit

includes soft skills to be developed by each student. As a complement, 6 ECTS are obtained on social skills in elective courses.

Students do not seem very confident in their skills in economics or management. Skills in management and economics might not be developed enough for each student, depending on their electives and projects. Outcomes in ethics are not well defined.

The programme contains 60% of compulsory courses (72 ECTS) and 40% of elective courses (48 ECTS) including the master's dissertation (24 ECTS) and elective subjects (24 ECTS), in which at least 6 ECTS should be taken from a list of social courses, including an internship. 3 minors (18 ECTS) are proposed: operational management, biosystems, environmental and sustainable development.

Programme implementation

Considering the small composition of the team (10 professors and associate professors, 5 guest professors) and its other activities at the faculty, the design and implementation of the programme is performing, thanks to the dedication of the teaching team and a very good organisation, supported by a large number of technical staff members.

The master's programme provides several opportunities for hands-on industrial experiences through internships, industrial projects or master's thesis topics. Although not mandatory, before the pandemic 100% students chose to do a summer internship between M1 and M2 and are very satisfied with the experience. The Industrial Projects course offers students the unique opportunity to work in small teams and apply acquired knowledge to a real-case example of an industrial challenge. This cooperation with an external company further enhances the students' presentation and communication skills.

Research activities, innovation and entrepreneurship training

Research activities are one of the strengths of the programme and have a strong impact on training. The various courses in chemical engineering are linked to the research themes of the laboratories; the equipment is accessible for the carrying out of student projects. The research teams grouped together in the "Centre for Sustainable Chemistry" have an appropriate and timely vision of modern chemical engineering. All teacher-researchers are assigned to this research unit and the issue of sustainability is reflected in all courses. It should be noted that approximately 25% of these master's thesis projects are carried out in industry.

Apart from the link with research, opening towards innovation and the setting up of professional activities or businesses does not seem to be implemented by specific activities and achievements. A training process for innovation and entrepreneurship should be developed.

Training for an international multicultural context

Students are exposed to a diverse multicultural environment thanks to the Erasmus+ programme (incoming and outgoing mobility), international internships, international students who join the programme or transversal teaching units and a few foreign teaching staff members who have been recently recruited.

New partnerships have been developed and existing agreements extended. To help expand mobilities, the staff intends developing dual master's degrees with preferred partners (e.g., Politecnico di Milano in Italy) or NTNU in Norway), which is a good idea.

Despite these efforts, in- and outbound mobility remains rather low:

- About 10% of the students did benefit from the Erasmus+ programme and their feedback is very positive.
- - Additionally, 10 to 15 % of the internships are carried out abroad.

Only 3 international students are admitted per year, representing 10 to 15% of the student numbers.

The reasons behind these modest numbers should be analysed and obstacles alleviated. The courses taught in English help the students acquire a very good command of this language, which will undoubtedly be a strong asset in their future careers in an international setting.

Sustainable development, social responsibility and ethics

The need to develop skills in sustainability and safety have been taken into consideration since the last CTI evaluation and are well integrated into the training programme in specific mandatory teaching units, such as “Sustainable Chemical Production Processes” and “Safety and Environmental Management”, which has been reformed, as well as in the project’s objectives. A new elective summer school on process safety is proposed, in collaboration with the Belgian Chemical Sector Federation.

Case studies are proposed in collaboration with industrial partners. We could suggest introducing broader and more recent approaches that couple environmental assessment with multi-criteria optimization, for eco-design processes.

Educational engineering

The students are exposed to various teaching methods and the part of projects and industrial case studies is very significant. There is a good balance between theory, practice, innovation and projects. Several large-scale equipment and test set-ups are available for exposing the students to practical and real-life experiments. Five guest professors from industry are involved in the project definition and monitoring. They are responsible or co-responsible for 15 to 20% of the teaching units. Some very interesting teaching approaches are used in some teaching units, such as in the new courses on safety or in the industrial project. Active learning methods are experienced and could be more widespread.

Student monitoring / failure management

The limited number of students allows for a personalised follow-up and direct contact with the teaching staff. The students find effective individual assistance from the staff, when they need it. The global success rate is 93%. For students who are not from the Bachelor in Chemical Engineering at UGent, and for foreign students, admission is subject to a successful participation in a preparatory programme.

Student selection and admission

The admission in M1 requires strong scientific skills and knowledge in different fundamental sciences for chemical engineers. The origin of the student population is diversified, with three sources of admission: the UGent Bachelor in Chemical Engineering & Materials Science, which represents a natural and very attractive appeal for the master’s programme; UGent graduates from another master’s programme (Chemical Engineering Technology, Bioscience Engineering or Chemistry), representing 5 to 10 students per year; international students, with about 3 admissions per year. Moreover, up to 5 per year exchange students are coming for one semester.

The teaching staff deplores the lack of gender diversity, but has no strong strategy for attracting more women to the programme.

Graduate Employment

Employability is excellent. Most students are recruited after the internship (at the end of M1) or in the first days after graduating. Although opportunities for accessing the international job market exist, students usually seek and find jobs in Belgium, in various sectors: the chemical industry and petrol refining (65-70%), biotechnologies (5-10%), research in Higher Education (25%). They mainly become process engineers, researchers of engineering in process design and development. 25% of graduates continue with a PhD. PhD graduates are perceived as “a plus” by

Belgium companies, with better career opportunities and salary. 95% of them are recruited by companies in Belgium or abroad.

The response rate to the 2021 employment survey was only 13,2 %. According to the survey, about 30% of the graduates have been employed abroad in their career. They work in various types of organisations, but mostly in international companies (65%) and universities (18%). The alumni met by the expert panel, all recently graduated, are very proud of their master's background. However, they do not seem to be very involved in relationships with students (mentoring, tutoring internships, etc.) or with teaching staff from the programme, and they should be encouraged to do so.

The MSc in Chemical Engineering is a useful programme that satisfies employers and students, who are very proud of it. Great progress has been made since 2016 to tackle the CTI's guidelines for improvement. An ambitious and timely vision has emerged, driven by strong industrial relationships and the dynamic research activity of the teaching staff in the Centre of Sustainable Chemistry. The first implementation of this vision in the programme shows some remarkable improvements notably regarding the approach of sustainability and safety.

The will to pursue the implementation, as well as to develop even more the active learning methods is a strength, although the ambition would benefit to be:

- shared for enhancing coherence in the implementation,
- explained and communicated for improving the programme's attractiveness towards a diversified public.

Summary analysis – MSc in Chemical Engineering

Strengths:

- Excellent anchoring with industry and research, notably with the Centre for Sustainable Chemistry;
- Broad scope of the programme that opens the door for positions in various sectors (refining, chemical industry, pharmaceutical industry, etc.);
- The scientific competences are very well defined;
- 100% of the students choose to do an internship;
- The effective integration of subjects such as safety and sustainability;
- The will to continue progressing with, for example, the integration of subjects such as artificial intelligence;
- Motivated and mature students;
- Good attractiveness towards the Bachelor in Chemistry from UGent.

Weaknesses:

- Unstable number of students;
- Low proportion of female students;
- The low number of permanent teaching staff with respect to the total number of students (taking into account both bachelor's & master's levels) and the high number of PhDs students;
- Skills in management and economics might not be developed enough for every student, depending on their electives and projects;
- Outcomes in ethics are not well defined.

Risks:

- Confusion between the engineering and the technical engineering programmes if the objectives and ambition are not clarified through a better communication;
- Workload of the teaching staff.

Opportunities:

- Improving programme design and coherence involving all lecturers, from academia and industry, with mixed bottom-up and top-down approaches;
- Taking advantage of the alumni for promoting the programme.

Master of Science in Civil Engineering

The aim of the programme is to train broadly educated civil engineers, well educated in the domains of civil and structural engineering. The specialization can be one of the 3 following:

- construction design;
- dredging and offshore engineering (it does not include a separate course on dams but navigation dams, weirs, energy dissipating structures and small hydropower devices are included in mandatory courses);
- operation management.

The programme coordinators strongly insist on the necessity of a solid and duly underpinned knowledge of civil and structural engineering.

In 2021-2022 this master's programme enrolled 120 students (for the 2 years of the programme) of whom 60 were first admitted. But the number of graduates has decreased: 57 in 2018-2019, with 19% of women, and 39 in 2020-2021 with 10% of women. It seems that this number should increase next year with the number of new enrolments. It should be mentioned that next year, the department will also propose an excellence programme on artificial islands to 30 motivated students of the entire university.

An Advisory Board exists since 2018 and includes 10 people from companies; 5 for each of the 2 majors (offshore and construction). The programme has evolved introducing Structural Reliability and Risk Analysis as a mandatory course. In the major Construction Design the course Glass and Timber Structures was replaced by Glass and Façade Structures, and BIM was added in the elective courses in 2018. This was done under the influence of the employers that are now happy with these choices. Parametric design has also been added as well as Performance-based Design. The topic Steel structures is included in all courses regarding structures. Curriculum revision takes place every 4 to 5 years.

Students think that the evolution of the programme as a result of their feed-back is not fast enough. The meetings involving students address only a part of the programme.

Curriculum: programme outcomes and learning outcomes

9 competences contribute to acquiring knowledge and 3 competences are linked to the putting of this knowledge into practice. As such, it is a real challenge to keep an equilibrium between theory and applied science for such a programme and it is necessary to explain to each new class of students the reasons for the choice of each of the subjects. The two professional specific competences are not very precise, but include the notion of social responsibility, which could lead some courses towards becoming mandatory. The emphasis on sciences and techniques in the field of civil engineering and their application is appropriate.

The mandatory courses represent 108 ECTS of the 120 of the master's programme, in both specializations. The option does not condition the subject of the master's dissertation, nor the choice of the elective courses in civil engineering and the elective social courses.

Elective social courses represent 6 credits. Since 2015-2016 this list has evolved: courses such as Sustainability Thinking, Sustainable Energy and Rational Use of Energy, Coaching and Diversity, HRM, Financial and Cost Price Reporting in Companies, Macroeconomics, have been added.

However, in this discipline it seems surprising that a mandatory course on ethics is not present while the M6-11 competence deals with the social responsibility of the civil engineer. A specific view on this social responsibility is treated in a project concerning the construction of a bridge, implemented with guest lecturers and very appreciated, but ethics in itself doesn't seem present. The programme includes 28% calculation methods, 10% material knowledge, 18% construction specifics, 44% water and soil.

Programme implementation

Courses are taught by a teaching staff from both academia and industry. This balance has been kept through the years. There are also guest lecturers on very specific subjects.

Each student knows the rules that will apply for the programme, many open discussions take place with the teaching staff, and the students are very happy with this approach: 95 % were very satisfied with the programme in the last review and found their teachers inspiring.

Projects represent 5% of the compulsory courses (master's dissertation set aside). They are considered as interesting by the students. Since half of the teaching staff are professionals from industry, these projects are nurtured by companies. About 45% of the students take on internships. This represents an increase since 2013-2014. The Poutrix association of students of Civil Engineering helps a lot with promoting internships, organizing 5 visits to companies each year and also a fair for companies in search of an intern.

Specific testimonials of companies providing internships were included in the 2020 edition of Poutrix "Civil Night" activity. This shows the great importance of this student association as regards the links with the companies. The efforts to increase the number of students taking up an internship has had an effect in 2017-2018, but with the COVID sanitary crisis it is difficult to judge the global effect today.

The master's thesis is well supervised with many intermediate presentations and an evaluation of the intermediate results, but due to the number of students it represents a heavy workload for the 20 tutors, each of them overseeing between 2 to 5 students.

Research activities, innovation and entrepreneurship training

Teaching activities are founded on academic research, which really appeals to the students.

Research is very present, for example the new course on glass is supported by a research team, as is the case with nearly every course. A high number of graduates from this master's programme are pursuing with PhD studies (16 in 2020/2021). Students may however bring their own subject for the dissertation thesis if this subject is approved by their supervisor. Elective subjects allow students to develop entrepreneurship skills if they wish, but it is not mandatory and it represents only 6 ECTS credits.

Training for an international and multicultural context

Students are offered tuition-free courses to improve their level of English until they reach level C1. The staff is in general not very satisfied with the students that they welcome from abroad. They consider that the communication about the university and the city should be improved, in order to attract more qualified students.

In 2016, the CTI suggested to select certain universities for a more intensive cooperation. Before, the faculty counted on 38 co-operation agreements and in 2020 17 of them were not renewed. It seems that for the remaining agreements, reactivation measures are needed, as only 10% of the students come from abroad. At the same time, the specificity of the master's programme on Offshore Design could contribute to a positive development. A person could be dedicated to realizing a benchmark, in order to know in which countries these skills would be appreciated.

Companies that need people in the area of Coastal Engineering could also help with this communication.

There seems to be a misunderstanding between students and lecturers on the real importance of sustainable development in this programme. The teaching staff considers that sustainable development is included in nearly all the courses, but the students disagree with this statement. The description of courses in the syllabus should be modified and discussed in SPC to reinforce this concept.

The subject Ethics of the Civil Engineer does not appear either, which seems a great shortcoming for graduates who will have professional responsibilities.

Educational engineering

All teaching methods exist in this programme with very diverse methods of evaluation in a good balance. The workload is perceived as high by 78% and very high by 18% of the students in the Bachelor in Civil Engineering, while for the master's programme the high and very high workload levels are considered respectively 65% and 8%. Deadlines for projects being too close are now avoided, but the subject could be discussed by the SPC if necessary. As half of the teaching staff comes from industry, interaction between students and companies is within close reach, which is very positive.

Student life

The voluntary engagement of students is very clear in this programme: all activities of the Poutrix student's association are well recognized but not through ECTS credits. Students judge that their participation will be a plus on their CV when searching for employment. This activity of bridging between students and companies and between the teaching staff and the students is very important for the programme.

For the time being, the programme takes place on another campus where there isn't enough free space for student life or for students to manage their projects. A new building will be built soon and students are impatiently waiting for this moment, as circulating from one campus to another by bicycle is inconvenient and can also be dangerous.

Student monitoring, failure management and employment

A bridging between the Bachelor in Civil Engineering Technology and this master's programme exists, however the number of students concerned has decreased. Furthermore, those students tend to take longer to graduate. The graduate employment remains very good, since CTI's last evaluation in 2016, and employers confessed that they were not able to find the number of graduates they need. As for all other programmes, the study guidance is efficient, and the students are very close to the teaching staff and to their delegates in case of a problem. Poutrix is also very present to solve the smaller problems of students with the teaching staff and the administration.

Assessment of results

In the self-evaluation report, we see that in the two majors all the assessment methods are present. The major appears on the diploma supplement.

Analysis summary – MSc in Civil Engineering

Strengths:

- Great motivation and appreciated specific skills of the teaching staff in the field of Civil Engineering;
- The specialization on “Dredging and Offshore Engineering” is rare, and thus very appreciated by both students and companies;
- Student associations playing a central role in connecting the teaching staff, industry and students together;
- The feed-back of the students in the satisfaction surveys and to direct questioning is very positive;
- There is a good mix of representatives from industry and academia in the teaching staff;
- On many subjects it is possible to realize a fruitful collaboration between departments during the master’s thesis, for example.

Weaknesses:

- There is a lack of good-level international students.

Risks:

- The problem of balance between direct use of software tools and the knowledge of methods in computation is very sensitive;
- The workload stays a bit high especially during 3rd year of the bachelor’s programme.

Opportunities:

- The new building on Campus Ardoyen will increase the possibilities of transdisciplinary activities;
- Naming of subjects in the programme could be adapted in order to better reflect the content and be more easily understood (e.g. Steel Structures).

Master of Science in Computer Science Engineering

The Master of Sciences in Computer Science Engineering aims to train engineers capable to build complex information processing systems, covering the development cycle from design to conception and implementation. The philosophy is to stimulate independent knowledge: learning how to learn.

The programme is built on 2 academic years and admissions concern mainly graduates from the Bachelor in Engineering, from FEA or other faculties, as well as foreign students. The curriculum is well balanced between computer science topics, including recent technologies (machine learning, information security, IoT, parallel systems), physical layers, modelling courses, and research and design projects. It is structured in compulsory courses to ensure a minimum set of competencies to all graduates, and a list of elective courses to fit the students’ expectations for their future. The programme is taught in English. The enrolment of students has increased in the last three years (from 67 in 2019, to 76 in 2021). The number of graduates increased accordingly (51 to 66). The rate of female students stays low, around 10%.

The programme is chaired by a programme co-ordinator, its development and monitoring is handled by the SPC committee, relying on feedback from students and lecturers, and across formal and informal exchanges with the industry representatives. The main evolutions since the last evaluation aim to enhance: sustainability, entrepreneurship and ethics skills, maths courses, recent technology knowledge, an increase in international exchanges, and introduce 2 main

options as a cluster of elective courses (AI, Embedded System). In fact, most of the students choose the elective courses, and the Embedded Systems option is not so attractive.

A new programme has been designed, in order to meet the conclusions of the previous CTI guidelines for improvement and will be implemented for the academic year 2023-2024.

The revision applies to the last 3 terms of the programme:

- Introducing new developments;
- Reducing the weight of some existing courses;
- Emphasis on the societal implications of computer science: increase attention to sustainability and ethical aspects introduced during the bachelor's programme;
- Clarify the structure of elective courses, introduction of two new major options and two minors.

Steering the programme both by academic staff and representatives from industry leads to a good balance between scientific depth and up-to-date technology expected by the job market.

Curriculum: programme outcomes and learning outcomes

The programme curriculum fits the objectives to acquire the following 6 competencies of the generic competencies model and 4 specific competencies, as well as the associated learning outcomes:

- Design complex digital information processing systems with an important hardware component;
- Design complex intelligent software systems with the help of modern programming models, language and other tools;
- Design complex communication networks and multimedia applications for various processing systems;
- Have a sound grasp of system models and design methodologies for information processing systems.

The programme of 120 credits consists of 3 parts: 60 credits of compulsory courses, 30 credits of elective courses, 24 credits for the master's dissertation. Compulsory courses consist of a minimal set of knowledge; elective courses are split between 32% on modelling, 32% on physical layer, 35% on computer sciences. Students have to follow some rules to ensure having a consistent curriculum. Since the last evaluation, 2 majors (Artificial intelligence, Embedded systems) and a set of elective courses are proposed to the students, to deepen their knowledge in these fields and as a guidance towards the profile expectations of industry. Most of the students choose the elective courses track. The open discussion with lecturers before each semester helps the students understand the objectives of the courses and fosters the consistency of the individual programmes.

The specificity of this programme is the Design Project lasting 2 terms, giving the students the opportunity to integrate their knowledge following a professional approach.

Programme implementation

The industry is present through many projects along the curriculum. Industry representatives welcoming students for internships are very satisfied. They appreciate the students' capabilities to adapt very quickly to the professional context.

Research activities, innovation and entrepreneurship training

This master's programme implements a specific approach to research and innovation, following the standard methods proposed by the FEA. The first step of training to the research methodology is the research project (3 credits), where students learn how to conduct a rigorous literature survey. It is a good preparation to the master's thesis.

Innovation and entrepreneurship are strengthened through a full-year Design Project (9 credits), conducted by groups of 7 students, aiming to implement a solution. All students validating the first

year of the master's programme have a functional prototype and a validated business plan. Students consider that this master's programme is a very good track towards entrepreneurship. They are also encouraged to take a business model/business plan course at the Faculty of economics. A student-entrepreneur status is available for students setting up their own business. The *Dare venture programme* is an additional option that provides students a framework for entrepreneurship.

Training for an international and multicultural context

To increase international mobility, the responsible of the programme organises a collaboration with IAESTE (Association for The Exchange of Students for Technical Experience) to develop internships abroad and to negotiate a bilateral agreement with a selective choice of foreign universities. The number of incoming students is satisfactory, an average of 30% before the pandemic, while the outgoing mobility stays lower at about 15% on average. The majority of PhD students come from abroad, and they serve as teaching assistants during the lab sessions and seminars. International guest speakers are invited and international researchers contribute to the exposure of students to an international experience.

Sustainable development, social responsibility and ethics

Some elective courses are dedicated to this topic, a sub-set of these courses are compulsory for a minimum of 6 credits. Other compulsory courses include legal and privacy issues, ethics and security. The re-design of the bachelor's programme introduces new courses to increase attention on these topics. In the new programme, which will start in 2023, these topics will be spread through different technical courses and projects.

Educational engineering

For part of the mandatory courses, the teaching methods deepen the scientific topics through lectures, but are well balanced with practical situations through coaching exercises and generic projects. The transversality and multidisciplinary are developed through the Design Project and the master's thesis. Both put students in conditions very similar to their professional future. New active learning methods have been implemented. Students have to be well organised in order to face the multiple projects and deadlines every 2 weeks. However, some lecturers are more flexible and accept some delays. Before each semester, the teaching staff do their best to coordinate in order to avoid bottleneck in project delivery.

Students are supported by a dedicated association, EKA, which helps them to choose elective courses. In addition, a wiki collects the opinions from previous students on specific courses. A regular and open dialogue with the teaching staff is organized on demand to help students. The staff in charge of the study trajectory ensures the follow-up of the students.

The failure rate for the master of computer sciences engineering is 23,5% for the 2020-2021 academic year. Students who failed the exam received feedback from the lecturers.

The programme represents a good balance between in-depth scientific skills and state-of-the art technology, supported by the excellence of the laboratories. The current programme and the new curriculum proposal are really offering a good preparation for students for their professional future: long lasting design projects and transversal projects give the students a valuable experience and preview of how they will have to work on later in their careers. Nevertheless, the competencies approach could be better implemented in the new curriculum. The specific involvement and strategy of the staff to develop the internationalisation didn't produce the expected results yet, but the will is there. The sustainability and ethics are now embedded in the different courses, which was expected.

Summary analysis – MSc in Computer Science Engineering

Strengths:

- The programme evolutions are motivated by scientific improvement as well as market expectations;
- Active learning strategies are proposed in different courses;
- Effective transversal approach to handle topics (ethics/privacy/sustainability);
- Involvement of the staff in strengthening the internationalisation;
- Strong links with the local IMEC laboratory;
- Scientific skills are explicitly strengthened in a specific research project;
- The Design Project prepares to professional skills;
- High motivation and good communication of the teaching staff.

Weaknesses:

- High administration tasks for the teaching staff;
- Burden for students to handle multiple learning platforms.

Risks:

- N/A.

Opportunities:

- Rely on the competence based approach and learning outcomes to design the new programme;
- Improve the gender balance.

Master of Science in Electrical Engineering

The stability of the students' interest in this programme is questioned. The online nature of the teaching during the COVID-19 sanitary crisis has reduced the master's hardware natural visibility. The programme attracts annually about 30 students, mostly from Ghent. The student number depletion was induced by the introduction of a new programme at the faculty level and may suggest a saturation of local student sources.

The Study Programme Committee (SPC) is in charge of long-term evolutions, emerging subjects, programme evaluation and strategy to attract new students. The project is perfectly adapted to the targeted job market in terms of knowledge, skills and know-how. The introduction of 2 specializations, Electronic Circuit Systems (ECS) and Communication and Information Technology (CIT) clarified the offer. Feedback on the programme seems to exist from faculty contacts with recent alumni and the potential employers' pool. Cross-disciplinarity is mainly achieved during projects and during the master's thesis and could be improved.

The matrix crossing the expected competences, including the soft skills, with the programme units, is provided.

The programme consists of 60 ECTS credits of compulsory courses and 60 credits of elective ones, offering the possibility of a very wide personalization of the curriculum, subject to approval by the SPC. 18 credits clustering may be recognized as so-called 'minors' in the diploma supplement. The last term 24 credit thesis on a selected or self-proposed subject related to the main subject, is achieved under a supervisor's guidance and ends with an oral presentation. The syllabus is clear and structured and available internally and externally.

Programme implementation

Internships in companies are managed, supervised, assessed in terms of skills, and allow to earn ECTS credits. Industry representatives highlight the good preparation of the students to the labour market, attested by the strong demand by the industry and by the short time the new recruits need to achieve efficiency in a professional situation.

Lab work, industrial projects, exercises, and the internship (chosen by an average of 50% of the students), meet the companies' expectations, strengthened with an enlarged contribution of professionals from the economic sector to the teaching.

Research activities, innovation and entrepreneurship

The curriculum is strongly driven by the applied research activities of the 3 departments, providing human resources and equipment. The graduate employment including 1/3 in PhD programmes and 2/3 in industry, attests that the programme clearly proposes a good balance between an applied and industry-oriented focus (applied engineer) and research-based approach (conceptual engineer) with long-term objectives.

Training for an international and multicultural context

The number of international incoming students may be largely improved. Switching to teaching in English has not produced a significant effect so far. The outbound mobility, concerning today about 1/6 of students, is far below the average of the faculty and could be improved.

The second master's year is the optimal window for Erasmus+ exchanges but may be the only one. The international mobility of the teaching staff should also be encouraged.

Sustainable development, social responsibility and ethics

A new course has been introduced at the bachelor's level. Furthermore, these aspects are more and more omnipresent along the curriculum in a diffused mode, especially during the projects. The evaluation of the learning outcomes is not clear. It has been understood that the Flemish acceptance of Electrical Engineering does not include Energy Engineering.

Educational engineering

The pedagogical and evaluation methods used to gain technical and soft skills represent a significant variety of different and balanced teaching methods: classroom situation lecture, guided exercises, practical lab, hands-on learning and projects.

Nearly a third of the time is spent in a lecture.

The project objectives have significantly improved the soft skills acquisition, including the management of deadlines, team working, and reporting.

Some of the off-campus teaching and evaluation methods, including flipped-classroom techniques, introduced in the pandemic context, have been maintained.

Student life

A specific student branch of the student association exists for the Institute of Electrical and Electronical Engineering and is operating.

Student monitoring and failure management

The bottom-up communication from the students to the faculty may deserve improvement.

The participation in graduate employment surveys is only of 15,6%.

Employment

67 % of the graduates have found a job before graduation and it takes only few months for an additional 28%. Jobs are in fundamental and applied research, engineering, consulting and information systems management. Companies include 9% of start-ups and offer 18,2% of international positions. The employment is mainly for a junior/senior technical position with a

satisfactory salary level.

The expert panel appreciated the excellence of the scientific and technical objectives and careful balance between theory and practice.

Analysis summary – MSc in Electrical Engineering

Strengths:

- Good balance between industrial (practice) and academic (theoretical) objectives;
- The connexion between teaching and research in dedicated buildings with good facilities;
- Flexibility and possibility to personalise the programme gives students great satisfaction.

Weaknesses:

- The location of the programme is far away from the city center.
- A lack of women in the programme.

Risks:

- Stabilisation of the number of incoming students, as student local sources seem saturated;
- Decrease of the interest of students in hardware.

Opportunities:

- Additional cross-fertilization with other disciplines offering opportunities to bridge gaps with other fields;
- Overall enthusiasm to return on-site after the sanitary crisis and hardware contact;
- The good links with research offering opportunities of internships in international companies;
- Post sanitary crisis allowing to develop international mobility.

Master of Science in Electromechanical Engineering

The programme aims to train engineers in various engineering disciplines around the themes of motion, force and energy. The world of electromechanical engineering encompasses development, design, manufacturing, testing and control of tools, machines, vehicles and other electrical and mechanical systems, as well as research on these topics.

The programme offers an in-depth training in all aspects of Electromechanical Engineering and its economic and societal implications based on a profound scientific basis. Graduates will have acquired a know-how in scientific synthesis, analytical reasoning as well as a scientific and technical independency. These skills provide mastery in developing, implementing and monitoring technical and scientific innovations.

60 to 85 students per year enrol for this 2-year degree programme. The balance between electrical and mechanical engineering is really specific and a good asset.

The specific competences of the programme (M1.3-M1.10 and M6.12 and M6.13) are showing that the Master in Electromechanical Engineering encompasses the complete design process of machines and electromechanical systems. Attention is also paid to management, innovation and energy efficiency.

The two focal points of the master's programme are research and design. Graduates should be able to carry out independent research in the electromechanical engineering domain, and should be able to conceive, design, implement and maintain complex electromechanical systems.

The soft skills are integrated into different courses and projects starting during the bachelor's programme. The learning outcomes could be more explicit. The same applies to the skills regarding the carrying out of scientific research. Concerning project management only generalities are passed on. For the future there is a need to reinforce soft skills with a focus on project management and basics in economics.

The programme of 120 credits consists of a general module (36 credits), main subject modules (36 credits), elective courses (24 credits) and a master's dissertation (24 credits).

The general module contains courses on all subjects related to Electromechanical Engineering, ranging from Electrical Drives over Machine Manufacturing to Management Skills.

Students can choose one out of five main subject modules with specialist courses:

- Electrical Power Engineering (handles all aspects of generation, distribution and use of electrical energy);
- Mechanical Energy Engineering (concerns energy conversion and energy use in industrial equipment - thermal systems, engines, machines);
- Mechanical Construction for Equipment (focuses on design, manufacturing and maintenance of machines and mechanical equipment);
- Control Engineering and Automation (control and automation applied to mechanical and electrical systems and processes in general);
- Maritime Engineering (design, construction and operation of maritime systems such as ships and offshore constructions).

Through elective courses, students broaden their knowledge and skills in technical and non-technical subjects. The master's dissertation is a final step in the learning process. It aims at training the ability to independently perform scientific research.

The syllabus is available and the competence/course matrix also.

Programme implementation

Internships are proposed during the summer period (4 weeks for 4 credits and 6 weeks for 6 credits). It is possible for students to do their master's thesis together with and in a company. Globally only 30% of the students carry out an internship.

Research activities, innovation and entrepreneurship

Research competences are explicitly strengthened in the master's dissertation (24 credits). On top of this, the master's courses all focus on the latest research findings, including those of the team of the lecturers. For the master's dissertation, the students can pick one of the many topics (200+ offered every year) that are proposed by the lecturers of the Electromechanical Engineering programme, or they can suggest a self-proposed topic.

Training for an international and multicultural context.

Students and teaching staff have a limited international mobility. The programme has difficulties in setting up Erasmus+ programmes with foreign universities. For Erasmus+ programmes a screening was done by the international relations officer and non-active agreements were cancelled, so more focus could be given to more active programmes.

Agreements have been signed with foreign universities, but common courses have to be developed to install student exchanges. The action should be continued.

Educational engineering

Lectures come first for more than 50% followed by seminars. Only 15% of projects and 10% of practical exercises are used. There is a need to develop more project-oriented teaching.

On-line courses have been developed.

Assessment of results

The assessment of competences is not yet developed. But the Electromechanical course aims at testing it.

Analysis summary – MSc Electromechanical Engineering

Strengths:

- A fundamentally good programme that combines electrotechnical and mechanical disciplines;
- The attractiveness of the programme demonstrated by the number of students;
- A well-constructed learning outcomes and competence based model.

Weaknesses:

- The low ratio of students doing internships and the decrease since 2016;
- The low internationalisation of this MSc (outgoing and incoming student mobility);
- Soft skills are insufficiently explicitly represented and visible in the curriculum (focus on project management and basics in economics).

Risks:

- N/A.

Opportunities:

- Reunification of all the research laboratories on the Ardoyen campus.

Master of Science in Engineering Physics

The Master of Science in Engineering Physics aims to give a wide knowledge in different fields relevant to physics: nanoscale materials, nanoelectronic devices, thin films, electronic and photonics, quantum optics, plasma and fusion technologies. In this respect, the programme develops both the pragmatic reasoning as well as the manipulation of complex systems.

The programme offers in-depth training in all aspects of engineering physics and its economic and societal implications based on a profound scientific basis. Students should be able to develop a sufficient maturity to be able to develop, implement and monitor technical and scientific innovations. 38 to 41 students are registered in this 2-year programme.

Since the last CTI evaluation in 2016, the physics programme has been strongly modified and clarified as recommended. In particular, the students have to choose 5 topics amongst 8 key topics that have been defined according to the European roadmap on physics. As a result of the previous guidelines for improvement and thanks to interactions between faculty and industry, all courses are nowadays part of consistent learning pathways towards 8 key topics; all courses related to physics & engineering.

With the definition of 8 key topics (instead of a list of multiple-choice modules), the recommendations raised in 2016 have been answered and since 2018, a new master's programme has been implemented accordingly.

For the Master of Science in Engineering Physics, three specific competences have been added to the generic competences, namely:

- 1-3: Possess the broad scientific knowledge, insight, and skills to analyse, model analytically and numerically, specify, design, and test experimentally, systems that are a direct application of the fundamentals of physics.

1-4: Have a thorough understanding of the most important physical theories (logical and mathematical structure, experimental support, known physical phenomena and applications), and the skills to engineer innovative applications in the areas: composition of matter from subatomic to molecular and macroscopic scale, states of matter and their transitions, semiconductors, and wave physics.

1-5: Have a thorough, in depth scientific knowledge, insight and engineering skills in several of the following areas: nanoscale materials, nano-electronics, complexity and criticality, thin films, advanced electronic and photonic devices, quantum optics, wave physics in living matter, and plasma technology.

Another competence has been added to the intellectual competences, namely:

3-6: Application-oriented reflecting on new physical insights and physical discoveries”.

These additions show the ambition of the programme to offer a complete overview of the current fields of interest in engineering physics.

The focal point of the master's programme is research. Graduates should be able to innovate and develop existing or new systems/products/machines/materials.

Additional courses on soft skills have been added in a new project course called Engineering Physics and Industry.

The competence-based approach is not completely assimilated by students: an effort should be made to better explain in advance the “why” of the courses and the structure of the programme.

The programme of 120 credits consists of:

- 42 credits in general and mandatory courses;
- 48 credits in elective courses divided into: specialized courses in the Master in Engineering Physics (30 credits), 5 topics amongst 8 key topics chosen by the students, elective social courses (6 credits), elective courses from Ghent University (12 credits);
- 6 credits on a project course Engineering Physics and Industry (1st year of the MSc) where the focus is on entrepreneurship and sustainability;
- 24 credits for the master's dissertation.

The general courses contain various subjects related to Engineering Physics, ranging from Maths, Physical Chemistry, Computing, to Nuclear Physics, Physics of Semiconductors and the link between Engineering Physics and Innovation.

The specialized courses on key topics in Engineering Physics are designed in such a way that the students who follow these courses are taught during 60 hours on one topic. A small number of credits is dedicated to non-scientific topics.

The competence/course matrix is available on the website.

Programme implementation

Internships are part of the elective courses. It is possible for students to do the internships abroad: 90 h (about 3 weeks – 3 ECTS) to 180 h (about 6 weeks – 6 ECTS).

Research activities, innovation and entrepreneurship training

Research competences are explicitly strengthened in the master's dissertation (24 credits). On top of this, the master's courses all focus on the latest research findings. For the master's dissertation, the students are proposed topics that are developed by the research groups at the university. Entrepreneurship is treated in the project course Engineering Physics and Industry.

Training for an international and multicultural context

There is no specific training to a multicultural, intercultural context to prepare the students for international openness. There are also very little outgoing students due to the restrictive requirements that oblige students to choose modules in the host institution that exactly replace the modules they could not follow at UGent. For foreign candidates to follow the master's programme, the background requirements can be dissuasive for students.

Sustainable development, social responsibility and ethics

Compulsory and elective courses are dedicated to this topic.

Educational engineering

Lectures come first, followed by seminars (tutorials). Project and practical work are also used.

Student monitoring / failure management, employment

The table below indicates that the number of graduates is lower than the number of students in the second year. One reason is the duration of the MSc thesis, which can go beyond the end of the academic year.

Academic year	First year	Second year	Number of graduates
2020 - 2021	14	27	22
2019 - 2020	21	20	13

Summary analysis – Master of Science in Engineering Physics

Strengths:

- Content of the programme was improved / reorganized;
- Unique programme in Flanders;
- High quality thesis reports;
- Use of social networks to keep track of the alumni;
- Yearly Engineering Physics Event with the stakeholders;
- Global balance of the programme between the different methods (teaching, internships, and projects).

Weaknesses:

- Only a small number of female students;
- Digital learning is insufficient;
- The competence-based approach is not completely assimilated by the students;
- Perception of the students that the focus on entrepreneurship and sustainability is not strong enough in the master's programme.

Risks:

- N/A.

Opportunities:

- As a lot of digital material exists since the sanitary crisis, new learning methods could be considered for the future, but should be implemented in a structured way.

MSc in Fire Safety Engineering (MSFSE)

International MSc in Fire Safety Engineering (IMFSE)

The Master of Science in Fire Safety Engineering (MSFSE) and the International Master of Science in Fire Safety Engineering (IMFSE) aim at providing “a top-notch education for graduates to emerge as leading experts in the field of Fire Safety Engineering.” In the IMFSE, students spend the second semester at Lund University (Sweden). Even if the MFSE programme attracts many students from abroad, mobility is not systematic.

The programmes fit the needs of industry and as such, the demand is not likely to decrease in the future.

Both programmes are unique, because they encompass all aspects of fire safety engineering and thus attract students from all over the world. Over the years, students from more than 80 nationalities attended courses in both programmes.

To support administrative issues, a dedicated staff was hired and financed thanks to EU funding that provided also scholarships for the students.

Since the EU funding is of limited duration, significant efforts have been made since the previous evaluation procedure in order to secure scholarship funding by sponsorship from private companies.

Currently, respectively 15 and 25 students are enrolled for the IMFSE the MFSE programmes. Students from Ghent (1 or 2 per year) are admitted to this master's upon completion of a Bachelor's programme in Electromechanical Engineering.

In order to compensate for the variety of programmes followed by the students prior to enrolling for the IMFSE, two tracks are proposed, according to the profile and prior knowledge of the students.

The MFSE programme started in 2015 and was evaluated before. Both programmes now include:

- More Safety and Fire Engineering related courses taught by the academic staff of the Department of Structural Engineering and Building Materials. This specific point is in answer to the lack of courses on structural behaviour pointed out in the previous assessment;
- The addition of a course on Data Driven Management of Fire Incidents, taking advantage of the modern evolution towards the use of big data;
- The replacement of a course on Project Management by a basic course on Structural Mechanics.

The Industrial Advisory Board helps keeping the objectives and learning outcomes of the programmes in line with the needs of industry. All these interactions translate into a good job placement of the graduates.

Curriculum: programme outcomes and learning outcomes

Both programmes illustrate theory with lab experiments and real-life case studies. The competences addressed by both programmes are in one or more scientific disciplines, intellectual competences, collaboration and communication, as well as in social responsibility, and professional skills.

Programme implementation

The first semester of the MFSE lasts longer than the first semester of the IMFSE, because the local master's programme starts earlier. IMFSE students are awarded 30 credits in 8 weeks of teaching + 2 weeks of examination. This short duration implies a high workload for IMFSE students.

Internships are very difficult to implement because of the administrative difficulties encountered by international students.

Active teaching (project work) is implemented. However, there are apparently no intermediate evaluations to check progress towards achievement, and students are sometimes lost with

managing in parallel too many demanding projects. Even if it is true that multiple project management is part of the professional life, as mentioned by one of the industrial representatives attending the panel, this is generally not done in “one shot” where only a final assessment is made. It would be useful if the teaching staff set up intermediate deadlines to check the progress made and guide students in their work.

This difficulty was in particular stressed in the Master of Fire Safety Engineering, where the 1st semester of the programme is shortened (from approx. 3.5 months to 2.5 months) due to exchanges with other institutions and faculties.

The link with industry is strong, as exemplified with several courses taught by professionals and the close interaction with alumni.

Training for an international and multicultural context

These masters’ programmes represent a good training for the international and multicultural context since most students come from abroad. Students appreciate this international aspect very much, as emphasised by some who declared that they resent the sorrow of separation when the students of the IMFSE leave for the second semester to Lund.

Sustainable development

Although the teaching staff and faculty managers often mentioned sustainability in relation with the programmes, there is no dedicated course nor dedicated teaching staff for this topic.

Educational engineering

The availability of the teaching staff, the speed with which they answer the questions they receive by e-mails, their will to see the students succeed, have been pointed out by students as well as alumni.

Several lecturers are international researchers (which leads to a significant percentage of students continuing with doctoral studies), whereas others are entrepreneurs.

The students receive a lot of extra information in addition to the taught subjects, which will be available for use in their future career.

There is a good balance between exams at the end of the semesters and assignments given during the year.

As for all programmes, the faculty provides special assistance for students with disabilities.

The Master of Fire Safety Engineering hired an employee to coordinate all activities and counselling for the international students. Especially Erasmus Mundus Masters’ programmes may need to adapt their active learning practices to limitations imposed by the internationalisation of the programme (lack of experimental work in the Textile European Master, and a semester too short and dense for the MSc in Fire Safety Engineering).

Analysis summary – MSFSE and IMFSE

Strengths:

- An excellent link to companies (courses taught by professionals, close interaction with alumni);
- The degree leads to good and numerous jobs offers in the field;
- A good gender balance (40% female students);
- An administrative staff dedicated to student’s integration, housing, visa issues, organization of courses.

Weaknesses:

- Organization of the first semester leading to a high workload for the students;
- Management of project-based learning without monitoring of the intermediate deadlines.

Risks:

- Loss of European programme funding threaten scholarships for incoming international students;
- Visa issues for students from some countries.

Opportunities:

- Active learning implemented in the programme;
- Contact with many students from all over the world enabling the students to understand different ways of thinking, culturally and technically speaking.

Master of Science in Industrial Engineering & Operations Research

The MSc in Industrial Engineering & Operations Research (IE/OR) has a highly scientific dimension, with strong and concrete industrial links all along the programme. Graduate profiles are highly in demand by supply chain and production management sectors of employment.

The 120 ECTS programme includes compulsory general courses (38 ECTS). As a track, one main subject (30 ECTS) is to be chosen between Manufacturing & Supply Chain and Transport & Mobility. In 2021, the Faculty Board approved the creation of a Sustainable Mobility Analytics track for 2022-23 thanks to the European Institute of Innovation and Technology (EIT) consortium on Urban Mobility. Flexibility is ensured, with a large number of electives. 15 ECTS are for in-depth electives, 15 ECTS for broadening electives, to be selected from other MSc level courses of the faculty, including an optional credited summer internship. A 24 ECTS MSc thesis concludes the programme.

A competence coverage matrix, including the UGent engineering profile and specificities of this MSc outcomes, serves as an instrument for quality enhancement. This matrix may serve to constructively align the proficiency levels thanks to a competence-based assessment, including the elective courses. The SPC meets on a regular basis (e.g. May, October, December in 2021). Accordingly, very frequent yearly updates on courses are made. Course-level feedbacks are shared via the OASIS platform. Programme-level feedback is managed by the Department of Education Policy of the faculty.

Curriculum: programme outcomes and learning outcomes

The programme-specific competencies comply with the Flemish framework and the CTI requirements. The programme outcomes and course learning outcomes follow the UGent FEA educational principles, with shared outcomes and specific IE/OR outcomes. According to the two existing tracks, the general curriculum structure is somehow confusing as non-homogeneous for a same degree. The elective disparity in volume and semester organization between tracks adds complexity in the curriculum architecture. Harmonization of the two, if not three (cf. expected SMA track) curriculum architectures may facilitate the overall IO/ER programme consistency, and facilitate the credit allocation.

Programme content

Incoming student background is not specifically IE/OR oriented, core courses predominate and limit the broadening perspectives. Since 2019, elective courses were reinforced to offer students more flexibility in their learning path. There are 30 credits of electives. In the in-depth electives, a minor can be selected, in either Artificial Intelligence since 2020-21 or Automotive Production

Engineering. Under approval by the SPC, new electives can be added dynamically to the offers (e.g. Investment Analysis in 2021), or suppressed depending on the needs, constraints, or topical overlaps.

Programme implementation

The number of students engaging in an internship is somehow homogenous and quite moderate since 2015-16 (35%), except for a decrease due to the sanitary crisis in 2020-21. Internships are considered as a broadening elective. In October 2021, company internships of 3 ECTS were formalized as being no longer valid. There is also now a possibility to take a research internship of 3 to 6 credits, in either an UGent Lab or external research institute.

An MSc thesis of 24 ECTS takes over two semesters, with subjects mainly proposed by departmental professors. On average, 25% of second year students engage in a master's thesis subject in cooperation with a company. PhD enrolment in UGent Labs after graduation remains low (around 1 per year). A first semester core course on Engineering Economy was introduced since the previous CTI evaluation to expose students to innovation and business concerns. The new EU EIT International Master School may add some more focus on innovation & entrepreneurship.

Training for an international and multicultural context

The IE/OR is taught in English and open to international students. The B2-level is compulsory for enrolment. Some broadening electives are still taught in Flemish. Project courses in teams, as well as some extra-curricular activities, enable a mixed national and international student population to reinforce the multicultural dimensions and skills. Erasmus+ exchanges take place during the first M2 semester.

Sustainable development

A final questionnaire on programme evaluation allows to identify the acceptance of graduate students on the sustainability approach of the programme. Outcomes linked to sustainability, energy efficiency, or environmental cost, are mainly covered by the newly integrated core course on Engineering Economics.

Educational engineering

Courses regularly balance theory and practice. Several pedagogical models are applied, ranging from lectures, seminars, coached exercises, group work, self-reliant or guided self-study activities. On both tracks, for core course and in-depth electives, around 40% of teaching is dedicated to lectures, 35% to seminars, including professional conferences and coached exercises (20% of the total). Less than 6% of course contents rely on group works and direct projects. Full project-based learning courses may be introduced in the curriculum structure to meet specific outcomes of the graduates' profile.

Student monitoring / failure management

An issue is the high scientific level of the programme for incoming students, especially for foreign students with a heterogeneous background. A preparatory programme is available for students (e.g. Bachelor or MSc in other engineering areas or from maths, physics, and informatics profiles). A BSc-level core course Algorithms & Data Structures (6 ECTS) has been introduced in semester 2 of the first year. In 2022-23, a new Algorithmic Programming course (AIPro, 4 ECTS) will take the replacement, with hands-on programming exercises via the Python language.

The overall atmosphere facilitates interactions between students and faculty staff. Given the diversity of the backgrounds of the incoming students and cultural and learning issues, student workloads in courses are to be analysed more finely.

Assessment of results

Assessment models mostly rely on written examinations with open questions, reports, assignments, and oral examinations. The level of peer assessment, participation and simulation assessment is lower.

Student selection and admission

In the 2021-2022 academic year, 20 new students joined the programme (22 new students in 2019-2020, 31 in 2020-2021): 9 from UGent BSc of Engineering, 3 from UGent MSc of Engineering Technology and 8 international students. The unbalanced student gender ratio (4:16) is somehow reflected in the faculty permanent teaching staff.

The IE/OR MSc is accessible to students from all BSc programmes in Engineering Sciences. The low IE/OR visibility in UGent undergraduate courses impacts the IE/OR MSc attractiveness.

Graduate Employment

There is an excellent employment rate and recognition of graduate profiles. Alumni find positions in supply chain consulting, as project managers, or process engineers. Graduates end up in very diverse sectors. Students receive many interesting job offers even before graduating, at regional, national and international levels.

There is a lack of persistent links with alumni a few years after their graduation. The long-term engagement of the alumni association and its potential connections with the student organizations (VTK and ORLean) could be reinforced apart from the IE/OR Industry Day (since 2018) or guest lecturers. The analysis and potential optimization in the student inflow and outflow and employability could be reinforced also given the diversity of the student population.

According to the previous CTI guidelines for improvement, the identified strengths have been maintained; the programme revisions according to the SPC and advisory boards remain reactive; the balance between part-time and full-time lecturers is efficient regarding the variety of expertise; the outstanding employment rates remain for the discipline. Due to its high scientific level, foreign students still have difficulties in the first year. The increasing number and variety of student applications adds some pressure on the screening and selection process. The potential ambiguity of the programme identifiers limits its visibility, especially for companies and potential incoming students.

Analysis summary – MSc Industrial Engineering & Operations Research

Strengths:

- Timely relevant programme with concrete industrial and company links;
- Flexibility offered in the curricula, with broadening electives;
- Diversity of incoming student's sources.

Weaknesses:

- Low IE/OR visibility in the UGent BSc undergraduate community, impacting attractiveness;
- Curriculum organization and clarity insufficient, with different curriculum structures depending on tracks;
- Few students to take the new Transport and Mobility track.

Risks:

- Graduate skill profile opacity between tracks and elective choices.

Opportunities:

- Transfer large Project Based Learning course models from other UGent MSc programmes.

Master of Science in Sustainable Materials Engineering

The Master of Science in Sustainable Materials Engineering aims to give a wide knowledge in different materials, especially metals, polymers and textiles, and to a small extent composites and ceramics. It goes from their extraction or production towards their use and recycling. There are two majors in the program: Metal Science and Engineering, and Polymer and Fibre Engineering. More or less 30 students are enrolled in this 2-year program.

The programme offers the students a good knowledge of the structure and properties of materials and on processing methods, together with a sensitization on the environmental issues (use of resources, waste management). Graduates should be able to design and optimize production methods while respecting the sustainable development principles.

Curriculum: programme outcomes and learning outcomes

All competences are described in 6 categories. Some are shared with the other MSc in Engineering programmes. Some competences are specific competences to this master's programme. The 1-4 to 1-6 competences concern specifically the applications and properties of materials. The 1-7 to 1-10 and 1-11 to 1-14 competences are specific to each major. These competences seem very close; they only differ by their application to either metals or polymers.

In the scientific competences, 3 items (2-6 to 2-8) have been added.

In the intellectual competences, 2 items (3-6 and 3-7) have been added.

In the competences in cooperation and communication, 2 items (3-5 and 3-6) have been added.

In the social competences, 1 item (5-4) has been added.

These additions show the concern of the programme to offer a complete overview of the current fields of interest in sustainable materials engineering. The focal point of the master's programme is research. Graduates should be able to innovate and develop existing or new systems/products/machines/materials.

Programme content

The programme of 120 credits consists of 4 parts:

- 36 credits of general courses,
- Compulsory credits:
 - 42 credits in Metal Science and Engineering;
 - 36 credits in Polymers and Fibre Engineering

Elective credits:

- 18 credits in Metal Science and Engineering
- 24 credits in Polymers and Fibre Engineering
- 24 credits for a master's dissertation.

The general courses contain various subjects related to Materials Science, ranging from Thermodynamics, Mechanical Properties, Structure of Polymers, Microstructural and Structural Characterisation of Materials, Polymer Processing and Composites. The compulsory courses on metals deal with the production of raw materials (extraction, recycling), the properties of metals, some computer simulation of structures or properties. The compulsory courses on polymers and textiles or composites focus on understanding the properties of these materials and on designing polymers with specific characteristics (flame retardant, antibacterial and so on).

With the elective courses gathered in clusters, the students can deepen their knowledge in different fields: materials, biomaterials, chemistry, ecology, factory, nano and smart materials. A small number of credits is dedicated to non-scientific topics.

Programme implementation

Internships are part of the elective courses. Although internships in industry are not compulsory, between 60 % and 75 % of the students carry out an internship in industry. There is the possibility for the students to do these internships abroad.

Research activities, innovation and entrepreneurship training

The master's courses all focus on the latest research findings. For the master's dissertation, many subjects are proposed by the professors of this master's programme and the students can propose their own subject.

Nothing concerns innovation and entrepreneurship. If students want to know about business in general, they will have to take extra-curricular courses or follow another master's programme.

Training for an international and multicultural context

There is no specific training to a multicultural, intercultural context to prepare the students for international openness. There are also very little outgoing students due to the restrictive requirements that oblige students to choose modules in the host institution that exactly replace the modules that they could not follow at UGent. For foreign candidates to follow the master's programme, the background requirements can be deterrent for the students.

Sustainable development

Following the former guidelines for improvement to include more sustainability in the courses, there has been a profound revision of the curricula starting at the bachelor's level to introduce these concepts. The bachelor's programme includes 18 credits on fundamentals on sustainability since 2020.

On top of that, sustainability is implemented in various master's courses. In this respect, the guidelines for improvement have been implemented.

Educational engineering

Lectures come first, followed by practical training, tutorials, and projects.

Student monitoring / failure management, employment

The table below indicates that the number of graduates is lower than the number of students in the second year. One reason is the duration of the MSc thesis which can go beyond the end of the academic year (see table from the SER below):

Academic year	First year	Second year	Number of graduates
2020 - 2021	14	16	12
2019 - 2020	14	17	15

Assessment of results

Most of the courses are described in terms of competences. The evaluation of the learning outcomes is done for some courses and needs to be continued for other courses.

Analysis summary – MSc Sustainable Materials Engineering

Strengths:

- Broad programme dealing with metals and polymers;
- Informal links between alumni and the teaching staff;
- New sustainability courses are present in the BSc programme (18 ECTS) and implemented in the MSc courses;
- Good ratio of student internships in industry;
- Steering committee with teaching staff from chemical, metallurgical, polymers and textile engineering to define/modify the academic programme.

Weaknesses:

- Low intake of foreign students for graduating in the MSc programme.

Risks:

- N/A.

Opportunities:

- N/A.

International Master in Textile Engineering

The number of students enrolled for textile engineering is low.

The initial engineering training programmes include multidisciplinary academic courses, technological courses and periods of training in a professional environment. The programme includes fundamental or applied research activities. The textile engineering programme is undergoing a full conversion from master's to international master's EMJMD (Erasmus Mundus Joint master's degree). The targeted student population is defined by diversity in order to match the international characteristics of the programme. Scholarships are budgeted for the coming years (till 2025-2026). The focus is on providing a diversified and international study programme.

The educational project meets a significant mix of scientific, technical, industrial and organisational skills from one or more professional sectors and from society. The target job market is national and international and aims at a wide textile-based industrial target. The textile industry is very global/international. The balance between theoretical lectures and laboratory/practical work could be improved. The textile industry is a process-based sector.

Curriculum: programme outcomes and learning outcomes

There are no common courses with MSc sustainable materials engineering, although 3 courses share common contents and are taught by the same professor (Polymer Technology, Dyeing and Intelligent Textiles). The courses in WE-TEAM (World Textile Engineering Advanced Master) are taught in one week and don't have practical (lab) sessions.

The Co-Creation course is common with the university wide elective course, which is also a compulsory course in the programme of Industrial Design Engineering.

The textile engineering master's degree is a stand-alone programme.

Internships are offered and even if not mandatory, they are being done and get good feed-back.

Training for an international and multicultural context

The international dimension of the programme is quite clear. In fact, it comes across as the main feature of the textile master's degree. It enables students to experience with multicultural, intercultural, and linguistic learning and ensures their international mobility. Because of the low number of students and scholarships, the sponsoring is guaranteed, but budgeting is only available

until 2025-2026.

Foreign students are taken well care of through social structures, networking and activities.

Sustainable development

The master's degree in textile engineering does not clearly demonstrate a focus on sustainable development.

Educational engineering

The international set-up of the master's degree in textile engineering results in a very theoretical approach of learning. Maybe the logistics of the several locations make it hard to organize but a more practical focus should be developed in the syllabus.

Student life

The school has a strong focus on the well-being of the students, in particular the international students. A 'family'-type approach is implemented, including interactions with academic staff after working hours on a social basis.

Student monitoring

Because of the scattered locations of the students, the monitoring is not controlled, some data regarding international students are not available at UGent.

Students and alumni provide positive feed-back on the value of the programme from both a technical and a cultural point of view. The international organisation of this programme requires a lot of administrative support from the university and seems to represent a financial challenge for its long-term existence under its current organization.

Analysis summary – International Master in Textile Engineering

Strengths:

- Strong interaction between students and the teaching staff;
- Mutual support across local and international students;
- Well-coordinated activities;
- Well balanced technical programme (courses): works well with different student backgrounds;
- Previous recommended corrective actions by CTI on sustainability are implemented;
- Diversity.

Weaknesses:

- Not enough balance between practical lab work and project work with ex-cathedra lectures;
- Insufficient interactions with industry;
- Sequence of courses not always logical, because essentially based on teaching staff availability.

Risks:

- Long term existence of the programme with a maximum of 25 students per year;
- Composition of a student body from different backgrounds;
- Needs a lot of administration/coordination.

Opportunities:

- Develop cross fertilization;
- Capitalize the international character by attracting world-wide industries.

Master of Science in Bioinformatics – Engineering track

The Master of Science in Bioinformatics started in 2015. It is distributed over three faculties and contains three tracks. The track Engineering in the Faculty of Engineering and Architecture is evaluated in this procedure by the CTI and this is its first such evaluation.

The Engineering track aims at “training bioinformatics software engineers who can develop on an independent basis new algorithms and complex software implementations to improve current techniques or to respond to new developments in the domain of bioinformatics and systems biology.”

The competences addressed by the Engineering track of Bioinformatics are in one or more scientific disciplines and include professional, teamworking and communication skills as well as capacities in social responsibility.

The programme is open to students with a BSc in Computer Science Engineering or Computer Science; no background in biology is requested. The programme provides students with the knowledge to understand data-driven biological problems.

The number of students in this track is still small and, since the programme is so young, there are even fewer graduates. Most of the graduates continue on a PhD track.

The primary goal of the engineering track is aimed at training professional computer scientists capable of solving computational problems in biology and related fields. This requires not only skills in computer science, but also in understanding the problems to be solved and communicating with the professionals in biology working on solving them.

The Engineering track is aimed at training bioinformatics software engineers who can develop on an independent basis new algorithms and complex software implementations to improve current techniques or to respond to new developments in the domain of bioinformatics and systems biology.

The general objective of the master's programme is to provide students with the scientific knowledge, skills, know-how and insights that enable them to function professionally and value-conscious in the domain of bioinformatics as well as in a broader context of biotechnology and engineering. Holders of the Master of Science in Bioinformatics degree are capable of critically using existing knowledge generated from scientific research to make improvements and to contribute in an original and innovative manner to the knowledge society.

The programme provides an excellent balance between engineering, scientific and communication skills, all of which are important in this field.

The study programme starts with basic courses in cellular and molecular biology to familiarize students, who mostly do not have a background in biology, with this subject. It then presents several courses in the biology-related aspects of mathematics and computer science: Bioinformatics, Statistical Genomics, Machine Learning, Distributed Systems and Optimisation Techniques. A Design Project introduces students to work in heterogeneous teams and shows them how theoretical knowledge can be applied in practical settings. One fifth of the programme consists of elective courses and the master's dissertation project counts for a quarter.

There is no compulsory course in Computer and Data Security. Given the sensitive nature of data used in most projects, this is an issue according to the expert panel.

Programme implementation

The programme specifically targets students coming from different disciplines by bringing them up to date in the areas they are unfamiliar with. The teaching staff manages to do this by leveraging courses already taught within the participating faculties, so the investment in providing these targeted programmes is relatively low. As a result, the curriculum can also be used for students from other universities in Belgium or abroad. The programme depends heavily on project work which introduces students to teamwork in groups of people with heterogeneous skills.

Research activities, innovation and entrepreneurship training

The students receive an excellent education since researchers are part of the teaching staff and most students currently enrol for a PhD after graduation. There is not much evidence of training for entrepreneurship.

Training for an international and multicultural context

The programme is conceived for international students. The attention given by the staff to individual students contributes to their integration. The programme outcomes are suitable for an international context.

Sustainable development, social responsibility and ethics

Computer Science applied to research in the field of biology, pharmacy or medicine, almost always involves handling confidential and/or sensitive data. The course currently does not teach a mandatory course in Data Security, but most students do take an elective course in security.

Educational engineering

The programme provides a good balance between theory, project work, collaboration skills and presentations skills. Students are well prepared for a career in bioinformatics. As the UGent campus is being reorganized, students need to commute regularly between classes taught in different locations. This will probably be resolved in the near future.

Student guidance and programme completion

Given the small number of students, monitoring can still take place in a fairly informal setting. The evidence suggests that students are monitored quite intensively and problems are laid bare earlier rather than later. This is very well, but the programme should prepare for a future increase in student numbers.

The expert panel concludes that Bioinformatics is an excellent addition to UGent's educational offer. It covers an area that is in high demand and many of the relevant industries are located nearby. The expert panel values the curriculum and the way in which it is executed. Students are enthusiastic and report good levels of participation in the programme and the curriculum. The fact that no attempt is made to homogenize the student group, but instead preserves their individual backgrounds, is laudable. Concerns raised of bioinformatics not being a proper engineering master's education are unfounded according to the expert panel. Students participate in a range of projects that challenge their engineering skills; these compensate for any perceived lack in specific engineering courses.

A large fraction of the students opts for enrolling for a PhD after their master's degree. Although half of the scholarships are for applied (rather than fundamental) research, the programme should watch out to not lose its relevance with industry.

The choice of electives is vast in order to achieve the "broad and in-depth education" claimed by the faculty. However, a more limited choice of electives could target either advanced science courses related to the curriculum or courses developing soft skills. Currently, soft skills are acquired mostly through 3 collective presentations.

Analysis summary – MSc Bioinformatics – Engineering track

Strengths

- Well-balanced curriculum at the intersection of three faculties;
- The curriculum has the flexibility to enrol students from outside the faculty and abroad;
- The programme is small enough so that all students know the staff and vice versa. This leads to instant quality control.

Weaknesses

- There is no compulsory course in computer and data security.

Risks

- A large fraction of the students opts for doing a PhD after their master's studies. The programme should watch out to not lose its relevance with industry.

Opportunities

- The expert panel wonders whether this unique interdisciplinary programme could be extended or broadened further to create, as it were, pharma informatics, medic informatics, molecular informatics, etc.

European Master in Nuclear Fusion and Engineering Physics

The European Master of Science in Nuclear Fusion and Engineering Physics (EMNFEP) is a programme offered jointly by seven European universities. Students enrolled in the programme choose two partner institutions and combine a curriculum following their personal interests. Part of these courses are specific to the topic 'fusion', while other electives can be picked from relevant courses of the regular programmes at the partner universities. Each partner acknowledges the study credits obtained in their partner's programme.

The programme is sponsored by a European grant until 2024. Its typical intake is 15-20 students per year for the whole programme, most of them come from outside the European Union. Of these, typically 5 are expected to choose UGent as their principal enrolment. UGent offers two courses on Plasma Technology and MHD (Magnetohydrodynamics). About half of their content is fusion-oriented, i.e. 6 EC equivalent. Next to that, UGent offers four Physics and Engineering courses that are part of the compulsory programme of the EMNFEP students.

The UGent-contribution to the European programme cannot be meaningfully assessed on its own; all courses fall under the normal didactic philosophy of the UGent engineering department, and so, they are being assessed by others. The expert panel deems it impossible to apply the criteria to the two half-courses that are specific to Fusion Physics and Engineering which constitute the core of the UGent part of the EMNFEP programme.

It is important to state that this is not to be read as a disqualification in any way. Indeed, many aspects of the programme are appealing: its intake is highly international, the programme is European by nature, the students travel and have access to EU research facilities, there is ample attention for language and culture, there is a varied course offer, hands-on workshops and lectures by specialist guest lecturers, etc. The alumni are very positive about the flexibility of the programme, that can be bent towards theory, practice or engineering according to the interests of the student. The students are very positive about the involved teaching staff, who are dedicated specialists in their field, with an outstanding staff-student ratio.

Curriculum: programme outcomes and learning outcomes

The programme defines intended learning outcomes. The panel advises UGent to revisit these. The present list is a mix of learning outcomes of the EMNFEP as a whole and those of the part of the European programme UGent offers. It would be much clearer if the list was focused on the UGent courses only, so that a 1-to-1 relationship between the learning goals and the taught programme can be established.

The cross-reference table provided is not acceptable in the present form; the table is empty for the two courses that are fusion-specific, some competencies are not addressed, competencies are cross-referenced to very few courses, almost all competences being achieved by the course Plasma Physics.

The cross-table should be reworked much more carefully. Having to base the assessment on the material provided, the expert panel can only conclude that the relationship between learning outcomes and the programme is lacking.

Programme content

From the two courses with fusion-specific content, one is taught by a variety of specialist guest lecturers. The expert panel has not seen the course material. The panel has spoken to the responsible lecturer and expects the course to be very well structured. But it did not have information on the teaching methods, the variation between ex-cathedra teaching, flipped classroom, hands-on work etc. The second one (MHD of plasmas) is new. It has not been taught yet and is still being designed.

Apart from this, it was observed that the programme offered at UGent has a strong emphasis on physics. Concerning the programme:

- It could be expanded with more engineering courses;
- In the 'non-fusion' courses, real-life examples from the fusion field could be integrated, to increase the relevance for fusion students;
- There could be more electives that are highly relevant for fusion, such as Robotics, Advanced Control, etc.;
- In general, the panel noted that the contribution of UGent to the EMNFEP is strongly physics centred. There appears to be an attractive opportunity to diversify, as the programme is embedded in a strong engineering department. Seeing that the fusion field needs engineers (more than physicists) this would be seen as a good development.

Programme implementation

The programme is implemented at the level of the European master's programme.

The programme offers good access to the European research laboratories. Links with industrial partners appear to be rare. The field work for the graduates of the programme is mainly offered by research organizations and much less by specialized industry.

Research activities, innovation and entrepreneurship training

The programme offered at UGent, including the internship (which is generally abroad) offers the students ample opportunity to be immersed in 'live' research activities. It provides easy access to the major European fusion laboratories with their (often large) experiments.

Neither the EFMSEP as a whole, nor the UGent contribution to the programme, include training in the field of innovation and business or setting up of a company. None of the competences that are related to these activities have a single cross in the cross-reference table provided.

Training for an international and multicultural context

The EFMSEP is clearly outstanding in this aspect, as well as the UGent-contribution to it.

Sustainable development, social responsibility and ethics

The programme, being centred on nuclear fusion as a sustainable energy source, does pay attention to climate change, the energy transition, and the technological aspects thereof, although this is not a major topic.

The programme does not appear to pay attention to (scientific) ethics in an explicit or dedicated manner. The cross-reference table has one cross in the related competence, in the course Continuum Mechanics. But no dedicated programme elements are directed at this competence as far as the panel knows. This is a missed opportunity, since nuclear fusion is a nuclear technology that aims at contributing to the mitigation of the existential challenge of humanity: climate change. There is ample room to have this conversation with students.

Educational engineering

The way the programme is delivered at UGent does not appear to be innovative in its educational approach. In none of the material provided did the educational approach come up. On the other hand, with the outstanding staff-to-student ratio the students have such direct access to world-class specialists that the teaching methods may be less significant than direct interaction.

An issue that was brought up by the students is that the programme takes in students with diverse disciplinary backgrounds. As a result, the level of difficulty of the courses, in particular the physics courses at UGent, is perceived differently by the students. They suggest that early in the programme a process should be implemented aimed at reducing the level differences between students.

Student life

It was remarked by the staff that the integration of the (international) students with the local student population should be improved. One way to do this is to make sure the working language in the 'cross-course' project is English.

Student monitoring / failure management, employment

It's a small programme, the few students are well looked after. The graduates find good positions, the majority (70%) as PhD-students.

Assessment of results

The UGent contribution to the European Master of Fusion Science and Engineering Physics can only be assessed as part of this larger programme, since it is only through the combined contributions of several universities that a coherent and complete programme is constructed. The conclusion of the expert team is that this EMNFEP programme as a whole provides a good experience to the students. But the team could not assess the details of the programme since no information was provided, nor was there a request to accredit the EMNFEP.

The content of the programme, the student selection, its Quality Assurance are all organised at the level of the European programme.

For these reasons, it is unclear to the panel how an accreditation could be given. This is not a judgement of the quality of the programme, simply a statement of the fact that the request for accreditation should be marked as 'not applicable'.

For the expert panel, the EMNFEP offers great flexibility to the students, who can choose to follow a physics or a more engineering-oriented track. The courses UGent offers are focused on physics, although some fusion-specific engineering topics have been integrated in one of the courses. This can be motivated as a choice of UGent to base their fusion content on the expertise of the local fusion group.

However, the panel sees this as a missed opportunity:

- The professional field is asking for engineers rather than physicists;
- UGent has a very strong engineering department, which could be involved in the fusion master. This could give access to many more relevant specialists, kindle cross-disciplinary projects and collaboration and generally create a richer, more interdisciplinary culture for the fusion students.

There are other attractive opportunities for collaboration, for example with the nuclear research centre SCK-CEN (Belgian Nuclear Research Center).

- This could make the programme more attractive to local (Belgian) students, too.

The programme presently relies on the European funding, which is mostly earmarked for international students. The panel suggests the following mitigation measures:

- Put an effort in recruiting local students;
- Consider offering the programme *also* as a 'master-after-master', i.e. as a further specialisation after a completed master's in a physics or engineering discipline, in collaboration with other Belgian universities.

The EMNFEP was initiated at a time when no fusion-oriented master's programmes were offered anywhere. That was also a rationale for pulling together the expertise from different universities to form a coherent programme that covers the interdisciplinary breadth of fusion research. This situation has changed fundamentally. There are now several specialised fusion master's programmes on offer at European universities in different countries, with a combined student intake many times larger than that of the EMNFEP. These exist without funding from European grants. And the student interest is consistently growing. All of which suggests:

- That UGent should do well to benchmark their programme against these single-university programmes;
- It is deemed possible to significantly increase the intake of local or European students.

Analysis summary – European Master in Nuclear Fusion and Engineering Physics

Strengths:

- The international dimension is strongly developed, through the multi-country character of the European master's programme;
- The alumni community is very positive about the programme;
- The flexibility of the programme is highly appreciated by the alumni: they can build a study programme to suit their interests;
- Very strong stakeholder community;
- The programme gives the students access to unique lab facilities all over Europe (including big science labs);
- Good balance of the programme as a whole (i.e. not just the UGent contribution) between the partners of the programme (teaching, internships, projects).

Weaknesses:

- Entry level discrepancy;
- Student comments: teaching plasma labs at UGent need to be updated;
- Societal context: notion of sustainability needs to be reinforced;
- In the UGent part of the programme, the link between the learning outcomes of the Engineering Physics courses delivered by UGent and their implementation in the fusion specific courses is not very clear;
- Low attractivity for Belgian and European students.

Risks:

- Viability of the programme funded by the European Commission on a 5-year basis.

Opportunities:

- Connect much more strongly to the engineering department/groups in Ghent, integrate engineering into the programme;
- Consider offering the degree also as a specialised programme 'master-after-master'.

Recruitment of engineering students

Students who have successfully completed their secondary education in Belgium can be admitted to UGent. UGent focuses on the students' background, especially in mathematics. From 2018, a positioning test common for all Flemish universities is mandatory, although it has no direct consequence on the enrolment, except giving feedback to the student on his personal knowledge level against the expectations of the faculty. The goal is to deter them to pursue on the programme if the gap is too large. The analysis of the results in the first bachelor's year show a strong link between the score of the test and the % of credit validation after year 1; the better the score, the better the credit validation performance rate. From 2018, the number of students participating in the UGent positioning test is decreasing from 509 to 380 for the BSc in Engineering, while it is more stable for the BSc in Engineering: Architecture.

For the last five years, the number of students enrolled is on average 350 for the BSc in Engineering and on average 120 for the BSc in Engineering:Architecture.

The admission at master's level is open to the students holding a bachelor's degree in engineering, from UGent FEA, or other universities, and the faculty allows intake admission for some students holding a first master's degree strongly related to the relevant UGent master's programme, or international students.

70 non-EU/EEA-students are enrolled for the 1st time in the master's programmes, but they are not considered at the appropriate scientific level. The total number of students in the master's cycle is stable, with an average of 730 students.

The language certification in English/Dutch (depending on the chosen programme) is required at B2 level.

For the Bachelor in Engineering, the large majority of students are coming from a general secondary education. Nearly a quarter of them have a technical secondary education background. A few students are from a secondary education in arts.

For the Bachelor in Engineering: Architecture, there is a balance between the three backgrounds. Some actions are taken by the university to attract some new students in secondary schools. The conditions for intake admission are detailed on the website.

For the foreign students the GRE (Graduate Record Examination) test is recommended.

The recruitment strategy for foreign students is shared between the central services of the faculty and the Programme Committee. The whole process is long and not compatible with deadlines for scholarships. All the conditions for admission are detailed in the Education and Examination Code of the university.

For those who score too low on the positioning test, a free week of "catch-up" in mathematics is organized for remediation.

More than 96% of the students are Belgian. There is a balance between female and male students in the Master in Engineering: Architecture. However, for the other programmes, efforts have to be continued. Diversity strategy for recruitment is not applicable, due to the non-selective process for admission at bachelor's level.

Despite the compulsory recruitment policies for admission at bachelor's level, the FEA conducts a fine analysis to highlight the correlation between the score at the positioning test and the credit validation success rate at the end of the first year; if that information is largely communicated to the candidates, it could help the awareness of students that are clearly not at the proper level.

Even if the number of candidates and admissions may decrease as a result of this information strategy, the success rate of the students should be improving.

Analysis summary – Recruitment of engineering students

Strengths:

- Additional tests and a catch-up week for students with low results at the positioning test;
- Fine analysis of the correlation between the positioning test score and the performance during the first year in the bachelor's programme;
- Large admission numbers at master's level.

Weaknesses:

- Non-selective process for admission, leading to significant drop out numbers or an excessive duration of the course.

Risks:

- No specific risks raised.

Opportunities:

- Development of foreign students' admission at master's level.

Employment of engineering graduates

Job offers are mainly collected by the university. The student associations "VTK" and "DLK" organise respectively a JobFair for Engineers and an Archiefair for Engineer-Architects. Alumni meetings to present the job opportunities are organised.

Specific employment or market opportunities surveys or analysis are provided.

Industry representatives and alumni attending the governance committee are the voice of the job market.

The rate of graduates that pursue a PhD depends on the master's programme. Of the last four years, an average of 130 master's graduates from FEA pursue a PhD and they represent 50% of the total PhD students at Gent university.

It is worth mentioning that following the previous CTI evaluation, the faculty has developed a graduate employment survey. Unfortunately, only few graduates participated in this survey (the average response rate is under 10%), perhaps because it is a bit long, combining an employment survey and a satisfaction survey on international programmes. The outcomes are unfortunately not representative.

There is a dedicated organisation for the alumni network management (AIG). A Vice-Dean and faculty staff are members of AIG and part of its governance. The website of AIG, in Dutch language only, shows a regular scheduling of meetings and events. The Engineer of the Year award highlights specific and interesting career paths; any additional information like the number of alumni members of this organisation is provided.

However, during the interview of students, alumni and industry representatives, it was evident that the network of alumni is not considered as something important, even unknown to some. Some master's programmes organise a specific follow-up of the career of the alumni through a LinkedIn network.

Statistics on work placement and subsequent follow-up of alumni careers is somewhat not so documented. There is still room for improvement.

The very good employment rate, as of now, is very fine for the current and future graduates and the industry representatives or individual alumni attendance to the governance committee is great to keep the curricula on tracks. An efficient alumni network could strengthen the reputation of specific master's programmes from the FEA across a larger scope of industry in Belgium and abroad, and serve both the graduates and the faculty.

The FEA could start to collect a core of detailed information from the recent graduates, on their job content and environment, as they are more attached to the university just after leaving it, and encourage them to join the AIG organisation.

Analysis summary - Employment of engineering graduates

Strengths:

- High employment rate;
- Significant rate of graduates enrolling for a PhD;
- Appreciation of the UGent FEA graduate profiles by industry.

Weaknesses:

- Low response rate to the employment survey;
- Lack of awareness of the importance of the alumni network.

Risks:

- N/A.

Opportunities:

- Varying according to the master's programme.

Overall summary of the evaluation

Since the last evaluation procedure, the faculty has implemented the main guidelines for improvement in order to strengthen the efficiency of its management and achieve a better alignment with the university; a multidisciplinary approach with the new management team across the different domains; a reinforcement of the industry representatives' involvement in the committees in charge of the evolutions of the programmes; strategic goals aligned with those of the university.

The bachelor's and master's programmes offered by the FEA are maintained at a very good level of science and technology; they fit the expectations of industry and maintain a high level of research, thanks to their academic staff. For recent graduates, enrolling for a PhD represents a significant alternative to taking a job in industry. The programmes are properly monitored, considering feedback from industry, students and teaching staff. The implementation of evolutions on a regular basis is a common approach.

The faculty must however pay attention to the sustainability of some programmes, either for financial or for attractiveness reasons.

Some areas still need to be improved: the internationalization of the programmes must be refined to meet the expectations of increasing the admission of foreign students; the strategy to spread soft skills and sustainability through the different curricula must also be developed, and the competencies and corresponding learning outcomes must be clarified. All conditions are there to spread active learning methods through more courses.

It makes complete sense that the internationalization and active learning are 2 of the 3 strategic goals of the faculty.

Overall analysis summary

For the faculty

Strengths:

- The faculty is attentive to the programme contents and evolutions to guarantee the students' success and the quality of education;
- An efficient organization;
- A pragmatic and efficient Quality System;
- A good cohesion among all the internal stakeholders;
- Competitive Erasmus+ programmes that ensure international attractiveness;
- The new Excellence Programme;
- Improvement of pedagogical methods implemented during the sanitary crisis.

Weaknesses:

- Lack of cross fertilization between most of the programmes;
- The alumni network is not considered as essential; lack of alumni structuration and offered services;
- Limited organisation for steering and supporting international strategy;
- Unbalanced gender ratio of students and permanent teaching staff.

Risks:

- Sustainability of the Erasmus Mundus programmes;
- Limited number of candidates in engineering in Belgium;
- Increase of administrative procedures.

Opportunities:

- Campus renovation to enhance student's life facilities;
- Ghent perceived as an attractive and innovative city.

Generic for the master's programmes

Strengths:

- Very strong links between research and training; research facilities support education;
- Access to high quality and state-of-the-art equipment and to an excellent scientific environment with a high number of PhD students;
- Good interactions between teaching staff and students;
- Student satisfaction with the provided education;
- The informal feedback system is very appreciated by the students;
- Decisions taken to re-design some programmes;
- Programmes appreciated and recognized by industry;
- Employment conditions for the graduates;
- Graduates easily adapt to new professional situations and fields.

Weaknesses:

- Lack of standardization of the criteria of evaluation of the soft skills;
- The course organisation doesn't consider the multi-campus factor;
- From the students' point of view, insufficient feedback on the satisfaction surveys, because only a part of the courses are treated each year;
- Low participation rate in the employment surveys.

Risks:

- Limited number of candidates for admission in engineering.

Opportunities:

- Take advantage of the elaboration of new programmes to put the focus on expected competencies;
- Strengthen the sustainability track: the concept is interwoven in different programmes but the strategy on how these aspects are included in the programmes remains unclear.

- End of the evaluation report -

Glossary

AS	Academic Secretary / Vice Dean of Research
ASAB	Academic Strategic Advisory Board
ATS	Administrative and Technical Staff
AAS	Assistant Academic Staff
CO	Counselling Office
CC	Curriculum Committee
DEP/DOWA	Department of Educational Policy
DS	Dissertation Supervisors (master's dissertation)
DLK/KOE	Student organisation - architecture (<i>De Loeiende Koe</i>)
EMNFEP	European Master in Nuclear Fusion and Engineering Physics
EQB	Education Quality Board
EC	Educational Council
EQCU	Educational Quality Control Unit
FCI	Faculty Committee for Internationalization
FC	Faculty Council
FCES	Faculty Council of Engineering Students
FEA	Faculty of Engineering and Architecture
FES	Faculty Education Services
FEC	Faculty Evaluation Committee
FMT	Faculty Management Team
FEP	Faculty's Educational Policy
FTE	Full Time Equivalent
IAG	Industrial Advisory Group
IOF	Industrial Research Fund
IRC	International Relations Committee
IRO	International Relations Office
ISAB	Industrial Strategic Advisory Board
MMM	Modelling, Making, Measuring
OAS	Other Academic Staff
PS	Professorial staff
PSC	Professorial staff committee
SER	Self-Evaluation Report
SRC	Scientific Research Committee
SPC	Study Programme Committee