FACULTY OF ENGINEERING AND ARCHITECTURE

EDUCATION QUALITY AUDIT

Self-Evaluation Report

15 November 2021

PART A - Annexes

Accreditation of Flemish Engineering Programmes by the Commission des Titres d'Ingénieur

GHENT UNIVERSITY

Ghent University
Faculty of Engineering and Architecture

Education Quality Audit
Self-Evaluation Report – November 2021
PART A - ANNEXES

Accreditation of Flemish Engineering Programmes by the *Commission des Titres d'Ingénieur*

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FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

FACULTAIR ONDERWIJSBELEIDSPLAN

2020–2021

Faculteit Ingenieurswetenschappen en Architectuur
Facultaire Dienst Onderwijsondersteuning
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UNIVERSITEIT GENT

0 PREAMBULE

Every year since 2015–2016, the faculty of Engineering and Architecture has published an educational policy plan and quality assurance plan. These documents describe the faculty's reflection on previous educational actions, and the faculty's goals and objectives on education and quality assurance. They should be read together with the faculty's quality assurance monitor.

Since the academic year 2019–2020, the faculty's quality assurance monitor is being updated in accordance with the university's quality assurance policy 'Eigen Regie 2.0'. The new technical developments and revised approaches will result in a more automated version of the quality assurance plan, but this process has been delayed as a result of the corona crisis. However, a revision of the educational plan was deemed necessary. This updated strategic plan holds the mission statement and the faculty's educational keystones, with the faculty's short- and mid-term goals and challenges. The faculty's monitor detail the operational aspects.

1 MISSION STATEMENT

The faculty of Engineering and Architecture is committed to training excellent engineers and architects, who are able to apply their technical and applied scientific skills and knowledge in any professional context, both in Belgium and abroad. It seeks to do so by providing all of its students with a high-quality and state-of-the-art research-based education. Our engineering, engineering technology, and architectural engineering programmes meet international standards and fulfill the requirements of the work field and industry. Our skilled graduates are able to adapt rapidly to global technological and economic changes, and contribute substantially to the socio-economic development.

2 KEYSTONES IN OUR EDUCATION

The faculty of Engineering and Architecture offers a wide range of bachelor's and master's programmes in engineering, engineering technology, and architectural engineering, that are built on a strong **foundation of mathematics and science**. Our graduates hold the necessary attitudes, and master the knowledge and engineering problem-solving skills to solve complex, advanced and multidisciplinary questions,

1 from a conceptual and analytical angle (engineering programmes),
2 with a technical and applied focus (engineering technology programmes)
3 from a creative and innovative architectural design perspective (architectural engineering programme).

The faculty's close ties with **industry,** and our industrial partners' input and needs, are reflected in our curricula. Students carry out industrial projects or master's theses, and are encouraged to gain work experience through internships in companies, architectural or design firms, research institutes or universities, in Belgium or abroad. Visiting lecturers contribute specific scientific or professional expertise.

Our **innovative and transformative research** shapes our educational programmes, as we integrate both research results and research skills into our curricula, stimulate creative reasoning in our students, and base our course materials on the most recent scholarly and scientific developments. We encourage critical independent thinking, and include scientific values and scientific integrity as essential elements in our student's formation.

Our programmes promote **entrepreneurial** and leadership skills, and address **sustainability** issues and ethical questions. In various cross-course **projects**, our students are confronted with real-life multidisciplinary problems with multifaceted solutions. Oral presentations and group work strengthen their communication skills.

Our students are trained to critically reflect on their own ideas and actions, and become **socially responsible engineers**, contributing to society at large. Societal or technological changes are incorporated in our courses and our state-of-the-art programmes, and our students graduate with strong life-long learning attitudes.

The faculty adopts an international perspective, and promotes **international** exchange of students and teachers through study exchanges, research mobility, field work, summer schools and international internships. With a number of dedicated international programmes, English master's programmes in engineering, specific international agreements and an increasing number of outbound mobility students, we offer our students every opportunity to gain international experience.

3 GOALS AND CHALLENGES

In the next paragraphs, the faculty's short- and mid-term goals and challenges will be discussed. A number of these goals overlap with the faculty's three guiding themes for the following years (in line with Ghent University's policy choices); active learning strategies, talent management and sustainability.

3.1 Active learning strategies and online learning

Our engineering programmes combine classic lectures, aimed at thorough knowledge-transfer, with interactive practicals, seminars, lab sessions and pc classes. These activating teaching methods encourage deeper insights, and ensure that our students put to use their scientific/mathematical and technological knowledge, and develop the necessary engineering skills. Project-based learning is a key element in our programmes, through various specialized and multidisciplinary projects.

In response to the COVID-19 pandemic, online learning has been adopted on a previously unknown scale. Best-practices from online learning will be analyzed, and will be combined with other didactic strategies to strengthen our active learning approach in the coming years.

3.2 Strengthening the industry-oriented identity of the engineering technology programmes

Since their integration from the university colleges to the university, the engineering technology programmes have gradually shifted from a primarily applied focus towards a more fundamental, conceptual and research-based approach. The faculty wants to mainain and strengthen the applied

focus and the industry-oriented identity of our engineering technology programmes, without disregarding the importance of their academic objectives. This strengthened focus complies better with the identity of the applied engineer, distinctive from the conceptual engineer.
The practical components in the bachelor's programmes (e.g. lab work, industrial projects, exercises, and a mandatory industry internship in all programmes), will be emphasized and intensified, reflecting the needs of the industry.

3.3 Talent management: a faculty excellence programme

Starting 2021–2022, the faculty will organize an excellence programme, 'Innovation for Society', encouraging talented students to apply their intellectual, technical-scientific and problem-solving skills to multidisciplinary and contemporary societal problems. The first edition, 'Engineers for fair institutions', inspired by the UN's sustainable development goals, addresses key issues on societal change, ethics, and technological challenges in law enforcement, justice and Belgium's legal system.

3.4 Sustainability as the backbone of all programmes

The faculty's study programmes are outlined on a central technical-scientific basis, with technique and technology at their center. Sustainability issues are interwoven throughout the courses and are an integral part of the faculty's programmes, but lack visibility and prominence. To fully prepare our future engineers and architects, today's sustainability challenges will be more prominently discussed in all study programmes. Sustainability aspects will be addressed in new and existing courses, and sustainability thinking as well as sustainability transitions will be incorporated into various projects.

3.5 Internationalization

The faculty aligns with Ghent University's integrated policy on internationalization, and will focus on a number of faculty-specific international aspects in the coming years. Through a limited number of international strategic partnerships, the faculty will promote mutual cooperation with these preferential partners. Monitoring the quality of incoming international (degree) students has been a challenge in the previous years. From 2021–2022 onwards, international applicants will be encouraged to take a GRE-test, or may be asked to take an international preparatory programme, allowing the faculty to better align, asses and evaluate incoming students' competences. We will also explore alternative ways of internationalization to ensure that our students acquire essential international and intercultural competences, e.g. through internationalization@home initiatives or opportunities arising from Ghent University's Enlight project.

The corona crisis has complicated international mobility of lecturers and students, but has also brought online welcome days, online support networks, and new communication strategies. These new insights will steer our efforts for our buddy programmes for international students and community building for our international staff.

3.6 Inclusion and diversity

The faculty endorses Ghent University's integrated diversity policy and action plan, and welcomes all talented students and staff, irrespective of gender, ideological, cultural or social background. However, implicit or explicit barriers still impede certain groups of talented students and teaching staff to choose engineering studies or to opt for an academic career at our faculty.

The faculty actively supports a number of initiatives such as a longitudinal research project in secondary schools (following a diverse group of children through their study progression, and stimulating STEM choices) and STEM activities for secondary school students (with STEM workshops and playful activities on science and technology). However, attracting diverse talent remains an important focus point and creating a diversity-oriented institutional culture will require new initiatives and continuous efforts in the coming years.

3.7 Life-long learning

Our graduates operate in an ever-changing world, requiring creativity and lifelong learning attitudes. UGain, Ghent University's Academy for Engineers, structures the lifelong learning offer for engineers. The industry's needs are translated into a variety of courses on specialized topics, allowing professional engineers to stay up to date with the latest technologies. With Ghent University's strategic policy plan on lifelong learning, new insights and new partnerships (e.g. with other faculties or universities) will bear fruit. In the coming years, a new postgraduate programme and a new advanced master's programme on the manufacturing industry will be organized in Kortrijk. With the financial stimulus from the Flemish government and in close collaboration with West Flemish economic spearheads, these new programmes connect industry, government and knowledge institutes to improve higher education. Together with the faculty's association with the Flemish Artificial Intelligence Academy, these prospective projects will boost our lifelong learning offer.

3.8 Community building and infrastructure

The faculty of Engineering and Architecture aspires to locate most of its students and study programmes in Zwijnaarde at the Campus Ardoyen. The faculty is dedicated to realize this master plan in the nearby future, with the construction of a large new auditorium building, in keeping with all faculty and university demands, and taking into account the mobility questions, financial concerns and sustainability issues. This also corresponds with Ghent University's vision to connect education and research infrastructurally (cf. UGent Verbeeldt 2050).
The faculty attaches particular importance to the participation and representation of students at all levels of policy formulation. The student organizations play an important role at the faculty, offering a rich variety of services and activities to the students. The faculty fully supports VTK's (Vlaamse Technische Kring) plans to build a new student house at the heart of the campus in Zwijnaarde, thus providing a physical meeting place for the faculty's student organizations and student representatives. These projects and combined efforts will not only advance community building for both students and staff, but will also help shape Campus Ardoyen towards a sustainable and future-proof campus.

ANNEX A.2 Courses offered by UGain

2017 *Total number of participants: 362 and 208 certificates issued*

- Milieucoördinator
- Black Belt in Lean
- Big data
- Laagspanningsinstallaties: ontwerp en exploitatie
- Bodemsaneringsdeskundigen module 1
- Bodemsaneringsdeskundigen module 2
- Integrale productontwikkeling
- Informatiebeheer voor bouwprojecten
- Additive Manufacturing
- Schadediagnose en herstelling van beton
- Energy Efficiency in industry
- Introduction to the use of CFD in Fire Safety Engineering
- Reinforcing and strenghtening of structures with FRP reinforcement

2018 *Total number of participants: 296 and 170 certificates issued*

- Milieucoördinator
- Black Belt in Lean
- Big data
- Laagspanningsinstallaties: ontwerp en exploitatie
- Geavanceerde statistische methoden
- Bodemsaneringsdeskundigen module 1
- Informatiebeheer voor bouwprojecten
- Blue Growth summerschool
- Energietechniek in gebouwen

2019 *Total number of participants: 451 and 255 certificates issued*

- Milieucoördinator
- Black Belt in Lean
- Big data
- Laagspanningsinstallaties: ontwerp en exploitatie
- Big data hands-on
- Leiderschap voor ambitieuze ingenieurs
- Schadediagnose en herstelling van beton
- Expertisetechnieken
- Informatiebeheer voor bouwprojecten
- Energie-efficiëntie in de industrie
- Constructief ontwerpen voor robuustheid
- Verkeersveiligheidsauditor
- Integrale productontwikkeling
- Blue Growth summerschool
- H-impact: Health Innovation and Entrepreneurship Program

2020 *Total number of participants: 241 and 118 certificates issued*

- Milieucoördinator
- Black Belt in Lean
- Energietechniek in gebouwen
- Big data
- Laagspanningsinstallaties: ontwerp en exploitatie
- Offshore wind energy
- Leiderschap voor ambitieuze ingenieurs
- Informatiebeheer voor bouwprojecten
- H-impact: Health Innovation and Entrepreneurship Program

ANNEX A.3 List of (paid/unpaid) visiting professors at FEA

Paid visiting professor	(*)	FTE	Affiliation
Kristiaan Borret	EA01	20%	Maître Architecte of Brussels (Belgium) (Bouwmeester)
Wim Boydens	EA01	20%	Studiebureau Boydens
Wouter Callebaut	EA01	10%	Callebaut Architecten
Asli Çiçek	EA01	10%	Asli Çiçek (Independent professional in design & architecture)
Joachim Declerck	EA01	20%	Architecture Workroom Brussels, Ecole Nationale Supérieure d'Architecture de Versailles
Jan Moens	EA01	50%	Bureau Bouwtechniek
Paulus Present	EA01	10%	Bureau Bouwtechniek
Dirk Somers	EA01	20%	Bovenbouw Architectuur, Delft University of Technology (The Netherlands)
Tijl Vanmeirhaeghe	EA01	20%	Haerynck Vanmeirhaeghe architecten
Ruben Verstraeten	EA01	50%	Ruben Verstraeten Architectuur
Hubert Druenne	EA08	10%	Tractebel Engineering (GDF Suez)
Jan Mertens	EA08	10%	ENGIE
Wim Serruys	EA08	5%	LVD Group
Tom Verstraete	EA08	10%	von Karman Institute for Fluid Dynamics
Bram Vervisch	EA08	10%	ORBITS Machinery Diagnostics
Jan De Saedeleer	EA14	10%	Federale Overheidsdienst Binnenlandse Zaken
Edwin Galea	EA14	10%	University of Greenwich
Steffen Grünewald	EA14	10%	TU Delft
Christian Gryspeert	EA14	10%	Brandweerzone Midwest
David Maeso Asua	EA14	15%	OFR Consultants
Filip Verplaetsen	EA14	10%	KU Leuven, Adinex
Filip Boelaert	EA15	10%	Departement Mobiliteit en Openbare Werken
Bart De Pauw	EA15	20%	TUC RAIL
Renaat De Sutter	EA15	10%	Ecolas
Herman Peiffer	EA15	20%	Alpha-Studiebureau, Geosound
Ann Pisman	EA15	20%	Departement Ruimte Vlaanderen
Robert Van der Bijl	EA15	20%	RVDB Urban Planning
Roger Jaspers	EA17	10%	TU/e

(*)
EA01 – Department of Architecture and Urban Planning
EA05 – Department of Information Technology
EA06 – Department of Electronics and Information Systems
EA07 – Department of Telecommunications and Information Processing
EA08 – Department of Electromechanical, Systems and Metal Engineering
EA11 – Department of Materials, Textiles and Chemical Engineering
EA14 – Department of Structural Engineering and Building Materials
EA15 – Department of Civil Engineering
EA17 – Department of Applied Physics
EA18 – Department of Industrial Systems Engineering and Product Design

Unpaid visiting professor	(*)	FTE	Affiliation
Maarten Delbeke	EA01	10%	ETH Zürich
Pieter Pauwels	EA01	20%	BIM-platform, TU/e
Günter Vermeeren	EA05	10%	Telindus
Marnix Botte	EA06	10%	Alcatel-Lucent Bell
Nele Famaey	EA06	10%	KU Leuven
Herbert Van de Sompel	EA06	20%	Data Archiving and Networked Services
Piet Verhoeve	EA06	10%	Televic Healthcare
Mamoun Guenach	EA07	10%	Alcatel-Lucent Bell
Richard Kleihorst	EA07	10%	NXP Semiconductors
Wenzhi Liao	EA07	10%	VITO
Filip Pattyn	EA07	10%	ONTOFORCE
Serge Claessens	EA08	10%	OCAS, DAF Group
Benoît Marinus	EA08	5%	Royal Military Academy
Hadi Pirgazi	EA08	10%	Atlas Copco
Marcel Sluiter	EA08	20%	TU Delft
Antoon Beyne	EA11	10%	BASF
René Bos	EA11	20%	Shell Technology Centre
Philip De Smedt	EA11	20%	Total, Cefic
Pieter Reyniers	EA11	10%	BASF
Carl Van Camp	EA11	10%	Zeopore Technologies
Joeri Vercammen	EA11	20%	IS-X Academy
Stephanie Vervynckt	EA11	10%	Umicore
Stefan Voorspoels	EA11	20%	VITO
Diego Lorenzo Allaix	EA14	10%	Politecnico di Torino
Emmanuel Annerel	EA14	10%	Promat Research and Technology Centre
Henk De Bleecker	EA14	5%	Permasteelisa Group
Hervé Degée	EA14	10%	Universiteit Hasselt, Université de Liège
Wim Moerman	EA14	10%	Willy Naessens Group
Raphaël Steenbergen	EA14	10%	Delft University of Technology
Guang Ye	EA14	10%	Delft University of Technology
Wolfgang Biel	EA17	10%	DEMO, Forschungszentrum Jülich
Emile Van der Heide	EA18	30%	TU Delft

(*)
EA01 – Department of Architecture and Urban Planning
EA05 – Department of Information Technology
EA06 – Department of Electronics and Information Systems
EA07 – Department of Telecommunications and Information Processing
EA08 – Department of Electromechanical, Systems and Metal Engineering
EA11 – Department of Materials, Textiles and Chemical Engineering
EA14 – Department of Structural Engineering and Building Materials
EA15 – Department of Civil Engineering
EA17 – Department of Applied Physics
EA18 – Department of Industrial Systems Engineering and Product Design

ANNEX A.4 Overview of the building infrastructure of the FEA

The FEA uses a number of campuses and buildings located at various places in and outside Ghent. The overall location of the different campuses and buildings in the Ghent area can be found on maps 1 to 3 (see next pages).
Maps for other campuses are available on https://www.ugent.be/nl/univgent/contact-adressen
Table 1 gives an overview of the total space available in the building infrastructure occupied by FEA, subdivided over the following categories:

- auditoria and classrooms (the latter are typically of a smaller size with movable furniture);
- PC- and laptop-rooms available to all students and used in various courses;
- practical-rooms equipped and used for specific lab or project sessions, often for larger groups of students; practicals include design studio spaces which are very actively used by architectural engineering students for various types of projects;
- libraries;
- lab and research spaces mainly intended for research purposes but sometimes also used by students, e.g. during master thesis research;
- offices and meeting rooms for staff, including service rooms, rest rooms,… ;
- storage and technical spaces.

The two main campuses are:

- Campus Ardoyen (nr. 16 on map 1) is located in Zwijnaarde, about 5 km from the city centre, and represents over 52% of the total floor area occupied by FEA. This campus houses the majority of the departments of the FEA with offices and research facilities, and also has several auditoria, classrooms, practicals and PC-rooms. The different buildings with their different facilities are listed in Table 1 and indicated on map 2. The FEA has the intention to move most of its research and teaching facilities that are still located on other campuses to campus Ardoyen in the future and this process is speeding up since the last 5 years. As a result there have been several new developments on the campus, with a new high-rise building ("iGent", nr. 126 on map 2) taken into use in 2015, a new student restaurant integrated in a new research building "Locus" (nr. 77 on map 2), taken into use in 2020, a new parking facility,... Also the faculty's main student association, VTK has taken initiative to build a multipurpose student hub on the site, to be inaugurated in 2022. These developments illustrate the evolution towards a vibrant, dynamic campus.
  The Ardoyen campus also houses a number of company and incubator buildings, indicated in grey on map 2, and the large research infrastructures of the VIB (The Flemish Institute for Biotechnology, www.vib.be, nr. 71 on the map). All this is part of Tech Lane Ghent Science Park, see http://www.techlane.be/about/ for more details.
- The campuses Boekentoren and UFO in the city centre (resp. nr. 4 and 3 on map 1) with the Plateau-building (label P on map 3) and the Technicum (label T1-T5 on map 3), represent nearly 24% of the floor area occupied by FEA. The Plateau-building is the location of the Dean's office and of the main teaching activities for the bachelor programmes, in particular those of the first and second year, and for the architectural engineering programme. The Plateau-building counts 14 auditoria (the largest ones providing place for 474, 280 and 236 students) and also has 8 studios and 5 PC-rooms The Technicum houses a number of research groups and infrastructures. Historically, this campus, located close to the city centre, is the oldest part of the FEA.

Other campuses used by the FEA in the Ghent area are:

- Campus Schoonmeersen (nr. 11 on map 1), with teaching facilities for students in engineering technology, and offices and research facilities for associated research groups (12% of FEA floor area);

- The Faculty of Sciences (Campus Sterre, nr. 12, and Ledeganck, nr. 10) and Campus UZ (nr. 13 on map 1) with mainly offices and research facilities for the research group Numerical Analysis and Mathematical Modelling, and for the Biomedical Technology Institute (together about 2% of the FEA floor area).

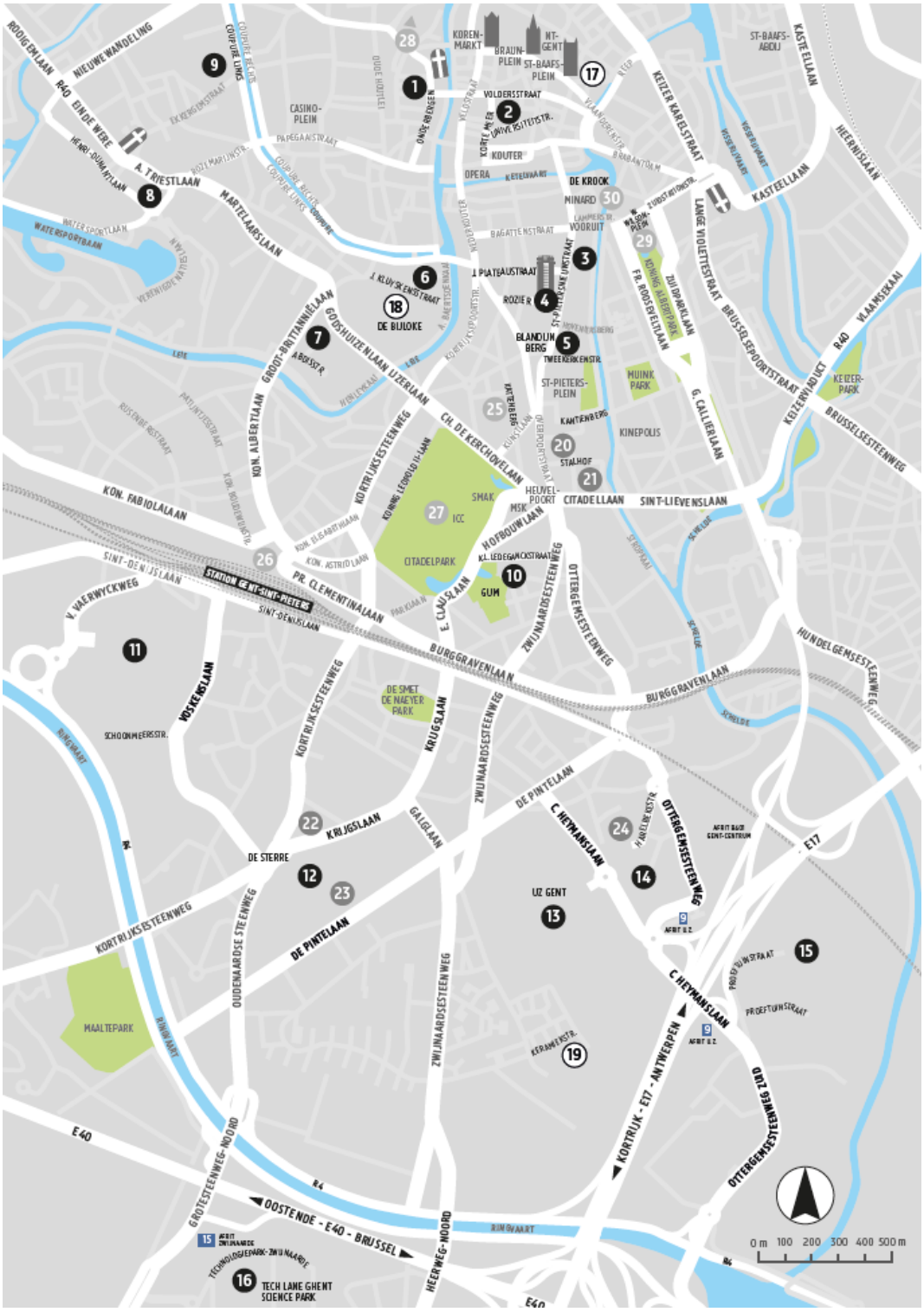
Outside of Ghent, the FEA is also present at Campus Kortrijk, with teaching and research infrastructure for students and staff in engineering technology programmes, and at Ostend Science park, mainly with specialized research infrastructure for the Maritime Technology Division.

Campus	Building	auditoria and classrooms	PC- and laptop-rooms	practicals & studios	libraries	lab & research spaces	offices & meeting rooms	storage & technical spaces	*total m² per building*	total m² per campus	% of total FEA Space
Ardoyen										39583	52,6%
	Metallurgie (46)	348	72	190	159	1421	1772	157	*4118*		
	Magnel (60)	456	205	165	110	5186	2091	1802	*10016*		
	Grondmechanica (68)	100	16		49	353	405	430	*1352*		
	Textielkunde (70A)	56		190		264	245	65	*820*		
	Volta (131)	158	74		62	323	619	368	*1605*		
	Industriele scheikunde (125)	350	50	238		1850	1697	215	*4399*		
	Baekeland (130)	118		679		471	396	64	*1729*		
	Smart-C (121)					579	344	18	*942*		
	Cleanrooms (123)					876		589	*1464*		
	iGent (126)	228	124	883		2785	6371	257	*10648*		
	AA-tower (122)						751	245	*996*		
	Centexbel (70)	29				650	352	80	*1110*		
	Homelab (108)					333	44	7	*384*		
Boekentoren										7537	10,0%
	Plateau (P)	1926	521	1822	570	32	2044	430	*7346*		
	Vandenhove (V)			68	79		38	6	*191*		
UFO										10367	13,8%
	Technicum 2 (T2)						303	124	*427*		
	Technicum 3 (T3)					959	1058	66	*2083*		
	Technicum 4 (T4)	77	8	936	22	2599	1344	1389	*6376*		
	Technicum 5 (T5)	40	22		23	1067	267	62	*1482*		
Schoonmeersen										8940	11,9%
	Gebouw B	759	405			185	147	65	*1562*		
	Gebouw C	1178	94		11	397	354		*2034*		
	Gebouw D	344							*344*		
	Gebouw P	278	586	157		3127	540	311	*4999*		
Faculty of Sciences										476	0,6%
	Campus Sterre (S8)						387	24	*411*		
	Ledeganck					40	15	9	*64*		
UZ										815	1,1%
	Blok B		12			71	465		*548*		
	Polikliniek 8					160	51	56	*266*		
Kortrijk										4368	5,8%
	Gebouw A	82		108		1347	227	37	*1801*		
	Gebouw B	70		379		405	273	89	*1216*		
	Gebouw C	189		570		43	89	127	*1018*		
	Rudolf						124	36	*160*		
	Gebouw D	24					127	21	*172*		
Campus Oostende						2426	88	722	*3236*	3236	4,3%
Total m²		6810,83	2189,53	6385,4	1085,53	27948,83	23029,6	7872,03	*75321,75*		
% of total m²		9,0%	2,9%	8,5%	1,4%	37,1%	30,6%	10,5%	*100,0%*		100,0%

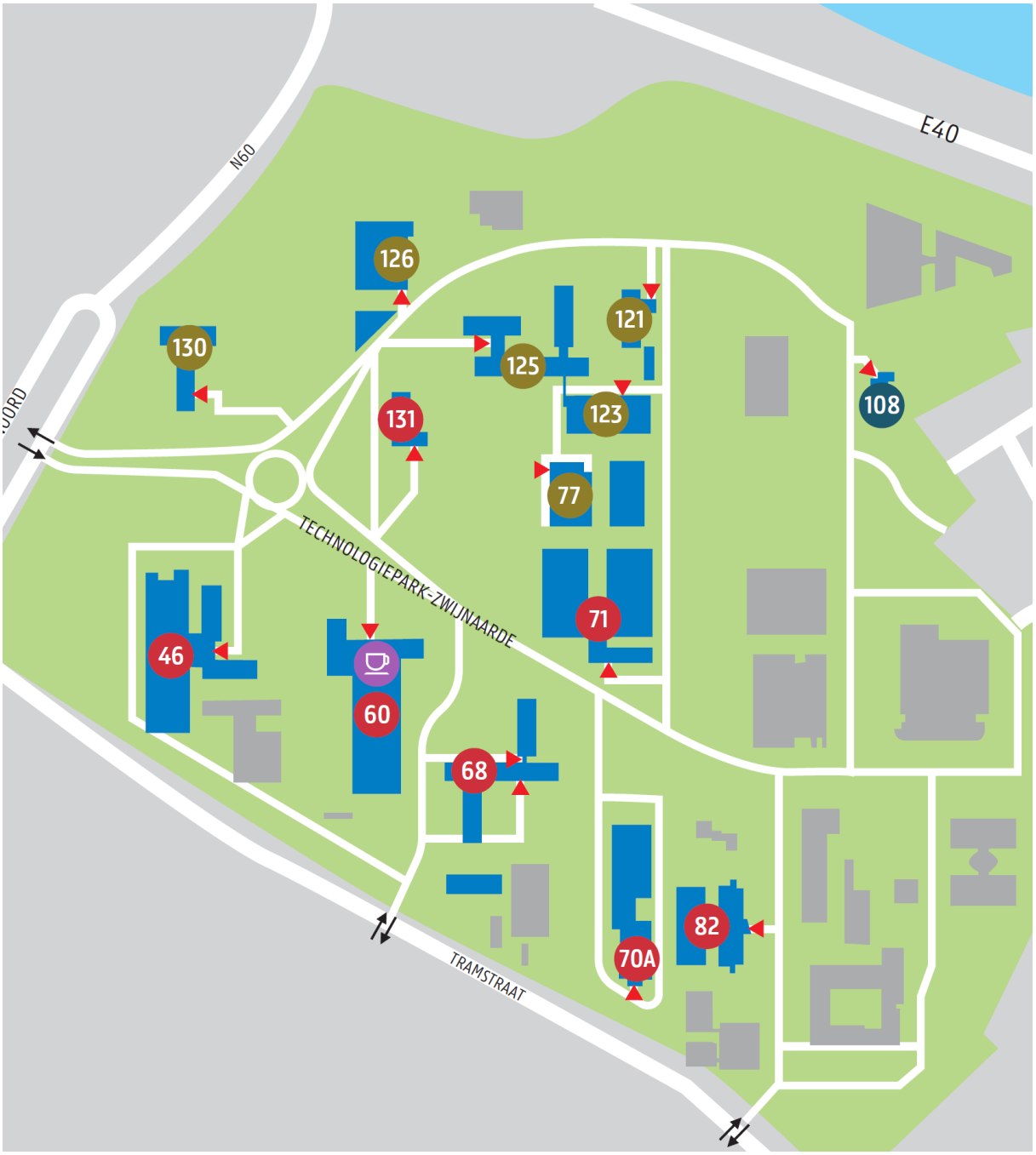
Table 1: Total space used by FEA for educational, research and other activities (figures for September 2021)

Map 1: Overall location of campuses and buildings used by FEA in Ghent:

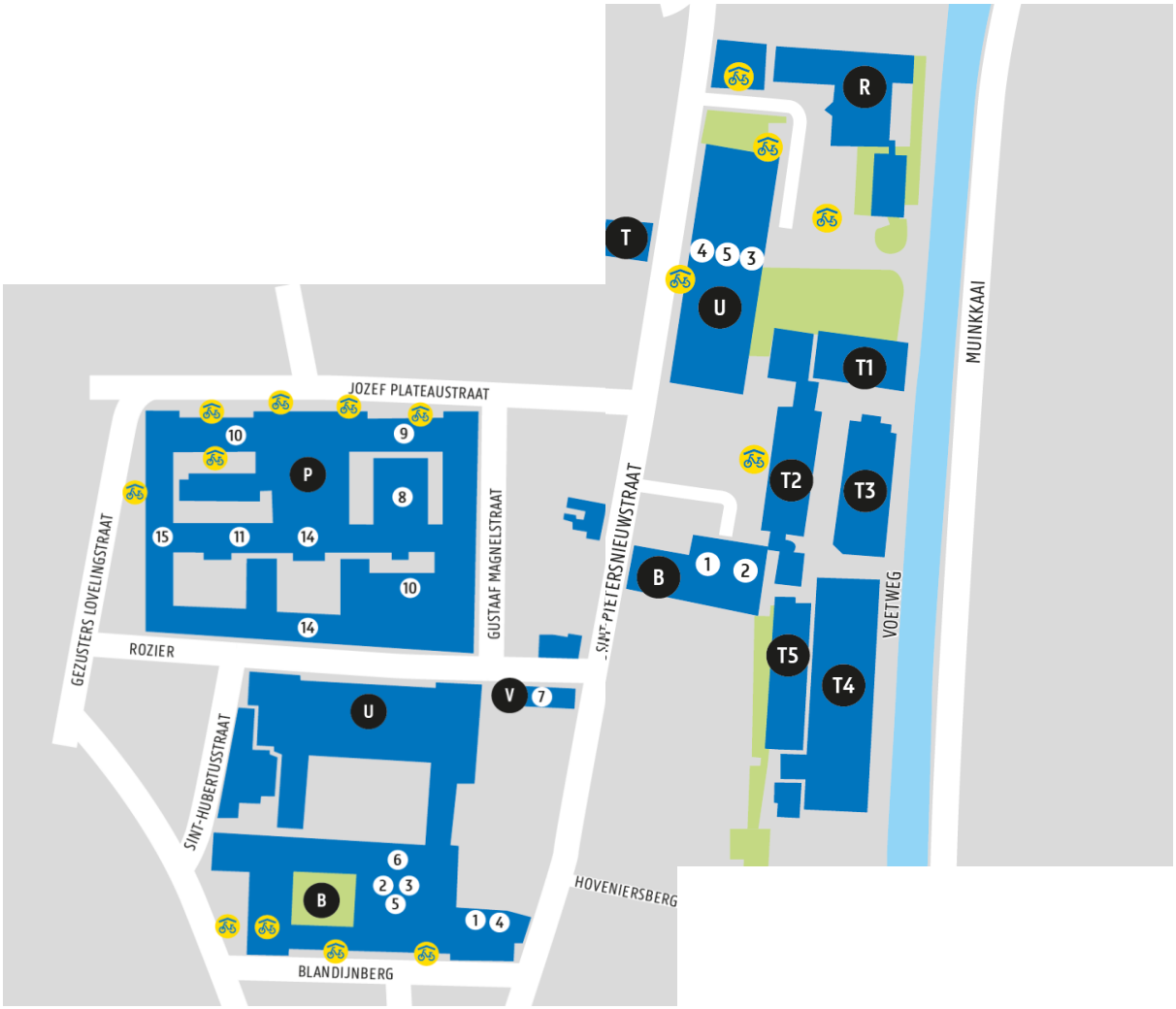
(3) Campus UFO
(4) Campus Boekentoren
(11) Campus Schoonmeersen
(12) Campus Sterre
(13) Campus UZ Gent
(16) Campus Ardoyen – Tech Lane Ghent Science Park



Map 2: Campus Ardoyen - Tech Lane Ghent Science Park



Map 3: Campus Boekentoren (left) and Campus UFO (right), with Plateau-building (P), Vandenhove building (V) and Technicum-buildings (T1-T5)



ANNEX A.5 ERC, Odysseus and Methusalem grantees working at FEA

ERC advanced grant

- **Piet Demeester**
  A new concept for ultra-high capacity wireless networks
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/piet-demeester.htm
- **Geert De Schutter**
  Smart casting of concrete structures by active control of rheology
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/geert-deschutter.htm
- **Lieven Eeckhout**
  Load Slice Core: A Power and Cost-Efficient Microarchitecture for the Future
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/lieven_eeckhout.htm
- **Dries Van Thourhout**
  Nano-Ridge Engineering for Densely Integrated III-V Lasers Directly Grown on Silicon
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/narios.htm

ERC consolidator grant

- **Wim Bogaerts**
  Photonic Integrated Circuits using Scattered Waveguide elements in an Adaptive, Reconfigurable Mesh
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/wim-bogaerts.htm
- **Kevin Van Geem**
  Process intensification and innovation in olefin Production by Multiscale Analysis and design
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/optima.htm
- **Veronique Van Speybroeck**
  First principle molecular dynamics simulations for complex chemical transformations in nanoporous materials
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/veronique-vanspeybroeck.htm

ERC starting grant

- **Bart Kuyken**
  Chip Scale Electrically Powered Optical Frequency Combs
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/bartkuyken.htm
- **Iwan Moreels**
  Photonics in Flatland: Band Structure Engineering of 2D Excitons in Fluorescent Colloidal Nanomaterials
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/phocona.htm
- **Sarah Verhulst**
  Robust Speech Encoding in Impaired Hearing
  https://www.ugent.be/en/research/research-ugent/eu-trackrecord/h2020/erc-h2020/sarah-verhulst.htm

Odysseus grant

- **Tijl De Bie**
  Exploring Data: Theoretical Foundations and Applications to Web, Multimedia, and Omics Data
  https://www.ugent.be/statistics/en/research/debie
- **Georgios Spyropoulos**
  Soft Integrated Ion-Based Circuits for Diagnostic and Closer-Loop Neurological Interventions
  https://research.ugent.be/web/result/project/5b55e381-32ef-11eb-a32f-1dc3591f6bd8/details/bof-sta-202009-012-soft-integrated-ion-based-circuits-for-diagnostics-and-closed-loop-neurological-interventions?12

Methusalem grant

- **Roel Baets**
  (starting 2008) Smart photonic chips in support of a safe and sustainable world and of a better health care for all; (Second phase from 2015 onwards) Smart photonic chips at the heart of systems that matter to people and society
  https://researchportal.be/en/project/smart-photonic-chips-heart-systems-matter-people-and-society
- **Piet Demeester**
  (Starting 2021) SHAPE: Next Generation Wireless Networks
  https://researchportal.be/en/project/shape-next-generation-wireless-networks

ANNEX A.6 Dublin Descriptors EUR-ACE Learning Outcomes

(A) Dublin Descriptors

Qualifications that signify completion of the first cycle are awarded to students who:

- have demonstrated knowledge and understanding in a field of study that builds upon and their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;
- can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;
- have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues;
- can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;
- have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

Qualifications that signify completion of the second cycle are awarded to students who:

- have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor's level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;
- can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
- have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;
- can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;
- have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

Glossary

1. The word '**professional**' is used in the descriptors in its broadest sense, relating to those attributes relevant to undertaking work or a vocation and that involves the application of some aspects of advanced learning. It is not used with regard to those specific requirements relating to regulated professions. The latter may be identified with the profile / specification.
2. The word '**competence**' is used in the descriptors in its broadest sense, allowing for gradation of abilities or skills. It is not used in the narrower sense identified solely on the basis of a 'yes/no' assessment.
3. The word '**research**' is used to cover a wide variety of activities, with the context often related to a field of study; the term is used here to represent a careful study or investigation based on a systematic understanding and critical awareness of knowledge. The word is used in an inclusive way to accommodate the range of activities that support original and innovative work in the whole range of academic, professional and technological fields, including the humanities, and traditional, performing, and other creative arts. It is not used in any limited or restricted sense, or relating solely to a traditional 'scientific method'.

(B) EUR- ACE Learning Outcomes

Note: *numbering added for convenience in mapping the FEA competence model to the EUR-ACE learning outcomes (see ANNEX A.8).*

1. Knowledge and Understanding

The underpinning knowledge and understanding of science, mathematics and engineering fundamentals are essential to satisfying the other programme outcomes. Graduates should demonstrate their knowledge and understanding of their engineering specialisation, and also of the wider context of engineering.

First Cycle graduates should have:

B1.1 knowledge and understanding of the scientific and mathematical principles underlying their branch of engineering;

B1.2 a systematic understanding of the key aspects and concepts of their branch of engineering;

B1.3 coherent knowledge of their branch of engineering including some at the forefront of the branch;

B1.4 awareness of the wider multidisciplinary context of engineering.

Second Cycle graduates should have:

M1.1 an in-depth knowledge and understanding of the principles of their branch of engineering;

M1.2 a critical awareness of the forefront of their branch.

2. Engineering Analysis

Graduates should be able to solve engineering problems consistent with their level of knowledge and understanding, and which may involve considerations from outside their field of specialisation. Analysis can include the identification of the problem, clarification of the specification, consideration of possible methods of solution, selection of the most appropriate method, and correct implementation. Graduates should be able to use a variety of methods, including mathematical analysis, computational modelling, or practical experiments, and should be able to recognise the importance of societal, health and safety, environmental and commercial constraints.

First Cycle graduates should have:

B2.1 the ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods;

B2.2 the ability to apply their knowledge and understanding to analyse engineering products, processes and methods;

B2.3 the ability to select and apply relevant analytic and modelling methods.

Second Cycle graduates should have:

M2.1 the ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications;

M2.2 the ability to formulate and solve problems in new and emerging areas of their specialisation;

M2.3 the ability to use their knowledge and understanding to conceptualise engineering models, systems and processes;

M2.4 the ability to apply innovative methods in problem solving.

3. Engineering Design

Graduates should be able to realise engineering designs consistent with their level of knowledge and understanding, working in cooperation with engineers and non-engineers. The designs may be of devices, processes, methods or artefacts, and the specifications could be wider than technical, including an awareness of societal, health and safety, environmental and commercial considerations.

First Cycle graduates should have:

B3.1 the ability to apply their knowledge and understanding to develop and realise designs to meet defined and specified requirements;

B3.2 an understanding of design methodologies, and an ability to use them.

Second Cycle graduates should have:

M3.1 an ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines;

M3.2 an ability to use creativity to develop new and original ideas and methods;

M3.3 an ability to use their engineering judgment to work with complexity, technical uncertainty and incomplete information.

4. Investigations

Graduates should be able to use appropriate methods to pursue research or other detailed investigations of technical issues consistent with their level of knowledge and understanding. Investigations may involve literature searches, the design and execution of experiments, the interpretation of data, and computer simulation. They may require that data bases, codes of practice and safety regulations are consulted.

First Cycle graduates should have:

B4.1 the ability to conduct searches of literature, and to use data bases and other sources of information;

B4.2 the ability to design and conduct appropriate experiments, interpret the data and draw conclusions;

B4.3 workshop and laboratory skills.

Second Cycle graduates should have:

M4.1 the ability to identify, locate and obtain required data;

M4.2 the ability to design and conduct analytic, modelling and experimental investigations;

M4.3 the ability to critically evaluate data and draw conclusions;

M4.4 the ability to investigate the application of new and emerging technologies in their branch of engineering.

5. Engineering Practice

Graduates should be able to apply their knowledge and understanding to developing practical skills for solving problems, conducting investigations, and designing engineering devices and processes. These skills may include the knowledge, use and limitations of materials, computer modelling, engineering processes, equipment, workshop practice, and technical literature and information sources. They should also recognise the wider, non-technical implications of engineering practice, ethical, environmental, commercial and industrial.

First Cycle graduates should have:

B5.1 the ability to select and use appropriate equipment, tools and methods;

B5.2 the ability to combine theory and practice to solve engineering problems;

B5.3 an understanding of applicable techniques and methods, and of their limitations;

B5.4 an awareness of the non-technical implications of engineering practice.

Second Cycle graduates should have:

M5.1 the ability to integrate knowledge from different branches, and handle complexity;

M5.2 a comprehensive understanding of applicable techniques and methods, and of their limitations;

M5.3 a knowledge of the non-technical implications of engineering practice.

6. Transferable Skills

The skills necessary for the practice of engineering, and which are applicable more widely, should be developed within the programme.

First Cycle graduates should be able to:

B6.1 function effectively as an individual and as a member of a team;

B6.2 use diverse methods to communicate effectively with the engineering community and with society at large;

B6.3 demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice;

B6.4 demonstrate an awareness of project management and business practices, such as risk and change management, and understand their limitations;

B6.5 recognise the need for, and have the ability to engage in independent, life-long learning.

Second Cycle graduates should be able to:

M6.1 fulfil all the Transferable Skill requirements of a First Cycle graduate at the more demanding level of Second Cycle;

M6.2 function effectively as leader of a team that may be composed of different disciplines and levels;

M6.3 work and communicate effectively in national and international contexts.

ANNEX A.7 Generic competence model at FEA and its relation with EUR-ACE Learning Outcomes

(a) Generic bachelor competences (except Architecture)

Field of competences GB1: Competences in one/more scientific discipline(s)

GB1.1 Have a clear understanding of the basic sciences and basic engineering sciences, and have the ability to apply them in a creative and purposeful way in the chosen specific engineering discipline.

GB1.2 Employ the basic sciences and techniques (statistics, ICT, CAD) in a creative and purposeful way.

Field of competences GB2: Scientific competences

GB2.1 Research and process technical and scientific information in a purposeful way.

GB2.2 Employ standard models, methods and techniques in assignments.

GB2.3 Schematize and model phenomena, processes, and systems.

GB2.4 Justify decision-making processes on rational grounds.

Field of competences GB3: Intellectual competences

GB3.1 Understand and structure learning experiences.

GB3.2 Think in a conceptual, analytical, system-oriented, problem-solving and synthesizing way at different levels of abstraction.

GB3.3 Show precision, perseverance and critical reflection.

GB3.4 Show scientific curiosity.

GB3.5 Justify further studies or professional opportunities on rational grounds.

Field of competences GB4: Competences in cooperation and communication

GB4.1 Master scientific and discipline-specific technical terminology (also in English).

GB4.2 Carry out concrete assignments systematically.

GB4.3 Work as part of a team.

GB4.4 Report results verbally, in writing, and graphically.

Field of competences GB5: Societal competences

GB5.1 Act in an ethical and social way.

GB5.2 Be aware of the business aspects of the engineering discipline.

Table 1 presents the relationship between the faculty's Generic Bachelor Competences (columns, numbers correspond to the bachelor competences as listed above) versus the EUR-ACE first cycle Learning Outcomes (rows, numbering as indicated in Annex A.7).

	GB 1.1	GB 1.2	GB 2.1	GB 2.2	GB 2.3	GB 2.4	GB 3.1	GB 3.2	GB 3.3	GB 3.4	GB 3.5	GB 4.1	GB 4.2	GB 4.3	GB 4.4	GB 5.1	GB 5.2
B1.1	X						X										
B1.2	X						X										
B1.3	X						X										
B1.4	X						X										
B2.1								X									
B2.2				X	X												
B2.3			X	X													
B3.1		X															
B3.2				X				X									
B4.1			X														
B4.2				X					X								
B4.3				X													
B5.1		X	X														
B5.2		X	X			X											
B5.3		X	X														
B5.4																X	X
B6.1													X	X			
B6.2												X			X		
B6.3																X	X
B6.4													X				
B6.5										X	X						

Table 1: Relationship between the faculty's Generic Bachelor Competences (columns) versus the EUR-ACE first cycle Learning Outcomes (rows)

(B) Generic master competences (except Architecture)

Field of competences GM1: Competences in one/more scientific discipline(s)

GM1.1 Master and apply advanced knowledge in the own engineering discipline in solving complex problems.
GM1.2 Apply Computer Aided Engineering (CAE) tools and advanced communication instruments in a creative and purposeful way.

Field of competences GM2: Scientific competences

GM2.1 Analyse complex problems and formulate them into concrete research questions.
GM2.2 Consult the scientific literature as part of the own research.
GM2.3 Select and apply the appropriate models, methods and techniques.
GM2.4 Develop and validate mathematical models and methods.
GM2.5 Interpret research findings in an objective and critical manner.

Field of competences GM3: Intellectual competences

GM3.1 Independently form an opinion on complex situations and problems, and defend this point of view.
GM3.2 Apply knowledge in a creative, purposeful and innovative way to research, conceptual design and production.
GM3.3 Critically reflect on one's own way of thinking and acting, and understand the limits of one's competences.
GM3.4 Stay up-to-date with the evolutions in the discipline to elevate the own competences to expert level.
GM3.5 Readily adapt to changing professional circumstances.

Field of competences GM4: Competences in cooperation and communication

GM4.1 Have the ability to communicate in English about the own field of specialisation.
GM4.2 Project management: have the ability to formulate objectives, report efficiently, keep track of targets, follow the progress of the project,...
GM4.3 Have the ability to work as a member of a team in a multi-disciplinary working-environment, as well as being capable of taking on supervisory responsibilities**.**
GM4.4 Report on technical or scientific subjects verbally, in writing and using graphics.

Field of competences GM5: Societal competences

GM5.1 Act in an ethical, professional and social way.
GM5.2 Recognize the most important business and legal aspects of the own engineering discipline.
GM5.3 Understand the historical evolution of the own engineering discipline and its social relevance.

Field of competences GM6: Profession-specific competences

GM6.1 Master the complexity of technical systems by using system and process models.
GM6.2 Reconcile conflicting specifications and prior conditions in a high-quality and innovative concept or process.
GM6.3 Synthesize incomplete, contradictory or redundant data into useful information.
GM6.4 Possess sufficient ready knowledge and understanding to evaluate the results of complex calculations, or make approximate estimates.
GM6.5 Pay attention to entire life cycles of systems, machines, and processes.
GM6.6 Pay attention to sustainability, energy-efficiency, environmental cost, use of raw materials and labour costs.
GM6.7 Pay attention to all aspects of reliability, safety, and ergonomics.
GM6.8 Have insight into and understanding of the importance of entrepreneurship.
GM6.9 Show perseverance, innovativeness, and an aptitude for creating added value.

Table 2 presents the relationship between the faculty's Generic Master Competences (columns, numbers correspond to the master competences as listed above) versus the EUR-ACE second cycle Learning Outcomes (rows, numbering as indicated in Annex A.7). Note that columns 3.3 and 6.9 are empty. These extra competences have no direct counterpart in the EUR-ACE outcomes.

	GM 1.1	GM 1.2	GM 2.1	GM 2.2	GM 2.3	GM 2.4	GM 2.5	GM 3.1	GM 3.2	GM 3.3	GM 3.4	GM 3.5	GM 4.1	GM 4.2
M1.1	X							X						
M1.2	X							X			X			
M2.1			X					X	X					
M2.2	X		X					X	X					
M2.3					X									
M2.4					X	X					X			
M3.1		X			X	X			X					
M3.2		X			X	X			X					
M3.3									X					
M4.1				X										
M4.2									X					
M4.3							X							
M4.4											X			
M5.1											X			
M5.2					X	X								
M5.3												X		
M6.1													X	
M6.2														X
M6.3														

	GM 4.3	GM 4.4	GM 5.1	GM 5.2	GM 5.3	GM 6.1	GM 6.2	GM 6.3	GM 6.4	GM 6.5	GM 6.6	GM 6.7	GM 6.8	GM 6.9
M1.1									X					
M1.2														
M2.1														
M2.2														
M2.3						X								
M2.4														
M3.1														
M3.2														
M3.3							X		X					
M4.1														
M4.2														
M4.3								X						
M4.4														
M5.1														
M5.2														
M5.3			X	X	X					X	X	X	X	
M6.1	X													
M6.2														
M6.3		X												

Table 2: Relationship between the faculty's Generic Master Competences (columns) versus the EUR-ACE second cycle Learning Outcomes (rows)

ANNEX A.8 List of Elective Social Courses as included in the FEA master programmes

(Link to the course specifications included, below the course name)

		Number of credits
1	Internship 1 https://studiekiezer.ugent.be/studiefiche/en/E099960/2021	3
2	Internship 2 https://studiekiezer.ugent.be/studiefiche/en/E099970/2021	3
3	Internship 3 https://studiekiezer.ugent.be/studiefiche/en/E099980/2021	6
4	International Internship 1 https://studiekiezer.ugent.be/studiefiche/en/E099920/2021	3
5	International Internship 2 https://studiekiezer.ugent.be/studiefiche/en/E099930/2021	3
6	International Internship 3 https://studiekiezer.ugent.be/studiefiche/en/E099940/2021	6
7	Safety of Electrical and Mechanical Installations [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E037810/2021	3
8	Sustainable Energy and Rational Use of Energy https://studiekiezer.ugent.be/studiefiche/en/E039060/2021	4
9	Rational Use of Materials https://studiekiezer.ugent.be/studiefiche/en/E065460/2021	5
10	Technology and Environment https://studiekiezer.ugent.be/studiefiche/en/E078010/2021	3
11	Water and Air Quality Engineering https://studiekiezer.ugent.be/studiefiche/en/E078751/2021	4
12	Ethics, Engineering and Society [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E075310/2021	3
13	Philosophy and Science [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E075060/2021	3
14	The Information Society and ICT https://studiekiezer.ugent.be/studiefiche/en/E076320/2021	3
15	Introduction to Psychology [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/A001900/2021	3

		Number of credits
16	Introduction to Human Resource Management https://studiekiezer.ugent.be/studiefiche/en/E076130/2020	3
17	Coaching and Diversity [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H001977/2021	3
18	Introduction to Entrepreneurship https://studiekiezer.ugent.be/studiefiche/en/E076431/2021	3
19	Dare to Venture https://studiekiezer.ugent.be/studiefiche/en/E076460/2021	4
20	Dare to Start https://studiekiezer.ugent.be/studiefiche/en/E076471/2021	3
21	Principles of Law and Construction Law [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E076621/2021	3
22	Commercial Law [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E076520/2021	3
23	Financial and Cost Price Reporting in Companies [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/E076930/2021	6
24	Powerful Learning Environments [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H002169/2021	6
25	Classroom Management and Reflection [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H002196/2021	4
26	The Teacher within School and Society [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H002197/2021	4
27	Psychology of Adolescence [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H002198/2021	4
28	Macroeconomics [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/F000083/2021	6
29	Introduction Industrial Psychology [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/H001010/2021	5
30	Business Skills https://studiekiezer.ugent.be/studiefiche/en/F000551/2021	4
31	Sustainability Thinking [in Dutch] https://studiekiezer.ugent.be/studiefiche/en/K001339/2021	5

ANNEX A.9 Truncus Communis of the BSc. in Engineering

SECOND YEAR (S3 and S4) and THIRD YEAR (S5 and S6)

Course	credits	BIO	CM	CIV	CS	EE	EM	EP
Physics II	6	S3						
Mathematical Analysis III	6	S3						
Mechanics of Materials	6	S5	S3	S3			S3	
Mechanics of Materials (partim)	3				S3	S3		
Sustainable Business Operations	3	S3	S3	S3	S3	S3	S5	S5
Transport Phenomena	6	S3	S3	S3			S3	S3
Electrical Circuits and Networks	6	S3			S3	S3	S3	S3
Analysis of Systems and Signals	6	S5	S5		S3	S3	S5	S5
Analysis of Systems and Signals (partim)	3			S3				
Engineering Project	6	S3+4					S4	S4
	3		S4	S4	S4	S4		
Modelling and Control of Dynamic Systems	6	S6	S6			S4	S6	S6
Cross-course Project	6	S6						

Table 1 gives an overview of the courses in the Truncus Communis. Semester 1 and semester 2 are identical for all programmes, as is the case for about 50% of semester three and four. Semester five and six are mainly programme-specific.

- Mathematical and scientific training : 65 credits;
- General engineering courses : 15 – 30 credits;
- Project line : 16 - 19 credits;
- Programme specific courses (mathematics, science, engineering courses) : 66 – 84 credits.

FIRST YEAR (S1 and S2)

Course	credits	all bachelor programmes
Basic Mathematics	3	S1
Physics I	6	S1
Mathematical Analysis I	6	S1
Discrete Mathematics I	4	S1
Chemistry: the Structure of Matter	4	S1
Modelling, Making and Measuring	4	S1
Informatics	6	S1 & S2
Mathematical Analysis II	4	S2
Geometry and Linear Algebra	7	S2
Chemical Thermodynamics	3	S2
Probability and Statistics	6	S2
Materials Technology	4	S2
Sustainability, Entrepreneurship and Ethics	3	S2

SECOND YEAR (S3 and S4) and THIRD YEAR (S5 and S6)

Course	credits	BIO	CM	CIV	CS	EE	EM	EP
Physics II	6	S3						
Mathematical Analysis III	6	S3						
Mechanics of Materials	6	S5	S3	S3			S3	
Mechanics of Materials (partim)	3				S3	S3		
Sustainable Business Operations	3	S3	S3	S3	S3	S3	S5	S5
Transport Phenomena	6	S3	S3	S3			S3	S3
Electrical Circuits and Networks	6	S3			S3	S3	S3	S3

Analysis of Systems and Signals Analysis of Systems and Signals (partim)	6 3	S5	S5	 S3	S3	S3	S5	S5
Engineering Project	6 3	S3+4	 S4	 S4	 S4	 S4	S4	S4
Modelling and Control of Dynamic Systems	6	S6	S6			S4	S6	S6
Cross-course Project	6	S6						

Table 1: Truncus Communis of the Bachelor of Science in Engineering (6 semesters); Biomedical Engineering (BIO), Chemical Engineering and Materials Science (CM), Civil Engineering (CIV), Computer Science (CS), Electrical Engineering (EE), Electromechanical Engineering (EM), Engineering Physics (EP).

FACULTY OF ENGINEERING AND ARCHITECTURE

REGULATIONS FOR COMPOSING A CURRICULUM

ACADEMIC YEAR 2021-2022

Important! *This translation is provided as a service to the foreign language speaking students and staff of Ghent University, and is provided 'as is'. No warranty of any kind, either expressed or implied, is made as to the accuracy, correctness, or reliability of this translation. Discrepancies or differences created in the translation are not binding and have no legal effect for compliance or enforcement purposes. If any questions arise related to the accuracy of the information contained in this translation, please refer to the official Dutch version that was approved by the Faculty Board.*

A curriculum is a list of course units per student per academic year.
All students should submit a curriculum application in OASIS following the stipulated regulations.

This document contains some of the most important curriculum regulations described in the Ghent University Education and Examination Code (EEC) 2021-2022 (marked in blue), as well as the faculty additions to it (approved by the Faculty Board d.d 17/06/2021).

GHENT UNIVERSITY

1 (RE)ENROLMENT

Students must first (re)enrol electronically via OASIS for every programme/course (Bachelor, Linking, Preparatory and possibly Master) for which they want to take course units in the academic year 2021-2022, before they can compose a curriculum in Oasis.

Attention! A curriculum will only be approved after the student **submits** his/her curriculum application **for approval** in OASIS.

2 IMPORTANT DEADLINES

- Each curriculum application has to be electronically submitted in OASIS **no later than 4 October 2021**.
- Adjustments to a curriculum with respect to first-term course units have to be submitted **no later than 14 November 2021** through the relevant faculty learning track counsellor.
- Adjustments to a curriculum with respect to second-term courses need to be submitted **no later than 28 February 2022** through the relevant learning track counsellor.
- The Curriculum Committee then notifies the students of their fixed curriculum before 15 November at the latest via OASIS. If a student has not submitted a curriculum proposal before 15 November, the Curriculum Committee will determine one itself and inform the student of the fixed curriculum before 1 December at the latest (EEC 2021-2022, article 30§4).

3 REGULATIONS FOR STUDENTS IN THEIR FIRST BACHELOR YEAR

- Students who have enrolled in a Bachelor's programme always need to take up **all the course units** of the first year of the standard learning track (BA1).
  The Curriculum Committee is obliged to grant exceptions to students with a special status or a working student status and students who have already obtained a Bachelor's diploma. In addition, substantiated exceptions are granted on an individual basis by the director of the Department of Educational Policy. (…) (mail to: uitzonderingkleincurriculum@ugent.be).
  If students wish to reduce their curriculum for the second term, the Curriculum Committee decides whether this request may be granted, taking into account the general guidelines concerning study progress. (EEC 2021-2022, article 30§4, 1°)
- Students who have not yet passed all the course units of the first year of the standard learning track of a Bachelor's programme, are required to take up **all remaining course units** of that first year when they enrol for the same programme again. This will guarantee that they may still pass the first deliberation set of the Bachelor's programme.
  The Curriculum Committee is obliged to grant exceptions to students with a special status or a working student status. In addition, substantiated exceptions are granted on an individual basis by the director of the Department of Educational Policy. (…) (EEC 2021-2022, article 30§4, 2°) (mail to: uitzonderingkleincurriculum@ugent.be).
- Students can only get a personalized learning track combining course units from the first and second (or later) year of the standard learning track of the Bachelor's programme, if they **have acquired at least 30 ECTS-credits (or have been exempted) in the first year of the standard learning track**. If sufficient study progress has been

made in the first term, or in exceptional cases that have been sufficiently substantiated, the Curriculum Committee may add course units to the curriculum if the student so desires. (EEC 2021-2022, article 30§4, 3°)

- *[**From the academic year 2022-2023**, an individualized learning path with a combination of course units programmed in the first and second (or a higher) standard learning path year of the Bachelor's programme is possible, regardless of whether the student has acquired (or is exempted from) ECTS-credits for at least 30 ECTS-credits in the first standard learning track year, provided that from that academic year the binding condition for students who failed for half of the ECTS-credits taken up in the first deliberation package of a Bachelor's programme is adjusted as determined in Article 24, § 1, 2°, third paragraph.]*
- Students can only get a personalized learning track combining the Bachelor's programme and consecutive Master's programme (or linking or preparatory programme) if they have acquired credits for all course units from the first year of the standard learning track, if they have been declared to have passed course units (cf. article 67) or if they have obtained exemptions. (EEC 2021-2022, article 30§4, 4°)

4 EXTENT OF A CURRICULUM

All students are allowed to compose a curriculum consisting of **at least 60 ECTS-credits**, unless:

- The student has not yet passed 30 ECTS-credits of the first year of the standard learning track of the Bachelor's programme.
- *[**From the academic year2022-2023**, students who have not yet passed 30 ECTS-credits may compose a curriculum of at least 60 ECTS-credits, provided that from that academic year the binding condition for students who have not passed half of the ECTS-credits taken up in the first deliberation package of a Bachelor's programme is adjusted as determined in Article 24, § 1, 2°, third paragraph.]*
- the student cannot yet take up a personalized learning track combining a Bachelor's programme and a consecutive Master's programme (or a consecutive linking or preparatory programme), because they have not yet acquired credits for all course units from the first year of the standard learning track of the Bachelor's programme.
- sequentiality is applied (cf. article 41, 10°)
- the Curriculum Committee decides that the student cannot yet start the Master's dissertation. This decision can only be made in exceptional cases and must be motivated.
  (EEC 2021-2022, article 30§4, 6°)

In addition to the instructions as described in article 30 of the Education and Examination Code (EEC), the Faculty of Engineering and Architecture prescribes that a curriculum cannot consist of more than **60 ECTS-credits**.

Exceptions are granted if the learning capacity coefficient is at least 30 ECTS-credits. The learning capacity coefficient 'S' (in ECTS-credits/ per academic year) is defined as the number of credits a student has obtained in the previous academic year.

The maximum extent of a curriculum is calculated as the sum of all course units that the student registers for in the present academic year through diploma contracts, credit contracts and examination contracts.

- If **S ≥ 30** then the **maximum** amount of ECTS-credits in the curriculum is **S+30**.

Students who want to take more than 60 ECTS-credits and who did not study at Ghent University in the previous academic year, need to contact the faculty learning track counsellor to prove that they meet the conditions as mentioned above.

5 COMPOSITION OF A CURRICULUM

a. When choosing course units the student has to give precedence to the course units of the standard leaning tracks that he has already started and this has to be done in the correct order of the standard learning tracks.
b. In the Bachelor of Science in Engineering (all programmes/main subjects) the course unit 'Cross-Course Project' can only be taken as the last bachelor's course unit.
c. In the Bachelor of Science in Engineering Technology (all programmes/main subjects) the course unit 'Bachelor Thesis' or 'Interdisciplinary Project' (Information Engineering Technology):
    i. can only be taken as the last bachelor's course unit
    ii. can only be taken as the second last bachelor's course unit if 'Business Administration' (if in the third standard learning track) or the **elective course** (if applicable) is taken as the last course unit.
d. In the Bachelor of Science in Civil Engineering Technology, the course unit 'Bachelor Work Placement' can only be taken if
    i. all other discipline-specific (civil engineering technology) course units of the second standard learning track were already taken in the previous academic year.
    ii. a minimum of 36 ECTS-credits discipline-specific course units of the Bachelor programme has already been taken in the previous academic year.

    Discipline-specific course units are course units from the *main subject Civil Engineering Technology* of the student's study programme, with the exception of 'Thermodynamics and Fluid Mechanics', and 'Physics of waves and particles'.
e. In a Master's programme the course unit 'Master's Dissertation' can only be taken as the very last master's course unit.
f. In the Master of Science in Civil Engineering Technology and in the Master of Science in Land Survey Engineering Technology, the course unit 'Multidisciplinary Project Building Technology' or 'Multidisciplinary Project Land Surveying' can only be taken if all other course units have been taken, with the exception of 'Master's dissertation' and 'Master Work Placement Building Technology' or 'Master Work Placement Land Surveying'.

6 STARTING COMPETENCIES

The student is personally responsible for the choice of his/her course units when composing the curriculum. The curriculum should be as close as possible to the standard learning track and the learning pathway of the programme. Students who wish to register for a course unit from a later standard learning track have to verify themselves whether they comply with the recommended starting competences. The responsible lecturer can ask to prove their previous knowledge.

A **strict policy of required starting competencies is adhered** to the course units in tables 1.a, 1.b, 2 en 3 (see the end of this document). This means that the student has to have passed (i.e. acquired the credit certificate or declared successfully passed for the deliberation set to which the course unit belongs) the course unit in the right column before the course unit in the left column in the curriculum can be taken. These required starting competencies are only strictly applied if they do not prevent the student from taking at least 60 ECTS-credits in the curriculum.

The starting competency in the table indicated by an asterisk is a **required sequentiality** as required by the Committee for Programmes, after the substantiated recommendation of the Faculty Council, on the proposal of the study programme committee involved. It is always binding, even when it prevents the student from taking at least 60 ECTS-credits in the curriculum (EEC 2021-2022, article 41, 10°).

The relevant faculty learning track counsellor and the Curriculum Committee ensure compliance with these required starting competencies and/or required sequentiality.

7 FREE OPTIONAL COURSE UNITS

Students whose programme allows for the inclusion of optional course units from open lists and who therefore can select non-nominally mentioned course units from Ghent University's course offer, can only do so after the approval of the Faculty. Therefore the student consults the relevant faculty learning track counsellor.

8 SUMMER COURSE, SUMMER SCHOOL ('SUMMER PROGRAMME') OR MOOC

Students who want to include a **Summer Course, Summer School** or **MOOC** in their curriculum should ask the prior permission to do so from the study programme committee concerned and the Curriculum Committee by contacting the relevant faculty learning track counsellor. A **Summer Course, Summer School** or **MOOC** has to meet the following conditions:

- The Summer Course, Summer School or MOOC is organized by a reputed institute;
- The Summer Course, Summer School or MOOC corresponds content-wise to the level of a course unit from a master's programme;
- The Summer Course, Summer School or MOOC leads to an official certificate with ECTS-credits and the student obtains a grade score or 'pass/fail' for this.

9 APPLICATION FOR EXEMPTIONS

Students who want to apply for exemptions based on previously acquired qualifications need to use the online application in Plato.

10 DEVIATIONS FROM THE CURRICULUM RULES

If the proposed curriculum, **in exceptional circumstances**, does deviate from the rules mentioned above and the stipulations in the study guide, the student has to consult the relevant faculty learning track counsellor (**before submitting a curriculum proposal in Oasis**), after which they can make a proposal to the Curriculum Committee together.

11 APPEAL

Students may file an appeal against an unfavourable decision on their application concerning the composition of a curriculum. They may file this appeal with the appeals body designated for this purpose by the Faculty Council. To do so, the student has to follow the procedure as described in the Education and Examination Code (EEC 2021-2022, article 30§6).

12 FACULTY CONTACT PERSON

Questions with respect to the curriculum can be submitted to the relevant faculty learning track counsellors:

For students of engineering, engineering: architecture, urbanism and spatial planning and postgraduate studies:
Sarah Bogaert
studietrajectIR.ea@UGent.be
tel. 09 264 41 43 or after an appointment through the reservation system

For students of engineering technology, Ghent:
Annelies Holvoet
studietrajectING.ea@UGent.be
tel. 09 264 37 33 or after an appointment through the reservation system

For students of engineering technology, Kortrijk:
Carine Vertriest
studietraject.kortrijk@UGent.be
tel. 056 24 12 53

Table 1.a | Required starting competencies Bachelor and Master in Engineering: Architecture

Course units with required starting competencies	Requirement: having successfully followed this (these) course unit(s) (i.e. having obtained a credit certificate) or having acquired the target competencies in another way
Architectural design 2 (E081211)	Architectural design 1 (E081111 or E081112)
Architectural design 3 (E081311)	Architectural design 2 (E081211)
Spatial Analysis and Urban Design Studio (E085095)	Architectural design 3 (E081311)
Architectural Design Studio: Design Development (E081603)	Architectural design 3 (E081311)
Masterstudio A (E081760) Masterstudio B (E081770) Masterstudio C (E081780) Masterstudio D (E081790) Masterstudio E (E081795)	Architectural design 3 (E081311)

Table 1.b | Required starting competencies Bachelors and Masters in Engineering

Course units with required starting competencies	Requirement: having successfully followed this (these) course unit(s) (i.e. having obtained a credit certificate) or having acquired the target competencies in another way
Mathematical Analysis III: Applications of Analysis and Vector Analysis (E001320) Mathematical Analysis III (E001321)	Basic Mathematical Tools (E001141) or Basic Mathematics (E001142)
Electrical Circuits and Networks (E090320)	Basic Mathematical Tools (E001141) or Basic Mathematics (E001142)
Analysis of Systems and Signals (E005020)	Basic Mathematical Tools (E001141) or Basic Mathematics (E001142)
Modelling and control of dynamic systems (E007120)	Basic Mathematical Tools (E001141) or Basic Mathematics (E001142)
Polymers (E068660)*	Organic Chemistry (E070310) + • General Chemistry (E070061) or • Chemistry: the Structure of Matter (E070070) + Chemical Thermodynamics (E070080)

* This **required sequentiality** as required by the Committee for Programmes, is always binding, even though the student cannot take up 60 ECTS-credits in his/her curriculum (EEC 2021-2022, article 41, 10°).

Table 2. | Required starting competencies Bachelors and Masters in Engineering Technology, Ghent

Course units with required starting competencies	Requirement: having successfully followed this (these) course unit(s) (i.e. having obtained a credit certificate) or having acquired the target competencies in another way
Network and Computer Security (E765003)	Computer Networks II: Network Management (E761031)
Master's Dissertation (E705002)	Interdisciplinary Final Project (E761043) or Bachelor's Dissertation (E711043/E741053/E731035/E721038)
Master Work Placement Building Technology (E715032) Master Work Placement Land Surveying (E715033)	Bachelor Work Placement (E711069)
Multidisciplinair Project Building Technology (E715026)	Mechanics of Materials (E702030) Structural Analysis Calculation Techniques I (E711023) Structural Analysis Calculation Techniques II (E711028) Design of Concrete Structures I (E711038) Geotechnics (E711064) Steel Construction I (E711034) Design Engineering (E711060) Design of Concrete Structures II (E711063)
Applied Instrumental Analysis (E725021)	Instrumental Analysis (E721042) Spectroscopy (E721041)

Table 3. | Required starting competencies Bachelors and Masters in Engineering Technology, Kortrijk

Course units with required starting competencies	Requirement: having successfully followed this (these) course unit(s) (i.e. having obtained a credit certificate) or having acquired the target competencies in another way
Master's Dissertation (E640100)	Bachelor's dissertation (E630710)

ANNEX A. 11 Selected overview of new educational infrastructure bought with additional FEA budget (recent years)

2020

- Virtual Reality setup: wireless VR headsets HTC Vive Pro Eye with corresponding controllers and sensors, two powerful workstations (one desktop and one laptop) – EA01 - € 7.017,47
- 2 sets of heat flux meters and a device for measuring airtightness of buildings - EA01 – € 7.797,62
- Photon counting unit for laboratories in photonics research – EA05 - € 12.519,14
- 60 Raspberry Pi 4 Model B + peripherals and operation systems – EA06 - € 4.634,21
- Renewal of the reciprocating compressor test stand – EA08 - € 7.649,06
- Fluke 434-II Power Analyzer and equipment for electrical and mechanical measuring techniques – EA08 - € 8.961
- Digital altimeter for measuring large objects + a digital profilometer – EA11 - € 7.756,00

2019

- Test stands for the Cross-course project electromechanical engineering – € 16.520
- BladeRF 2.0 micro and peripherals – EA05 - € 2.433
- Multi-deployable data acquisition unit for physiological measurements and signal processing in biomedical engineering – EA06 - € 16.470
- ULTIMAKER S5 3D-printer – EA08 - € 4.792,50
- Versastat 3F-400 Floating Potentiostat/Galvanostat – EA11 - € 4.344,07
- Desktop for GIS-applications – EA15 - € 3.974,91

2018

- 10 Turtlebot 3 Hamburger robots for project-based education – EA06 - € 7.125
- Heat pump labs: measuring equipment and data acquisition equipment for two test benches on heat pumps – EA08 - € 12.364
- 2 industrial inverters (electrically controlled industrial drives), based on direct torque control, for asynchronous electrical machines – EA08 - € 3.966,24
- Central active inverter (Active line module 230V) to expand motor-drive test setups – EA08 - € 5.297,20
- 10 setups for interactive practicals on electrical drive and measurement techniques (transformers) – EA08 - € 20.000
- 2 high-end USB-microscopes for in-situ microscopy (practicals and demos during lectures) – EA11 - € 5.358
- 4 vibration sensors (miniature size) and 1 impact hammer – EA15 - € 3.408

2017

- 3D-printer Photocentric Liquid Crystal Pro and CNC milling machine Roland Modela MDX-540 – EA01 - € 14.677,01
- Second-hand N9917A 18 GHz FieldFox Microwave Analyzer (incl. full 2-port vector network analyzer, spectrum analyzer) – EA05 - € 18.011
- 8 oscilloscopes for student projects and practicals – EA06 - € 4.792
- Heavy duty (tec) Peltier/Seebeck cooling element – EA11 - € 3.600

- Fine grinding mill and melting bank for processing recycled plastics – EA11 - € 6.886
- Robotic arm for 3D-concrete-printing process – EA14 - € 14.550
- Embroidery machine Brother VR + software – EA18 - € 4.132,23
- Form2 SLA printer and resin cartridges – EA18 - € 4.021,79

Departments

EA01 - Department of Architecture and Urban Planning
EA05 - Department of Information Technology
EA06 - Department of Electronics and Information Systems
EA08 - Department of Electromechanical, Systems and Metal Engineering
EA11 - Department of Materials, Textiles and Chemical Engineering
EA14 - Department of Structural Engineering and Building Materials
EA15 - Department of Civil Engineering
EA18 - Department of Industrial Systems Engineering and Product Design

FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

INNOVATION FOR SOCIETY

EXCELLENTIEPROGRAMMA

Faculteit Ingenieurswetenschappen en Architectuur
www.ugent.be

UNIVERSITEIT GENT

Doelstelling:
De faculteit Ingenieurswetenschappen en Architectuur wil haar studenten de mogelijkheid bieden om deel te nemen aan een 1-jarig extracurriculair programma met technisch-maatschappelijke inslag. Dit programma heeft tot doel zowel verbredend als verdiepend te zijn, en interdisciplinaire samenwerking binnen en buiten de faculteit te bevorderen. Studenten zullen in contact komen met diverse werkvormen en eindopdrachten, die jaarlijks kunnen wisselen.
Concreet zal er rond een wisselend jaarthema gewerkt worden, waarbij innoverende en veelzijdige oplossingen voor een belangrijk hedendaags maatschappelijk probleem bedacht en/of geïmplementeerd zullen worden.
Het excellentieprogramma richt zich op goede, gemotiveerde en veelzijdige studenten die naast hun reguliere bachelor- of masteropleiding graag een stevige extra uitdaging willen aangaan. Er wordt bij de selectie niet louter gemikt op topstudenten (op basis van studieresultaten), maar op een brede mix van profielen. Hierbij zullen motivatie, enthousiasme en creativiteit een doorslaggevende rol spelen.
Op termijn heeft de faculteit de ambitie om het facultair excellentieprogramma om te vormen tot een interfacultair honoursprogramma.

Inhoud:
Er wordt gewerkt rond een jaarlijks wisselend thema. Dit thema is telkens gelinkt aan 1 of meerdere van de United Nations Sustainable Development Goals (zie https://sdgs.un.org/goals), bekeken vanuit een Gentse of Belgische context en vanuit de rol die de ingenieur kan spelen bij het behalen van die doelstelling(en).
Elk jaarthema wordt gedragen door een voldoende grote groep van ZAP en OAP leden, die adequate begeleiding en inhoudelijke expertise voorzien.

Volgende jaarthema's worden voorgesteld (zie bijlage):
AJ 2021-2022: Engineers for fair institutions
AJ 2022-2023: Het multifunctioneel eiland
Na academiejaar 2022-2023 beslist het facultair bestuur over ingediende voorstellen voor een jaarthema. Er wordt over gewaakt dat door de jaren heen verschillende ingenieursdisciplines aan bod kunnen komen.

Toelatingsvoorwaarden:
Het programma kan enkel gevolgd worden door studenten met een inschrijving in een van de studieprogramma's van de faculteit Ingenieurswetenschappen en Architectuur.
Elke student die minstens het eerste bachelorjaar (industrieel ingenieur, burgerlijk ingenieur of burgerlijk ingenieur-architect) volledig heeft afgewerkt kan kandideren. Studenten uit eerste bachelor kunnen ook kandideren, maar hun selectie is voorwaardelijk op slagen voor het volledige eerste modeltrajectjaar. Een student kan niet tegelijkertijd zowel aan dit excellentieprogramma deelnemen als aan een ander honours- of excellentieprogramma, en zal bij gelijktijdige selectie een keuze moeten maken. Het excellentieprogramma is ook niet combineerbaar met een Erasmus-uitwisseling of een ander type van uitwisseling in hetzelfde academiejaar.
Studenten die het eerste bachelorjaar niet gevolgd hebben aan de faculteit, maar een andere vooropleiding genoten, kunnen op basis van dossier eventueel ook toegelaten worden tot de selectieprocedure. Hierbij dient minimaal een equivalent van 60 ECTS behaald te zijn door de student in een universitaire opleiding.

Promotie:
Het excellentieprogramma wordt breed aangekondigd en gecommuniceerd naar de studenten via infosites, Ufora, lesgevers, monitoraat en trajectbegeleiding. We rekenen in het bijzonder ook op de lesgevers om getalenteerde studenten persoonlijk aan te spreken en te motiveren.
Er wordt een website voorzien met de nodige informatie, evenals een emailadres.

Selectie van de kandidaten:
Studenten die aan het programma wensen deel te nemen dienen voor de jaarlijkse deadline te kandideren. Een kandidatuur bestaat onder andere uit:

- kort CV
- motivatie om deel te nemen
- beschrijving van de input die de student denkt te kunnen hebben
- extracurriculaire activiteiten (o.a. muziek-, kunst- of sportbeoefening, engagementen bij andere organisaties, werk- of ondernemingsactiviteiten, etc.)
- eventuele vragen specifiek aan het gekozen jaarthema
- deelname aan andere excellentieprogramma's, honoursprogramma's of uitwisselingen
- puntenlijsten.

Uit de inschrijvingen wordt door de selectiecommissie een shortlist opgesteld. Deze studenten worden uitgenodigd voor een kort gesprek en/of bijkomende proef om hun kandidatuur te verdedigen.

In functie van het jaarthema legt de selectiecommissie het maximaal aantal te selecteren kandidaten vast (waar we als leidraad 20 tot 40 studenten vooropstellen). Er wordt een rangschikking opgesteld van de studenten op de shortlist, inclusief een voldoende lange reservelijst (o.a. om rekening te houden met studenten die niet slagen of deelnemen aan andere programma's of uitwisselingen).

De selectiecriteria omvatten naast de studieresultaten en studievoortgang ook motivatie, inzet, creativiteit, veelzijdigheid, en het beschikken over vaardigheden met meerwaarde voor het jaarthema. De geselecteerde kandidaten moeten een brede intellectuele belangstelling hebben, beschikken over de nodige sociale en communicatieve vaardigheden en bereid zijn tot het verleggen van hun grenzen. Bovendien wordt er gestreefd naar een diverse mix van profielen.

De ingediende dossiers worden vertrouwelijk en met respect voor de privacy behandeld in overeenstemming met de generieke gedragscode voor de verwerking van persoonsgegevens en vertrouwelijke informatie. In het bijzonder worden de ingediende gegevens enkel gebruikt voor de desbetreffende selectieprocedure en worden ze verwijderd eens het jaarthema gestart is.

Inschrijving:
De geselecteerde kandidaten kunnen zich inschrijven via Oasis. Er is geen studiegeld verschuldigd voor het excellentieprogramma.
Indien in het excellentieprogramma vertrouwelijke informatie aan bod komt, zal aan de studenten gevraagd worden een eenzijdige verklaring van vertrouwelijkheid en overdracht van rechten te ondertekenen. Studenten die dit weigeren zullen in desbetreffend geval niet kunnen deelnemen aan het programma.

Onderwijstaal:
De onderwijstaal wordt bepaald in functie van het gekozen jaarthema en kan jaarlijks wijzigen. Voor AJ21-22 is de onderwijstaal het Nederlands. Het is mogelijk dat gastsprekers een andere taal gebruiken.

Organisatie:
Het programma heeft een capaciteit van 20 tot 40 studenten per jaar, die in functie van het jaarthema vastgelegd wordt.
Het programma loopt telkens gedurende een volledig academiejaar. De activiteiten bestaan enerzijds uit lezingen/workshops door gastsprekers of sitebezoeken die de studenten verplicht moeten voorbereiden en bijwonen, en anderzijds uit het uitwerken van de probleemstelling(en) of opdracht(en) van het jaarthema. Er wordt naar gestreefd de studenten te confronteren met uitdagende werkvormen die niet in hun reguliere opleiding aan bod komen. Om die reden kunnen bestaande vakken niet in het excellentieprogramma geïncorporeerd worden. Omgekeerd kunnen studenten ook geen vrijstellingen krijgen voor reguliere opleidingsonderdelen door deelname aan het excellentieprogramma.
Om de cohesie tussen de geselecteerde groep studenten te bevorderen kunnen sociale activiteiten georganiseerd worden.

Activiteiten (lezingen, workshops, sitebezoeken, sociale activiteiten) en groepswerk kunnen georganiseerd worden tijdens

- de 24 lesweken van het academiejaar, inclusief weekends en vakantieperiodes
- de zomervakantie voorafgaand aan de start van het academiejaar
- de inhaalweken

Tijdens de examenperiodes worden geen activiteiten gepland. Tijdens de lesweken worden de activiteiten ’s avond georganiseerd na de reguliere lessen. De activiteiten kunnen ook op locatie buiten de universitaire gebouwen plaatsvinden.

Idealiter komen de studenten elke lesweek op een vast moment samen, maar de frequentie kan in functie van het jaarthema of een eventuele groepsindeling aangepast worden. Minstens elke 4 lesweken wordt er een feedbackmoment georganiseerd met alle studenten.

Studenten die zich niet voldoende inzetten of gemaakte afspraken niet naleven kunnen uit het programma gezet worden na een unanieme beslissing door de begeleidingscommissie. Zij kunnen nadien niet meer opnieuw kandideren voor een volgend jaarthema. Van deze regel kan afgeweken worden in geval van individuele bijzondere omstandigheden.

Studietijd:
Tijdens de lesweken schatten we de tijdsbelasting in op 1 avond per week voorbereiding en 1 avond per week activiteit (al dan niet gesuperviseerd groepswerk, lezing, workshop of bezoek). Daarnaast zullen de studenten presentaties, teksten, posters en andere output zelfstandig moeten voorbereiden.
We stellen een equivalentie van ongeveer 15 ECTS voorop voor het excellentieprogramma, in overeenstemming met de centrale richtlijnen.

Evaluatie:
Er wordt een finaal jurymoment georganiseerd in de inhaalweek van het tweede semester. De studenten stellen hun werk voor aan de hand van een of meerdere presentaties of posters, waarna een expertenjury eindfeedback geeft op het geleverde werk. De examencommissie oordeelt over het slagen van de studenten.
Omdat het excellentieprogramma samenwerking en interdisciplinariteit wil bevorderen, krijgen studenten geen individueel eindresultaat. In plaats daarvan krijgen studenten die het volledige programma succesvol doorlopen een getuigschrift met het facultair logo en ondertekend door de decaan.
Indien mogelijk wordt een feestelijke proclamatie georganiseerd.

Kwaliteitszorg:
Op het einde van elk academiejaar wordt een globale bevraging georganiseerd onder de deelnemende studenten. Specifieke activiteiten kunnen ook afzonderlijk geëvalueerd worden. Doel is om de kwaliteit van het programma te bewaken en eventuele pijnpunten te signaleren. De resultaten worden besproken in overleg met het facultair bestuur. Op basis hiervan kan het huishoudelijk reglement herzien worden.

Samenstelling van de betrokken commissies:
Het excellentieprogramma wordt beheerd door een dagelijks bestuur.
De begeleidingscommissie bestaat uit de coördinatoren van het jaarthema en wisselt dus jaarlijks.
De selectiecommissie bestaat uit de 4 leden van het dagelijks bestuur aangevuld met 2 leden van de begeleidingscommissie.
De examencommissie bestaat uit de leden van het dagelijks bestuur en de leden van de jaarlijks wisselende begeleidingscommissie.

Dagelijks bestuur:
Hendrik De Bie (vertegenwoordiger opleiding burgerlijk ingenieur)
Sofie Van Hoecke (vertegenwoordiger opleiding industrieel ingenieur)
Jelle Laverge (vertegenwoordiger opleiding burgerlijk ingenieur-architect)
Femke De Backere (OAP-voorzitter)

Administratieve ondersteuning:
Charlotte Louwagie en Marion Roels

Begeleidingscommissie: zie jaarthema's

Tijdslijn:
AJ x-1: selectie van studenten voor AJ x
Lancering oproep bij aanvang tweede semester.
Deadline kandidaturen voor of na paasvakantie.
Opstellen shortlist.
Gesprekken of bijkomende proef voor einde lessen tweede semester.
Eindselectie bekend maken ten laatste begin juli.
AJ x: uitwerking jaarthema met geselecteerde studenten.
AJ x+1: proclamatie tijdens een facultair event (zoals bijvoorbeeld Engineer of the year Award of TechBoost)

AJ 2021-2022: Engineers for fair institutions

In academiejaar 2021-2022 richten we ons in het FEA excellentieprogramma op UN sustainable development goal 16, namelijk *Peace, Justice and Strong Institutions*.
Dit is een doel waar een nieuwe ingenieursaanpak grote maatschappelijke veranderingen teweeg kan brengen, maar tevens op grote problemen van ethische aard botst.

Aan de hand van verschillende cases verkennen we een aantal grote technologische en ethische uitdagingen die gesteld worden aan de ingenieur van de 21e eeuw. Deze cases bestrijken drie belangrijke stappen in ons juridisch systeem, van misdaadpreventie over rechtspraak tot strafuitvoering:

1. Heel wat politiedepartementen, vooral in de Verenigde Staten, maken gebruik van gecompliceerde algoritmen en/of AI, enerzijds om locaties te zoeken met een hoge waarschijnlijkheid van misdaadpleging (*predictive policing*) of anderzijds om bijvoorbeeld gezichtsherkenning uit te voeren. Dergelijke systemen botsen op zeer veel kritiek van burgerrechtenbewegingen wegens ongewenste feedback loops, onduidelijkheid omtrent de beslissingsvorming en *racial profiling*. Zie bijvoorbeeld:

https://www.vice.com/en_us/article/xwbag4/academics-confirm-major-predictive-policing-algorithm-is-fundamentally-flawed
https://www.theverge.com/2018/4/26/17285058/predictive-policing-predpol-pentagon-ai-racial-bias
https://www.technologyreview.com/2019/12/20/79/ai-face-recognition-racist-us-government-nist-study/

2. Wanneer de rechtbank een vonnis uitgesproken heeft, dan is het een delicaat probleem om deze vonnissen publiek en zoekbaar te maken mits inachtneming van de anonimiteit van de betrokkenen.
3. De vzw De Huizen (www.dehuizen.be) voert al jaren inspanningen op zowel het Belgische als het Europese niveau om tot een radicaal nieuwe manier van strafuitvoering te komen. Hierbij wordt het achterhaalde gevangenisconcept (het *panopticon*) uit de 19de eeuw vervangen door moderne detentiehuizen die een kleinschalige en gedifferentieerde aanpak beogen, waarbij herintegratie in de maatschappij centraal staat. Architectuur wordt hier op cruciale manier ingezet.

Voor dit jaarthema werken we met 4 concrete cases, die we nu verder bespreken:

Case 1: predictive policing

Vandaag wordt vanuit criminologische hoek met veel interesse gekeken naar de toepassingsmogelijkheden van AI op vlak van criminaliteitsbeheersing- en bestrijding. In deze case wordt ingegaan op de mogelijkheden van *predictive policing*.
Kunnen we misdaad voorspellen en voorkomen? Het lijkt fictie, maar er wordt al volop mee geëxperimenteerd. Hoe gaat *predictive policing* in zijn werk? Wat zijn de voordelen en gevaren? Hoe veranderen nieuwe technologieën het werk van de politie?

In deze case staan we stil bij de uitdagingen in het omgaan met criminaliteitsvoorspellingen en welke impact deze ontwikkelingen kunnen hebben op de maatschappij. We zullen enerzijds bestuderen welke predictieve modellen het meest geschikt zijn om criminaliteit te voorspellen op basis van data uit verschillende organisaties, en welke technische problemen daarbij opduiken. We bekijken anderzijds ook de ethische vraag hoe wenselijk het is om dergelijke modellen in de praktijk te gebruiken.

Bronnen:

Rummens, A. & Hardyns, W. (2020). The effect of spatiotemporal resolution on predictive policing model performance. *International Journal of Forecasting* (online first). https://doi.org/10.1016/j.ijforecast.2020.03.006

Rummens, A. & Hardyns, W. (2020). Comparison of near-repeat, machine learning and risk terrain modeling for making spatiotemporal predictions of crime. *Applied Spatial Analysis and Policy* (online first). https://doi.org/10.1007/s12061-020-09339-2

Hardyns, W. & Rummens, A. (2018). Predictive policing as a new tool for law enforcement? Recent developments and challenges. *European Journal on Criminal Policy and Research*, 24(3), 201-218. doi: 10.1007/s10610-017-9361-2

Rummens, A., Hardyns, W. & Pauwels, L. (2017). The use of predictive analysis in spatiotemporal crime forecasting: Building and testing a model in an urban context. *Applied Geography*, 86, 255-261. doi: 10.1016/j.apgeog.2017.06.011

Case 2: Raciale bias in gezichtsherkenning

Binnen het domein van “machinaal leren” is er de afgelopen jaren een grote vooruitgang geboekt, onder meer op vlak van object- en gezichtsherkenning. Bij gezichtsherkenning worden gezichten gescand om het geslacht van een persoon, het ras, emoties en zelfs de identiteit te bepalen. Jammer genoeg hangen de prestaties van deze technieken sterk af van het gezichtstype. Verschillende onderzoekers hebben een “raciale bias” vastgesteld bij gezichtsherkenningstechnieken: een studie van het MIT toont aan dat bij 3 algoritmes de nauwkeurigheid 99.2% bedraagt voor mensen met een lichte huidskleur, terwijl voor mensen met donkere huidskleur de nauwkeurigheid afneemt tot 80% en zelfs 67%.

Hoewel het onderzoek over eerlijkheid van machinale leertechnieken in het algemeen nog niet zo ver staat, worden gezichtsherkenningstechnieken al ruim ingezet door politiediensten om verdachten te identificeren. De prestaties van de algoritmes spelen dan een zeer belangrijke rol: als de resulterende herkenning een bias vertoont kan dit leiden tot verkeerde arrestaties en interventies. Bovendien kunnen deze interventies dan opgenomen worden in dezelfde datasets die men gebruikt om dergelijke technieken te ontwikkelen. Dit creëert negatieve feedbacklussen die bestaande biases uitvergroten.

In januari 2020 heeft de politie van Detroit zo verkeerdelijk een willekeurige man gearresteerd die geïdentificeerd was op basis van gezichtsherkenning op camerabewakingsbeelden, dit terwijl zijn jonge kinderen toekeken. Hij werd vastgehouden voor 30 uren, en nadien vrijgelaten wegens gebrek aan bewijs. Het zogenaamde COMPAS-programma dat door het gerecht in de VS wordt gebruikt om risico op recidivisme te voorspellen, vertoont eveneens een grote bias: voor hetzelfde misdrijf onder vergelijkbare omstandigheden voorspelt het een veel hoger risico voor zwarte beklaagden dan voor witte beklaagden.

Taak

Deze case heeft als doel om een applicatie te ontwikkelen die aantoont dat raciale bias optreedt in gezichtsherkenningstechnieken, zelfs wanneer de datasets zorgvuldig worden samengesteld. Een bestaand gezichtsherkenningsalgoritme zal eerst getraind worden op een dataset van gezichten van personen. De applicatie zal enerzijds de mate waarin raciale bias voorkomt in de dataset kwantificeren en anderzijds ook voorbeelden geven van raciale bias (bijvoorbeeld, twee personen die het algoritme niet gemakkelijk van elkaar kan onderscheiden).

De studenten zullen verder ook verschillende vormen van bias bestuderen die de eerlijkheid van machinale leertechnieken bepalen (discriminatie op basis van invoer, representatie of predictie). Verder willen we nagaan of het mogelijk is om het herkenningssysteem bij te sturen om het biasprobleem te vermijden. De studenten zullen de assumpties van traditionele classificatie in vraag moeten stellen. Ze kunnen hiervoor andere paradigma’s verkennen (zoals causale inferentie) of argumenteren dat het gebruik van geautomatiseerde systemen fundamenteel onwenselijk is in bepaalde contexten.

Interdisciplinaire samenwerking zal hier een grote rol spelen, aangezien in de literatuur veel verschillende definities van “eerlijkheid” worden gehanteerd die niet overeenstemmen met de manier waarop dit begrip wettelijk is vastgelegd. De correcte vertaling van juridische concepten naar technische specificaties is een uitdagend en belangrijk onderdeel van dit probleem.

Bronnen:

“Facial recognition to 'predict criminals' sparks row over AI bias”, BBC News, June 24, 2020, https://www.bbc.com/news/technology-53165286

Allyn, Bobby. “'The Computer Got It Wrong': How Facial Recognition Led To False Arrest Of Black Man,” June 24, 2020. https://www.npr.org/2020/06/24/882683463/the-computer-got-it-wrong-how-facial-recognition-led-to-a-false-arrest-in-michig.

Du, Mengnan, et al. "Fairness in deep learning: A computational perspective." IEEE Intelligent Systems (2020).

“Machine Bias”, ProPublica, May 2016. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

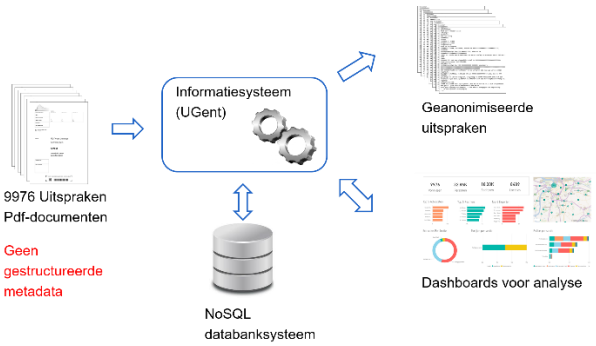
O'Neil, Cathy. *Weapons of math destruction: How big data increases inequality and threatens democracy*. Broadway Books, 2016.

Barocas, Solon et al. Fairness and Machine Learning. https://fairmlbook.org/

Case 3: tekstanonimisering van vonnissen

Tekstanonimisering is een soort datasanering, die bedoeld is voor privacybescherming. Het is een proces waarbij alle persoonsgegevens die voorkomen in een tekst zodanig worden gewijzigd dat het onmogelijk wordt om de betrokkenen te identificeren.

Via een samenwerking tussen onze faculteit en de faculteit Recht en Criminologie wordt momenteel gewerkt aan een informatiesysteem om arresten van de Vlaamse Hoven van Beroep (semi)automatisch te anonimiseren. Een dergelijk informatiesysteem is heel belangrijk wanneer men arresten en vonnissen publiek toegankelijk wil maken.



Het beoogde informatiesysteem wordt gevoed met arresten in pdf-formaat en verwerkt de inhoud van deze pdf-documenten op een semantische manier. De geïdentificeerde semantische tekstcomponenten worden bewaard in een NoSQL databanksysteem en geven onder meer aan welke tekstcomponenten duiden op personen, bedrijfsnamen en adressen. Persoonsgebonden informatie wordt vervolgens geannoteerd met een label dat de rol van een persoon binnen het arrest aangeeft.

Bv. ‘magistraat_1’, ‘geïntimeerde_1’, ‘advocaat_1_geïntimeerde_1’, ‘griffier_1’, ‘derdepartij_4’, etc. Deze labels worden dan tenslotte gebruikt om de tekst te anonimiseren en daarbij toch nog een deel van de leesbaarheid te garanderen.

Een probleem bij het annoteren is dat namen en woorden door schrijffouten en afkortingen soms op een andere wijze worden herhaald in de tekst en daardoor onterecht aan een nieuwe persoon worden toegeschreven. Bv. ‘Verdonck’ en ‘Verdonk’ worden in het geval van een typfout als twee verschillende

personen gezien. Dit probleem is in de literatuur omschreven als een *coreferentieprobleem*. De bedoeling van het werk van de studenten is om na te gaan hoe bestaande coreferentiedetectietechnieken kunnen worden aangewend in het anonimiseringsproces om zo tot betere resultaten te komen. Het werk omvat een korte literatuurstudie, het experimenteren met code die voorhanden is in de onderzoeksgroep en het ontwerpen en implementeren van een mogelijke oplossing.

Case 4: kleinschalige detentiehuizen

We voorzien volgende drie thema's:

- Op zoek naar locaties voor detentiehuizen in het Gentse: we ontwikkelen een geavanceerde beslissingstool of -matrix waarmee we voor leegstaande locaties kunnen kijken of ze al dan niet in aanmerking kunnen komen voor de ontwikkeling van een detentiehuis.
- Ontwikkelen van een virtuele tool die buurtbewoners toelaat een detentiehuis en de werking ervan digitaal te verkennen.
- Conflict kleinschaligheid versus grootschaligheid: de detentieproblematiek kan abstract herleid worden tot een keuze tussen kleinschaligheid en grootschaligheid. Analoge problemen stellen zich ook voor bijvoorbeeld woonzorgcentra, waar grotere schaal vaak ook voor grotere problemen zorgde tijdens de coronacrisis. We bestuderen de economische randvoorwaarden voor zowel woonzorgcentra als voor detentiehuizen vanuit deze invalshoek.

Voor deze case zijn we in nauw contact met vzw De Huizen en met Stad Gent (Schepen van Sociaal Beleid en Armoedebestrijding) die dit initiatief erg ondersteunt en ons onder andere een lijst van leegstaande panden zal bezorgen. Dit initiatief behoort ook tot het nieuwe regeerakkoord.

Bronnen:

From Prison to Detention House, a story of civilisation, Hans Claus, TEDxAntwerp https://youtu.be/sRcbVduOoE8

De geselecteerde studenten zullen in vier groepen opgedeeld worden om de vier cases in detail te bestuderen en uit te werken. Om de vier weken voorzien we een gezamenlijke feedbacksessie, waar de verschillende groepen hun vorderingen voorstellen, en waar de ethische aspecten in detail behandeld worden (al dan niet door een gastspreker). De sterktes van de deelnemende studenten worden optimaal ingezet: zo kunnen soms groepswissels noodzakelijk blijken.

Coördinatoren van het jaarthema AJ 2021-2022

EA01: Ronald De Meyer en Ruben Verstraeten
EA05: Cedric De Boom, Thomas Demeester, Femke Ongenae, Pieter Simoens
EA06: Gert de Cooman
EA07: Guy De Tré, Bart Goossens
RE21: Eva Lievens
RE23: Wim Hardyns, Gert Vermeulen
WE02: Jonathan Peck

AJ 2022-2023: Multifunctioneel Eiland

In het voorgestelde excellentieprogramma “Multifunctioneel Eiland” wordt er een link gelegd tussen verschillende disciplines zowel binnen als buiten de ingenieurswetenschappen. Het onderwerp is ontstaan naar aanleiding van lopend en toekomstig onderzoek binnen verschillende FEA-onderzoeksgroepen en -consortia en leunt aan bij de sustainable development goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure) en 13 (Climate Action).

Zoals de titel zegt, is het de bedoeling om verschillende mogelijke functies van een kunstmatig eiland voor de Vlaamse kust te exploreren waarbij ook de fase van het ontwerp en de constructie ervan aan bod komt. Er zijn ook “zijsprongen” mogelijk waarbij een bepaald aspect verder wordt uitgewerkt dat de toepassing op het multifunctioneel eiland overstijgt.

De mogelijke functies die kunnen behandeld worden zijn de volgende:

1. Kustverdediging:
    a. Ontwerp- en constructietechnieken van kustverdediging
    b. Bouwen van eiland: offshore geotechniek en baggertechnieken
    c. Hydrodynamische invloed van eiland op getijwerking in Schelde-estuarium
    d. Socio-economische impact van overstroming in kustzone
2. Energieproductie
    a. Offshore elektriciteitsproductie (wind, valmeercentrale)
    b. Omzetting van elektriciteit naar waterstof (power-to-gas)
    -> mogelijke zijsprong rond de waterstofeconomie (pijpleidingen, gebruik in transport, materiaaldegradatie door omgevingsinvloeden)
    c. “Stopcontact op zee” – supergrid op zee
3. Scheepvaart / logistiek
    a. Link met binnenscheepvaart
    b. Logistiek, bijv. landingsplaats voor een kleine wig met crew voor de offshore sector
    c. Connecties voor gevaarlijke lading zoals gas (LNG, H_2) die hier connectie maken met het schip om dan via een leiding verder gepompt te worden

Daarenboven zijn er nog andere aspecten die aan bod kunnen komen, met name:

4. Beheer, onderhoud en exploitatie van hoogwaardige infrastructuur in een agressieve offshore omgeving
    a. Tribologie in waterige omgeving
    b. Oogsten van offshore windenergie / golfenergie: ontwerp en constructie van draagstructuren en uitdagingen verbonden aan corrosie-vermoeiing

De opzet zou zijn om eerst een inleidend programma aan te bieden waarin de bovenvermelde functies en aspecten aan bod komen, eventueel nog aangevuld met andere onderwerpen zoals ecosysteemfuncties, aquacultuur en juridische aspecten zoals ruimtelijke planning om het plaatje compleet te maken. Daarna zullen de studenten zich verdiepen in één van de bovenvermelde functies of aspecten (1 tot 4) volgens een systeem van “gestuurde vrijheid”, waarbij de studenten in zekere mate zelf het parcours bepalen, en met blended learning. Hiervoor kunnen de studenten zich ook inwerken in een bepaald thema aan de hand van bijv. krantenartikels. De finaliteit van het programma kan verschillen volgens het onderwerp ((numerieke) simulatie, kleine opstelling, white paper, etc.). Gezien de maatschappelijke relevantie wordt overwogen om af te sluiten met een beleidsadvies en (bijv.) een debat met o.a. beleidsmakers en ambtenaren om enige media-aandacht aan te trekken.

Het streefdoel is 25 à 30 studenten te laten deelnemen en hiervoor zo'n 50-tal studenten te interviewen voor selectie. De geselecteerde studenten kunnen dan zelf hun voorkeur qua uit te werken onderwerp uitspreken.

Coördinatoren van het jaarthema AJ 2022-2023
EA08: Lieven Vandevelde en Stijn Hertelé
EA15: Peter Troch
in samenwerking met EnerGhentIC consortium (www.ugent.be/energhentic/en)

ANNEX A.13 Internship statistics of FEA

This annex provides an overview of data on internships for academic years 2014-2015 until 2020-2021. The impact of the coronavirus pandemic and its restrictions is visible for the last two academic years. Internships are assigned to the academic year in which they are *included* in the curriculum. As such, an internship included in 2020-2021 may have been executed in the summer of 2020 in the academic year 2019-2020. In the graphs, no distinction is being made between 4 (3 credits) and 6 week (6 credits) internships.

Number of internships per year

Between 2014-2015 and 2018-2019, we have seen a steady increase in the yearly number of students taking up an internship in their curriculum (Figure 1), a trend that was abruptly interrupted by the coronavirus pandemic in 2019-2020 and especially in 2020-2021.

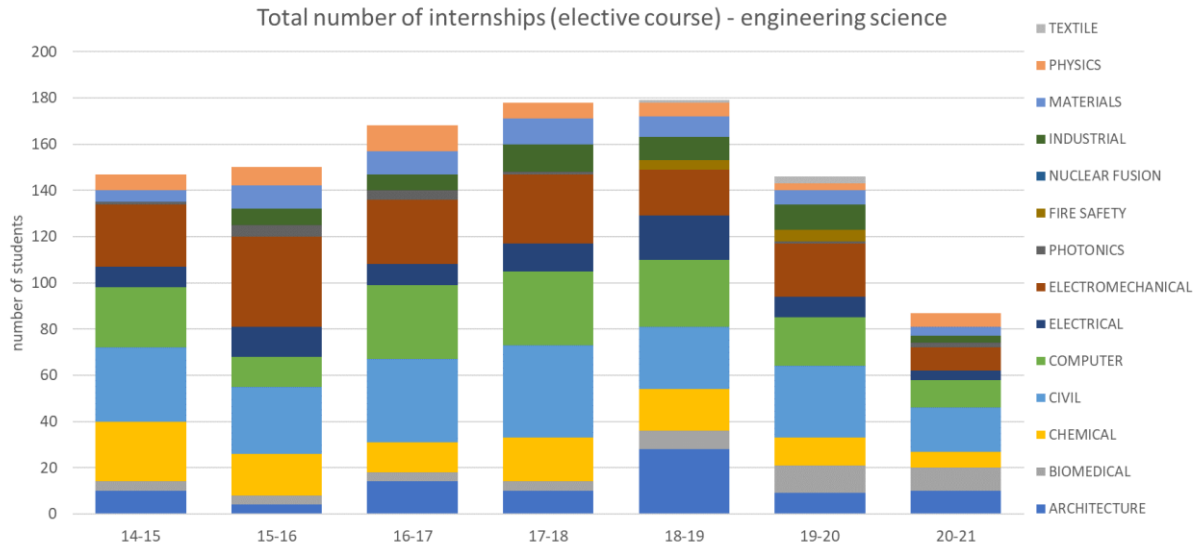


Figure 1. Global overview of the number of internships over the past 7 academic years

While in 2014-2015 14.1% of all Architecture and Engineering Science master students had an internship in their curriculum (Figure 2), this number had increased to 16.2% in 2018-2019.

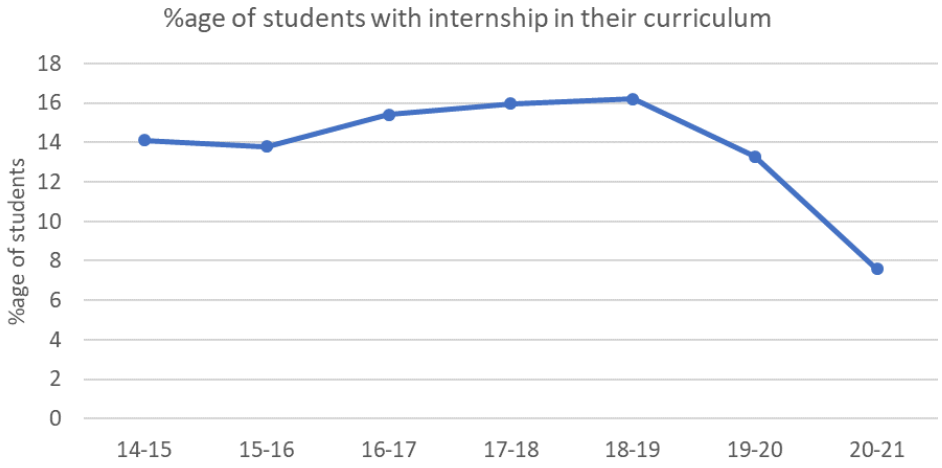


Figure 2. Evolution in the overall percentage of master students with an internship in their curriculum (during studies)

The effective number of executed internships is higher than the numbers indicate, as each year 20 to as much as 40 voluntary internships are registered in Plato, but are not taken up in the curriculum. As these numbers include short as well as interrupted internships and lack complete documentation, they are not included in the above statistics.

Over the 3-year period 15-16 to 18-19, 25% of the internships in the MSc in Engineering Science and Architecture were international.

Students graduating with/without an internship

Students can take up an internship over the summer between 3rd bachelor and 1st master (to be included in their 1st master curriculum), or during the summer between the 1st and 2nd master (to be included in their 2nd master curriculum). Figure 3 displays, for the last 5 academic years, the number of students graduating indicating how many of these students had an internship in their curriculum.

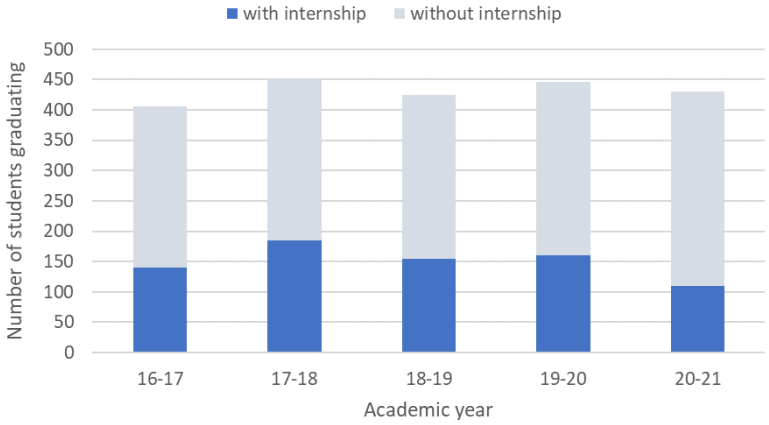


Figure 3. Number of graduating students with or without an internship in their curriculum.

In relative numbers (Figure 4), over 1/3rd of our master students in engineering (architecture) graduate with an internship in their curriculum (overall average). Programmes with the highest number of graduates taking up an internship are chemical engineering and material science.

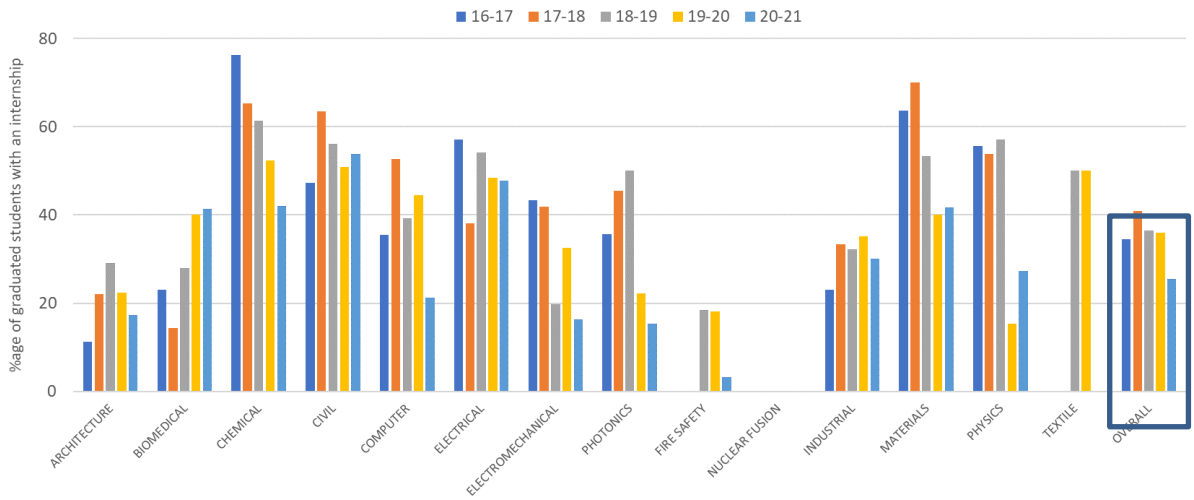


Figure 4. Percentage of graduating students with an internship in their curriculum over the past 5 academic years. Data are split per programme; overall average is displayed on the right.

Appreciation by the work field and grades obtained

The industry supervisor grades the practical aspects of the report (technical skills, organization, initiative) and personal skills and attitude (creativity, commitment, critical sense, independence) of the intern. Each of these items is marked on the following scale

- Insufficient (poor project; did not take the opportunity to learn something new) (0-9)
- Pass (student barely did what was expected from him/her) (10-11)
- Sufficient (could be better; some flaws) (12-13)
- Average-good (performance according to expectations) (14-15)
- Very good (good job; better than expected) (16-17)
- Exceptionally good (little to nothing to improve) (18-19)

Figure 5 provides an overview of the assessment of all internships for the last three years that have been evaluated by an industry supervisor and later by an academic promotor for the MSc in Engineering Science and Architecture. The chart demonstrates a very high level of appreciation of the intern by the industry supervisor. The technical skills, organisation and initiative are overall most appreciated; the creativity of the student scores least (but still overall good to very good).

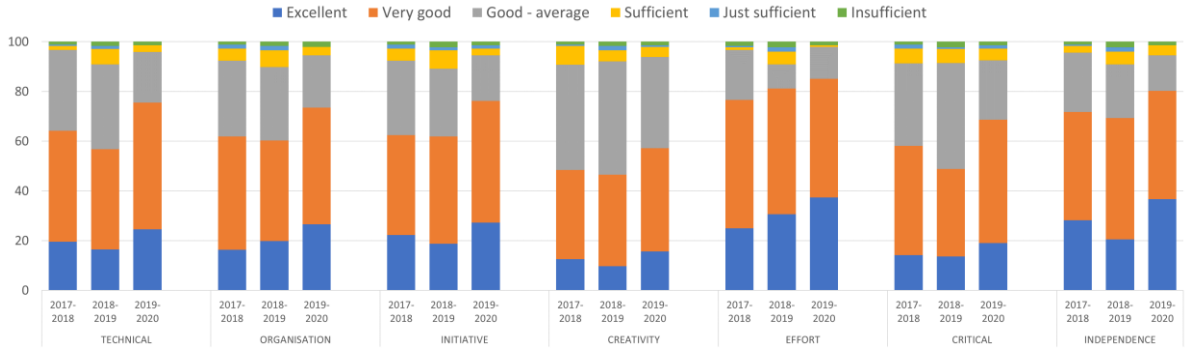


Figure 5. Appreciation of the intern and internship by the industry advisor.

Figure 6 displays the distribution (left) and average and standard deviation (right) of the assigned grades for the same categories and the same three academic years.

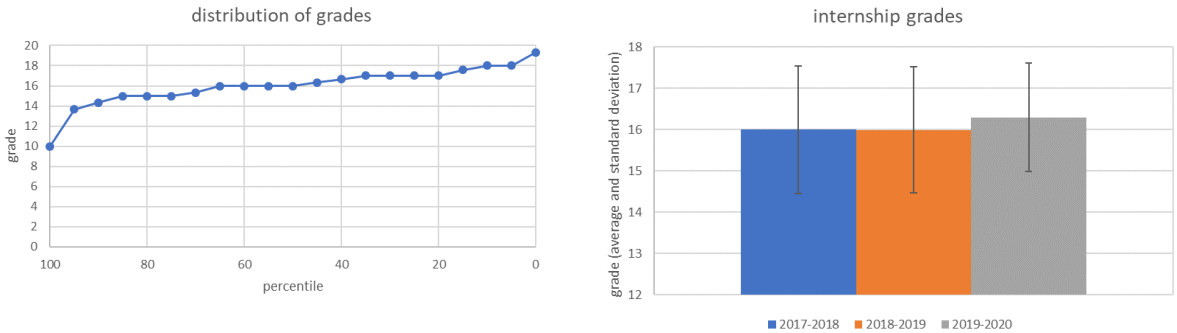
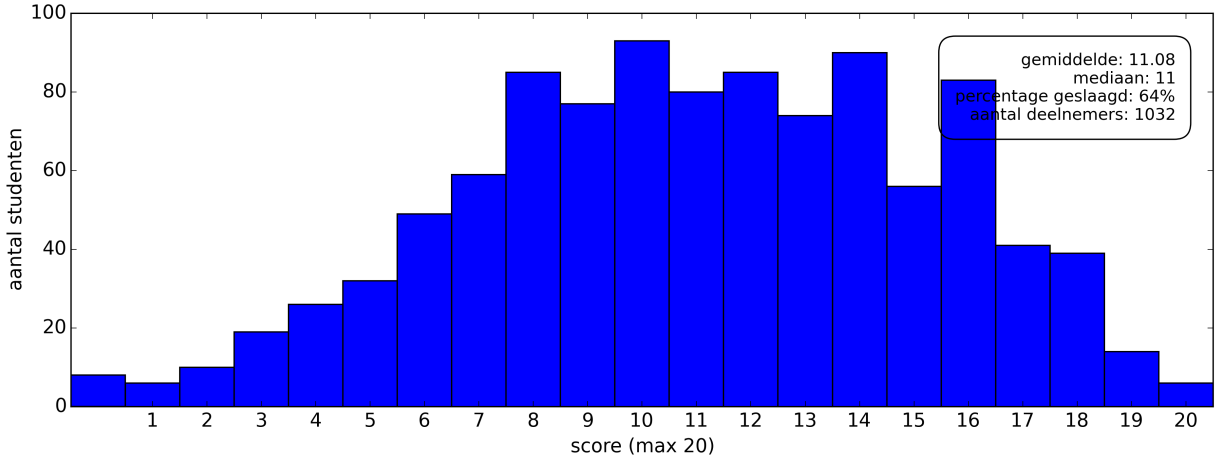


Figure 6: Distribution of internship scores for academic years 2017-2018 to 2019-2020. Left: grade obtained (vertical) by a given percentage of students (horizontal) averaged for the 3 academic years; right: average and standard deviation for the three academic years.

IJkingstoets burgerlijk ingenieur juli 2019: algemene feedback

Positionering ten opzichte van andere deelnemers

In totaal namen 1032 studenten deel aan de ijkingstoets burgerlijk ingenieur die aangeboden werd aan aspirant-studenten burgerlijk ingenieur aan de VUB, KU Leuven en UGent. 661 deelnemers zijn geslaagd. De figuur hieronder toont de verdeling van de scores van de 1032 studenten. Deze figuur laat je toe om je te positioneren ten opzichte van de andere deelnemers.

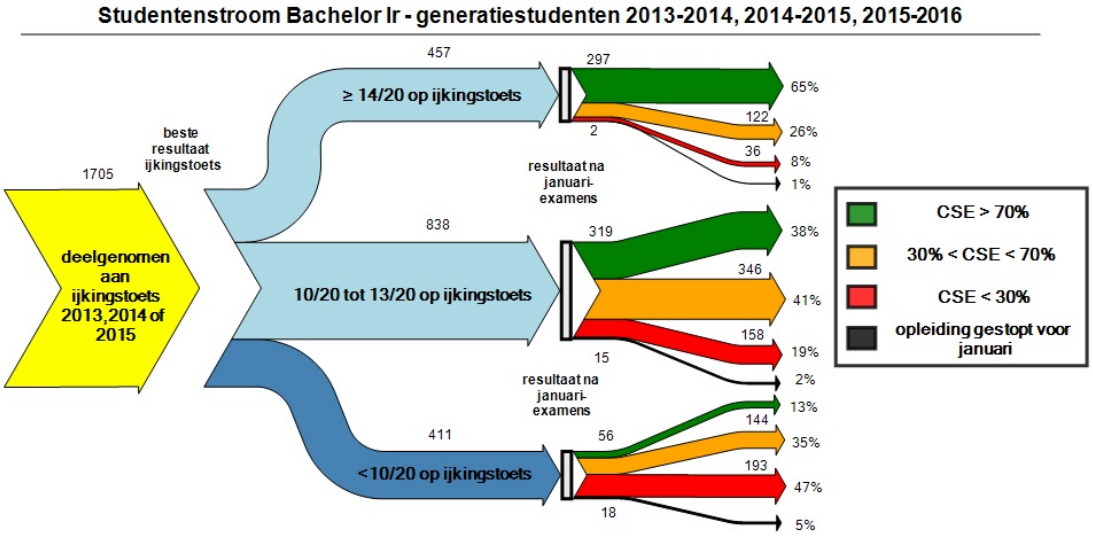


Verdeling van de scores over de verschillende deelnemers van de ijkingstoets van juli 2019

5.7% van de deelnemers haalde 18/20 of meer.
17.7% van de deelnemers haalde 16/20 of meer.
31.9% van de deelnemers haalde 14/20 of meer.
47.3% van de deelnemers haalde 12/20 of meer.
64.1% van de deelnemers haalde 10/20 of meer.
20.3% van de deelnemers haalde 7/20 of minder.

Vervolgtraject voorbije edities

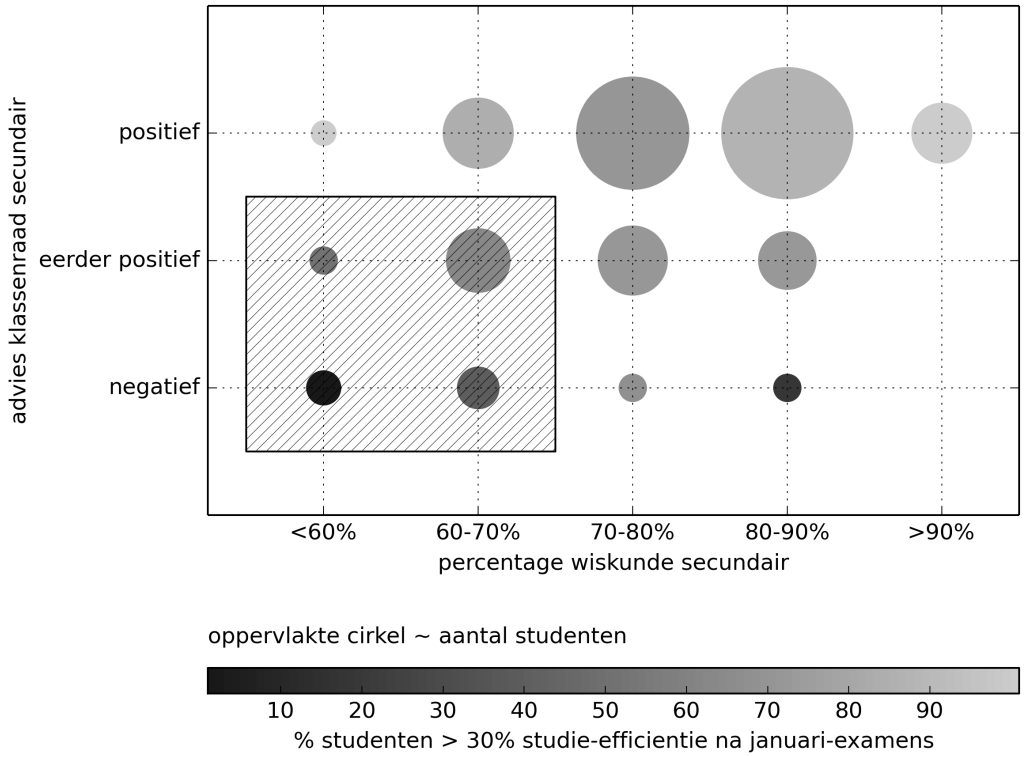
Heel wat van de deelnemers aan de ijkingstoets zijn aan de opleiding bachelor in de ingenieurswetenschappen (KU Leuven, UGent, VUB) of bachelor in de ingenieurswetenschappen: architectuur (KU Leuven) gestart. De figuur hieronder toont de studentenstroom tot na de januari-examens. Deze figuur toont dat de wiskundige voorkennis gemeten tijdens de ijkingstoets, een belangrijke factor is voor je toekomstige studiesucces. Bij de groep die slaagde op de ijkingstoets heeft een aanzienlijk deel na de januari-zittijd een hoge studie-efficiëntie (groene stroom). Van studenten uit de groene stroom weten we dat ze bijna allemaal hun bachelor in drie jaar zullen behalen. Een goede ijkingstoetsscore is echter geen garantie op succes in de opleiding. Hard werken, een goede studieaanpak en motivatie blijven heel belangrijk! Voor studenten die niet slaagden op de ijkingstoets blijkt het heel moeilijk te zijn om het bijspijkeren van de voorkennis te combineren met hun studie. Meer dan de helft van de vroegere deelnemers is ofwel al gestopt met de opleiding in de loop van het eerste semester (zwarte stroom) of heeft een zeer lage studie-efficiëntie in januari (rode stroom). Van studenten uit de rode stroom weten we dat het heel moeilijk zal zijn om het bachelordiploma ingenieurswetenschappen te behalen.



Vervolgtraject van de deelnemers aan de voorbije edities van de ijkingstoets.

Signalen uit het secundair onderwijs

Vanuit het secundair onderwijs heb je ook heel wat waardevolle signalen gekregen die je kunnen ondersteunen bij je studiekeuze. Het advies van de klassenraad en het percentage wiskunde behaald in het secundair onderwijs zijn factoren die samen met de score op de ijkingstoets je een zicht kunnen geven op je toekomstig studiesucces. De figuur hieronder toont hoe het advies van de klassenraad en het percentage wiskunde uit het secundair samenhangt met studiesucces in de opleiding voor de huidige generatie eerstejaarsstudenten. De kleurschaal geeft aan welk percentage in deze groep meer dan 30% van de credits uit het eerste semester behaald heeft.
Mooie resultaten wiskunde én een positief advies van de klassenraad voor ingenieurswetenschappen zijn positieve signalen voor toekomstig studiesucces. Studenten met een lagere score op wiskunde in het secundair onderwijs of die een negatief advies van de klassenraad kregen, bevinden zich in de gearceerde rechthoek. Deze groep bevat relatief weinig studenten die in het eerste semester meer dan 30% van de credits behaald hebben.



Verband tussen het advies van de klassenraad, het percentage wiskunde uit het secundair onderwijs en studiesucces in het eerste semester van de opleiding burgerlijk ingenieur bij 401 eerstejaarsstudenten academiejaar 2015-2016. De oppervlakte van elke bol is evenredig met het aantal studenten uit de subgroep. De kleurschaal geeft aan welk percentage in de subgroep meer dan 30% van de credits uit het eerste semester behaald heeft.

Juiste antwoorden en statistieken per vraag

Hieronder staan de vragen, met telkens het juiste antwoord, het percentage dat deze vraag juist heeft beantwoord en het percentage dat deze vraag heeft blanco gelaten.

Oefening 1

Beschouw de driedimensionale ruimte met een cartesiaans assenstelsel xyz en de rechte r met volgende parametervoorstelling: $\begin{cases} x = -2t \\ y = -2t + 1 \\ z = 2t - 1 \end{cases}$ met $t \in \mathbb{R}$.

Welk van onderstaande vectoren is evenwijdig met de rechte r?

(A) $(0, 1, 1)$ (B) $(0, 1, -1)$ (C) $(1, 1, 1)$ (D) $(1, 1, -1)$

Oplossing: D
juist beantwoord: 80 %
blanco: 5 %

Oefening 2

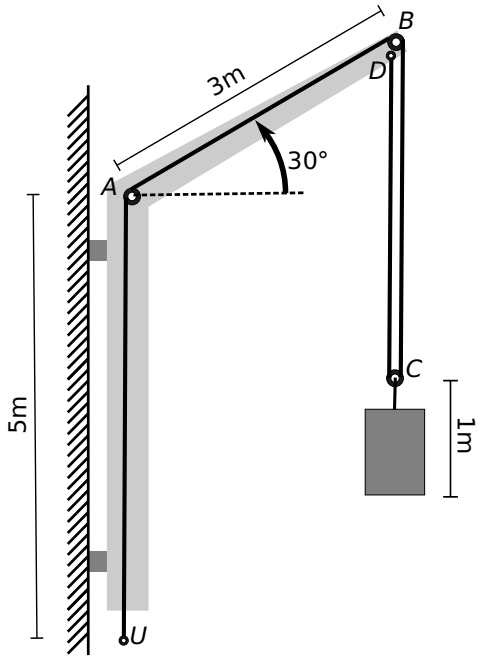
Voor een veelterm $P(x)$ van graad 2 geldt: de hoogstegraadscoëfficiënt is 1, $x = 2$ is een nulpunt en $P(1) = 3$. Wat is de coëfficiënt bij de eerstegraadsterm?

(A) -6 (B) -4 (C) 4 (D) 6

Oplossing: A
juist beantwoord: 90 %
blanco: 3 %

Oefening 3

Onderstaande figuur toont een takelinstallatie die dient voor het optillen en verplaatsen van lasten in een atelier. Een kabel loopt vanaf het uiteinde U via de katrollen A, B en C naar het punt D van de takelinstallatie. De posities van de punten U, A, B en D zijn vast. De last hangt aan katrol C. Alle relevante afmetingen staan aangegeven op de figuur (niet op schaal). De bediening van de last gebeurt door de kabel langer of korter te maken. Hoe lang moet de kabel zijn opdat de onderkant van de last zich op dezelfde hoogte als het uiteinde U bevindt?
In de berekeningen mag de positie van B dezelfde genomen worden als de positie van D en mogen de afmetingen van de katrollen verwaarloosd worden en dus 0 genomen worden. Het resultaat mag afgerond worden tot op een geheel aantal meter.



(A) 18 m (B) 19 m (C) 20 m (D) 21 m

Oplossing: B
juist beantwoord: 71 %
blanco: 5 %

Oefening 4

Bereken volgende limiet: $L = \lim_{x \to +\infty} e^{(1/x)}$.

(A) $L = 0$ (B) $L = 1$ (C) $L = e$ (D) $L = +\infty$

Oplossing: B
juist beantwoord: 95 %
blanco: 1 %

Oefening 5

De grafiek van de functie $f : \mathbb{R} \to \mathbb{R}$ is de rechte door de punten $(0, 1)$ en $(7, 6)$. De functie g is de inverse functie van f. Bepaal $g(3)$.

(A) $g(3) = \frac{14}{5}$ (B) $g(3) = 3$ (C) $g(3) = \frac{17}{6}$ (D) $g(3) = \frac{22}{7}$

Oplossing: A
juist beantwoord: 73 %
blanco: 17 %

Oefening 6

Beschouw de driedimensionale ruimte met een cartesiaans assenstelsel xyz en de punten $A(2, 2, 4)$, $B(0, -4, 2)$, $C(0, -5, 2)$ en $D(2, -1, 4)$. Welke van de onderstaande uitspraken is als enige waar?

1. De rechten AB en CD zijn evenwijdig.
2. De rechten AB en CD zijn kruisend.
3. De rechten AB en CD snijden elkaar in het punt $(-1, -7, 1)$.
4. De rechten AB en CD snijden elkaar in het punt $(1, -3, 3)$.

Oplossing: C
juist beantwoord: 61 %
blanco: 11 %

Oefening 7

Zij $f : \mathbb{R} \to \mathbb{R}$ en $g : \mathbb{R} \to \mathbb{R}$ functies. Welke van de onderstaande uitspraken is dan als enige zeker waar?

1. Als $f(2) < 0 < g(2)$, dan is $|f(2)| \neq |g(2)|$.
2. Als $f(2) \geq g(2)$, dan is $|f(2)| \geq |g(2)|$.
3. Als $g(2) < f(2) < 0$, dan is $|g(2)| > |f(2)|$.
4. $|f(-2)| = |f(2)|$ en $|g(-2)| = |g(2)|$.

Oplossing: C
juist beantwoord: 92 %
blanco: 3 %

Oefening 8

Beschouw het volgende stelsel in de onbekenden x, y en z met c een reëel getal.

$$\begin{cases} x + y + z = 1 \\ 2x + 2y = 2-2z \\ y + z = c \end{cases}$$

Welke van de volgende beweringen is als enige waar?

1. Er bestaat juist één waarde van c waarvoor dit stelsel geen oplossing heeft.
2. Er bestaan verschillende waarden van c waarvoor dit stelsel geen oplossing heeft.
3. Er bestaat juist één waarde van c waarvoor dit stelsel oneindig veel oplossingen heeft.
4. Er bestaan meerdere waarden van c waarvoor dit stelsel oneindig veel oplossingen heeft.

Oplossing: D
juist beantwoord: 72 %
blanco: 14 %

Oefening 9

Beschouw het vlak met een cartesiaans assenstelsel xy en de vector $\vec{e}$ met lengte 1. De vector $\vec{e}$ maakt een hoek θ met de positieve y-as. Hoeken in tegenwijzerzin worden positief genomen. De hoek θ voldoet aan $\frac{\pi}{2} < \theta < \pi$, zodat de vector $\vec{e}$ in het derde kwadrant ligt. Wat is dan de x-coördinaat van de vector $\vec{e}$?

(A) $\cos\theta$ (B) $-\cos\theta$ (C) $\sin\theta$ (D) $-\sin\theta$

Oplossing: D
juist beantwoord: 36 %
blanco: 4 %

Oefening 10

Bereken $I = \int_0^{\sqrt{\pi}} 2x\sin(x^2)\,dx$.

(A) -2 (B) -1 (C) 1 (D) 2

Oplossing: D
juist beantwoord: 71 %
blanco: 11 %

Oefening 11

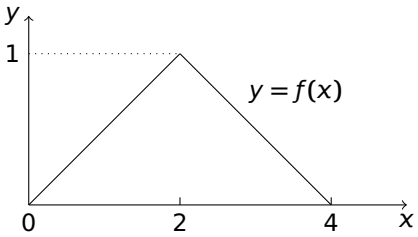
Wannes en Younes gaan fietsen op een lang recht fietspad. Ze vertrekken beiden op hetzelfde punt. Wannes fietst het eerste deel van het traject met een constante snelheid van 28 km/uur. Younes vertrekt 1 minuut later en rijdt ook met een constante snelheid. Twee minuten nadat Younes vertrokken is, haalt hij Wannes in. Daarna fietsen ze nog 4 km samen verder aan een snelheid van 24 km/uur. Wat is de gemiddelde snelheid waarmee Younes het gehele traject fietste?

(A) 27 km/uur (B) 30 km/uur (C) 33 km/uur (D) 36 km/uur

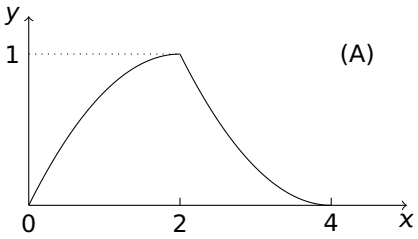
Oplossing: A
juist beantwoord: 74 %
blanco: 7 %

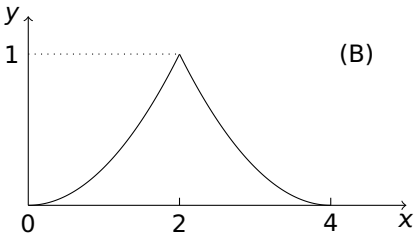
Oefening 12

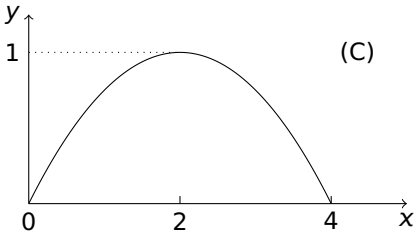
Gegeven de functie $f : \mathbb{R} \to \mathbb{R}$ met als grafiek onderstaande figuur.

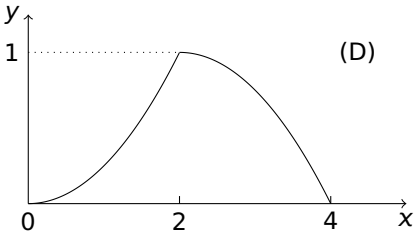


Verder is de functie g gegeven door $g : \mathbb{R} \to \mathbb{R} : x \mapsto g(x) = \frac{x}{2}$. Welk van onderstaande figuren toont de grafiek van het product p van deze functies $p : \mathbb{R} \to \mathbb{R} : x \mapsto p(x) = f(x) \cdot g(x)$?









Oplossing: D
juist beantwoord: 82 %
blanco: 5 %

Oefening 13

Op een elektronisch circuit wordt een spanningsbron aangesloten die een tijdsafhankelijke spanning V produceert. Het verband tussen de tijd t uitgedrukt in seconden (s) en de spanning V wordt gegeven door $V = V_0 \cos(\omega t)$, met $V_0 = 50$ volt en $\omega = 100\pi$ rad/s. Hoeveel keer wisselt de spanning V van teken gedurende de eerste seconde?

(A) 25 keer (B) 50 keer (C) 100 keer (D) 200 keer

Oplossing: C
juist beantwoord: 62 %
blanco: 7 %

Oefening 14

In de driedimensionale ruimte bekijken we het punt $P(1, 2, 0)$ en het vlak v met vergelijking $x + 2y - z = 1$. Voor welk van volgende punten A_i $(i = 1, 2, 3, 4)$ snijdt de rechte PA_i het vlak v **niet**?

(A) $A_1(2, 2, 1)$ (B) $A_2(3, 1, 1)$ (C) $A_3(-1, 4, 1)$ (D) $A_4(4, 0, 1)$

Oplossing: A
juist beantwoord: 62 %
blanco: 27 %

Oefening 15

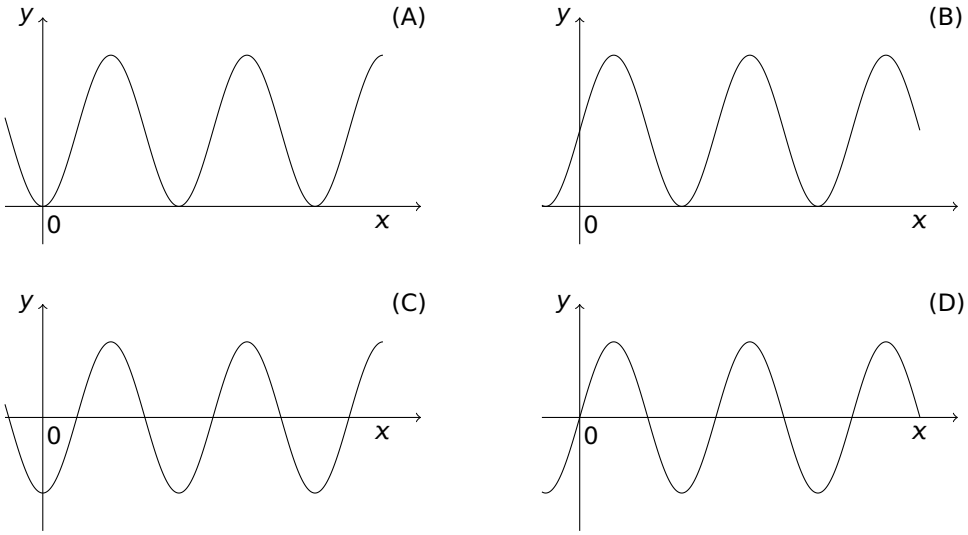
Van de matrices $A = \begin{pmatrix} a & 1 \\ a & b \end{pmatrix}$ en $B = \begin{pmatrix} 1 & 2 \\ -2 & a \end{pmatrix}$ is gegeven dat $A \cdot B = B \cdot A$. Wat kun je besluiten over de reële getallen a en b?

1. $a = -1$ en $b = -1$.
2. $a = -1$ en $b = -2$.
3. Dergelijke getallen a en b bestaan niet.
4. De getallen a en b zijn beide willekeurig.

Oplossing: B
juist beantwoord: 64 %
blanco: 13 %

Oefening 16

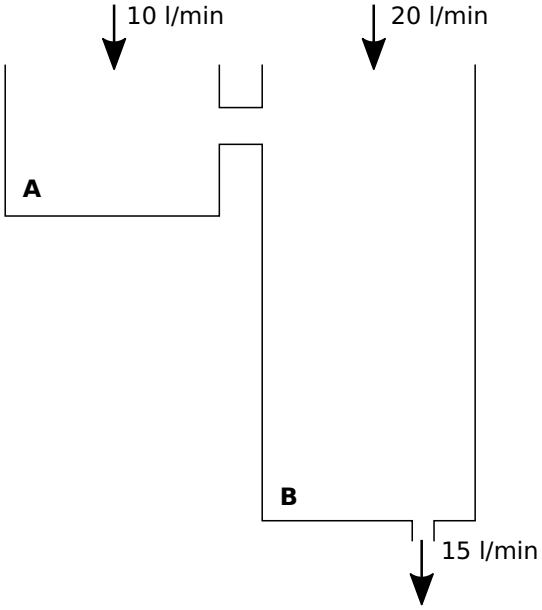
Welke van onderstaande figuren kan de grafiek voorstellen van de functie $f : \mathbb{R} \to \mathbb{R} : x \mapsto f(x) = \int_0^x \sin t \, dt$?



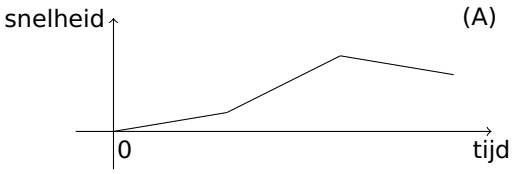
Oplossing: A
juist beantwoord: 59 %
blanco: 4 %

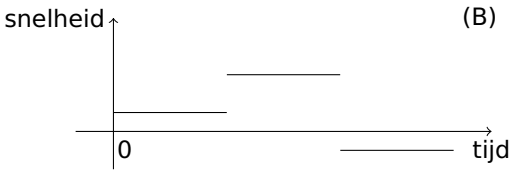
Oefening 17

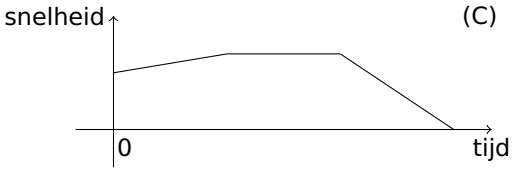
Een klein vat A en een groot vat B zijn met elkaar verbonden zoals getekend in onderstaande figuur. Beide vaten hebben een grondvlak van 25 dm^2. De onderkant van de verbinding bevindt zich op een hoogte van 2 dm boven het grondvlak van vat A en 10 dm boven het grondvlak van vat B. Door de verbinding kan tot 30 liter per minuut stromen.

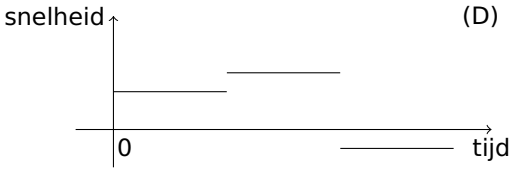


Aanvankelijk zijn beide vaten leeg. Vanaf een bepaald ogenblik (tijd=0) stroomt er 10 liter vloeistof per minuut in vat A en 20 liter per minuut in vat B. De vloeistof loopt ook weg uit vat B langs een leiding waardoor 15 liter per minuut kan stromen. 5 minuten nadat vloeistof van vat A naar vat B begint te stromen wordt de rechtstreekse toevoer van de vloeistof aan vat B afgesloten, terwijl de toevoer aan vat A gelijk blijft aan 10 liter per minuut. Welke van de volgende grafieken geeft weer met welke snelheid het niveau van de vloeistof in vat B toeneemt?









Oplossing: B
juist beantwoord: 70 %
blanco: 6 %

Oefening 18

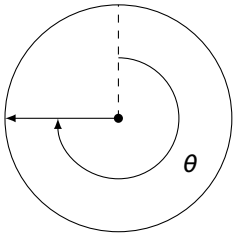
Gegeven de functie $f : \mathbb{R} \to \mathbb{R} : x \mapsto f(x) = |x^2 - 4x + 3|$. Voor de waarde $x = a$ bereikt deze functie een minimum. Bepaal $f(a)$.

(A) $f(a) = 0$ (B) $f(a) = 1$ (C) $f(a) = 2$ (D) $f(a) = 3$

Oplossing: A
juist beantwoord: 57 %
blanco: 3 %

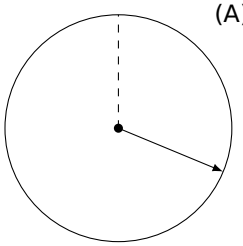
Oefening 19

Een wijzer van een meetinstrument maakt een hoek θ met de verticale, zoals getoond op onderstaande figuur. Een hoek in wijzerzin wordt hier positief gekozen, alle hoeken zijn uitgedrukt in radialen. Op tijdstip $t = 0$ s staat de wijzer zoals aangeduid op de figuur, $\theta = \frac{3\pi}{2}$.

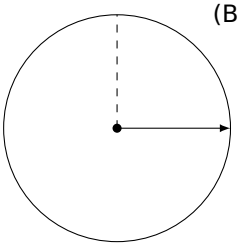


Het verband tussen de hoek θ en de tijd t is gegeven door $\theta = \frac{3\pi}{2} - \omega t$ met $\omega > 0$ een constante hoeksnelheid die zo gekozen is dat bij $t = 10$ s de wijzer de eerste keer een hoek $\theta = \frac{\pi}{4}$ maakt met de verticale. Welke van onderstaande figuren toont de stand van de wijzer op $t = 7$ s?

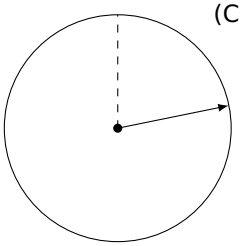
(A)



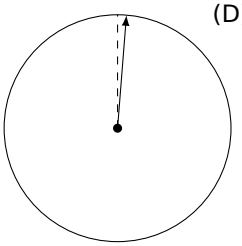
(B)



(C)



(D)



Oplossing: A
juist beantwoord: 70 %
blanco: 4 %

Oefening 20

De matrix A is een 2×2-matrix die de migratie van de bevolking tussen een bepaalde stad (S) en haar omliggende landelijke omgeving (L) beschrijft op jaarbasis.

Als $X = \begin{pmatrix} x_S \\ x_L \end{pmatrix}$, met x_S het aantal inwoners in S en x_L het aantal inwoners in L,
dan geeft AX het respectievelijk aantal inwoners weer na één jaar.

Ga uit van volgende gegevens:

- het totaal aantal inwoners blijft constant;
- 90% van de stadsbevolking verblijft na één jaar nog steeds in de stad;
- 80% van de bevolking in de landelijke omgeving verblijft na één jaar nog steeds in deze landelijke omgeving;
- deze migratietendens blijft enkele jaren dezelfde.

Met welk percentage is het aantal inwoners in de stad na twee jaar veranderd (toegenomen of afgenomen) wanneer de beginsituatie gegeven is door $x_S = 200\,000$ en $x_L = 130\,000$?

(A) $-5{,}95\%$ (B) $+3\%$ (C) $+5{,}1\%$ (D) $+10\%$

Oplossing: C
juist beantwoord: 68 %
blanco: 16 %

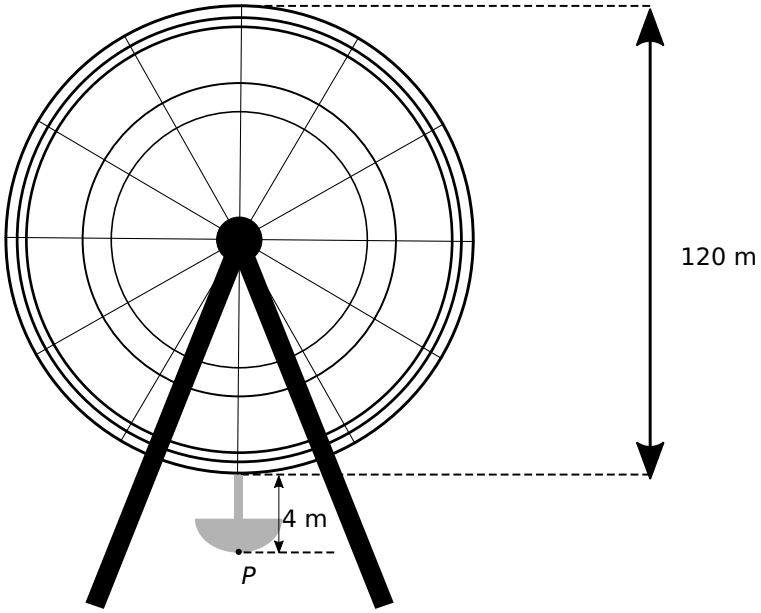
Oefening 21

Welk van de volgende getallen is het grootst? Alle hoeken zijn uitgedrukt in radialen.

(A) $\tan(4{,}5)$ (B) $\dfrac{1}{\cos(3{,}5)}$ (C) $3\sin(3)$ (D) $\cos(6)$

Oplossing: A
juist beantwoord: 58 %
blanco: 10 %

Oefening 22



De figuur toont een principetekening van een reuzenrad met één gondel. Het wiel van het reuzenrad heeft een diameter van 120 m en roteert met een constante hoeksnelheid omheen de centrale as. De gondel is scharnierend opgehangen aan de buitenkant van het wiel van het reuzenrad. Het onderste punt P van de gondel hangt 4 m onder het scharnier. In de berekeningen mag je het wiebelen van de gondel verwaarlozen en veronderstellen dat het punt P zich op elk moment verticaal onder het scharnier bevindt. De lengte van het afgelegde pad van het punt P nadat het reuzenrad vijf volledige omwentelingen heeft gemaakt noemen we l. Welk van de volgende uitspraken is dan geldig?

1. $l \leq 600\pi$ m
2. 600π m $< l \leq 640\pi$ m
3. 640π m $< l \leq 680\pi$ m
4. 680π m $< l$

Oplossing: A
juist beantwoord: 62 %
blanco: 11 %

Oefening 23

Hoeveel verschillende oplossingen (x, y) heeft het volgende stelsel vergelijkingen?

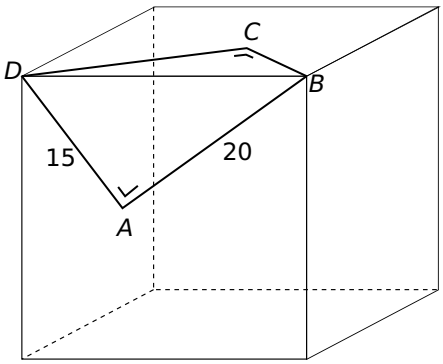
$$\begin{cases} (2x-y+3)(x+2y)=0 \\ (x+y-3)(4x-2y-3)=0 \end{cases}$$

(A) 1 (B) 2 (C) 3 (D) 4

Oplossing: C
juist beantwoord: 31 %
blanco: 32 %

Oefening 24

De rechthoek $ABCD$ met lengte 20 en breedte 15 wordt gevouwen zodat de diagonaal BD gemeenschappelijk is met een ribbe van een kubus en de hoekpunten A en C in de zijvlakken van deze kubus liggen. Bepaal de afstand tussen de punten A en C nadat de rechthoek gevouwen is.

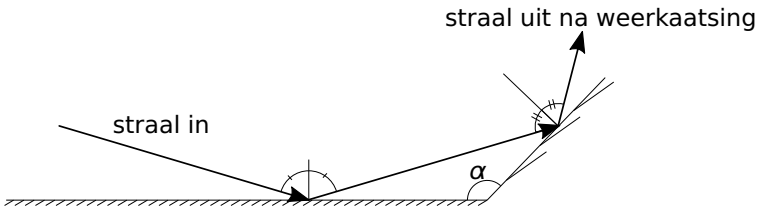


(A) $|AC| = \sqrt{271}$ (B) $|AC| = 12\sqrt{2}$ (C) $|AC| = \frac{25}{2}\sqrt{2}$ (D) $|AC| = \sqrt{337}$

Oplossing: D
juist beantwoord: 18 %
blanco: 46 %

Oefening 25

Bij een vlakke spiegel wordt elke straal zo weerkaatst dat de hoek die de inkomende straal maakt met de loodrichting op de spiegel, dezelfde is als de hoek die de uitgaande straal maakt met de loodrichting op de spiegel. De inkomende en de uitgaande straal bevinden zich ook steeds in eenzelfde loodvlak op de spiegel.
Twee vlakke spiegels worden tegen elkaar gemonteerd zoals aangegeven op de figuur. De hoek α tussen beide spiegels kan ingesteld worden. Bij welk van onderstaande waardes voor de hoek α zal elke straal die door beide spiegels weerkaatst werd, loodrecht staan op de inkomende straal?



(A) $\alpha = 112{,}5°$ (B) $\alpha = 120°$ (C) $\alpha = 127{,}5°$ (D) $\alpha = 135°$

Oplossing: D
juist beantwoord: 38 %
blanco: 50 %

Oefening 26

Het complexe getal $z = r(\cos\theta + i\sin\theta)$ met $r > 0$, voldoet aan $3r = 5z + 20i$. Bepaal $\sin\theta$.

(A) $\sin\theta = -\frac{4}{5}$ (B) $\sin\theta = -\frac{3}{5}$ (C) $\sin\theta = \frac{3}{5}$ (D) $\sin\theta = \frac{4}{5}$

Oplossing: A
juist beantwoord: 33 %
blanco: 50 %

Oefening 27

Gegeven de functie $f : [a, +\infty[\to \mathbb{R} : x \mapsto f(x) = x\sqrt{2x+3}$, met $a \in \mathbb{R}$ de kleinste waarde waarvoor $x\sqrt{2x+3}$ gedefinieerd is. A is het punt op de grafiek van f met x-coördinaat a. B is het punt op de grafiek van f met x-coördinaat 3. C is het snijpunt van de x-as met de raaklijn in B aan de grafiek van f. Bepaal de oppervlakte O van de driehoek ABC.

(A) $O = \frac{27}{8}$ (B) $O = \frac{81}{8}$ (C) $O = \frac{135}{8}$ (D) $O = \frac{243}{8}$

Oplossing: B
juist beantwoord: 42 %
blanco: 42 %

Oefening 28

Je mag aannemen dat volgende bewering waar is:

Als minstens één deelnemer aan de ijkingstoets op ruimtereis is geweest, dan eten alle deelnemers deze namiddag een ijsje.

Welke van onderstaande beweringen is dan zeker waar?

1. Alle deelnemers eten deze namiddag een ijsje.
2. Geen enkele deelnemer eet deze namiddag een ijsje.
3. Als er een deelnemer is die deze namiddag geen ijsje eet, dan is geen enkele deelnemer op ruimtereis geweest.
4. Als alle deelnemers deze namiddag een ijsje eten, dan is een deelnemer op ruimtereis geweest.

Oplossing: C
juist beantwoord: 83 %
blanco: 2 %

Oefening 29

Twee robotten bevinden zich op een lijn van 100 m lang, afgebakend met twee muren (zie onderstaande figuur). Op tijdstip $t = 0$ s vertrekken beide robotten: robot A vertrekt op plaats $x = 0$ m met een snelheid van $+10$ m/s en robot B vertrekt op plaats $x = 100$ m met een snelheid van -10 m/s. Een positieve snelheid betekent dat de robot naar rechts beweegt, een negatieve snelheid komt overeen met een beweging naar links.
Bij elke botsing van robot A (met de andere robot of met de muur op $x = 0$ m) wordt zijn snelheid met een factor -2 vermenigvuldigd (m.a.w. terugkerend aan dubbele snelheid). Bij elke botsing van robot B (met de andere robot of met de muur op $x = 100$ m) wordt zijn snelheid met een factor $-1/2$ vermenigvuldigd (m.a.w. terugkerend aan halve snelheid).

Bijvoorbeeld op tijdstip $t = 5$ s botsen de robotten op $x = 50$ m tegen elkaar (eerste robotbotsing), waarna robot A met snelheid -20 m/s beweegt en dus terugkeert richting $x = 0$ m en robot B met snelheid $+5$ m/s beweegt en dus terugkeert richting $x = 100$ m. Robot A botst even later tegen de muur op $x = 0$ m, waarna hij zich beweegt met snelheid $+40$ m/s. Op welke locatie vindt de tweede robotbotsing dan plaats? Geef de afgeronde x-coördinaat. De afmetingen van de robotten mogen verwaarloosd worden.

(A) 63 m (B) 71 m (C) 82 m (D) 93 m

Oplossing: B
juist beantwoord: 73 %
blanco: 6 %

Oefening 30

Gegeven zijn een continue functie $g : \mathbb{R} \to \mathbb{R}$ en de functie $f : \mathbb{R} \to \mathbb{R}$ met $f(x) = g(x+1)$ voor alle $x \in \mathbb{R}$. Verder zijn twee reële getallen a en b gegeven met $a < b < 0$. Welke van de volgende beweringen is als enige altijd waar?

1. $\int_a^b f(x)\,dx = \int_{a-1}^{b-1} g(x)\,dx$
2. $\int_a^b f(x)\,dx = 1 + \int_a^b g(x)\,dx$
3. $\int_a^b f(x)\,dx = b - a + \int_a^b g(x)\,dx$
4. $\int_a^b f(x)\,dx = \int_{a+1}^{b+1} g(x)\,dx$

Oplossing: D
juist beantwoord: 44 %
blanco: 15 %

ANNEX A.15 Positioning Test

Context and Rationale

Before 2003, admission to the studies in engineering at the Belgian universities was subject to successful participation to an entrance exam. This entrance exam focused on mathematical skills, but was annulled in the Flemish region (the entrance exam is still obligatory in Wallonia), despite negative advice from the engineering faculties involved.

To take measures against a decrease in the first year success rate, the engineering faculties of the Flemish universities have taken the initiative to organize a non-obligatory "Positioning Test". The purpose of this test is threefold:

- Encourage secondary school students to prepare their engineering studies;
- Give feedback to participants about their skills, so they can reflect on their choice to take up engineering studies;
- Recommend remedial actions upfront (most notably to take part in summer courses in preparation for their studies).

The positioning test was first organized in 2012, and enjoys a growing number of participants. Inspired by this model, other, non-engineering, faculties are joining the initiative, resulting in 16 positioning tests being organized in 2021. In view of this success, the Flemish government decided to make participation to the test a requirement for starting the studies, provided that the positioning test for this specific studies has proven its validity. In 2021, participation is required for

- Bachelor of Science in Engineering
- Bachelor of Science in Engineering: Architecture
- Bachelor of Science in Engineering Technology
- Bachelor of Science in Veterinary Medicine

Each year, the list of bachelor programmes for which taking the positioning test is required is revised by the Flemish Government.

Concept

The positioning test for engineering studies focuses on the mathematical knowledge acquired during secondary education, covering the topics of the 6 math hours per week programme. The test itself consists of typically 30 multiple choice questions, taking 4 hours, drawn from following categories:

- Mathematical reasoning
- Mathematical concepts and their application
- Numeracy skills
- Spatial visualization ability (BSc in Engineering: Architecture only)
- Modelling (mathematics applied in a physics context)

For each of these categories, questions of varying difficulty are included in the test.
Due to the pandemic, the examination time was restricted to 3 hours in the years 2020 and 2021. Therefore, the number of questions was reduced to 22 (instead of 30).

The test itself is organized twice a year (once at the end of June or beginning of July, and once in the second half of August). At the latest one week after taking the test, participants get feedback, consisting of their individual score, their relative position within the group of

participants and advice for remedial action, if needed. Participants with a particularly low score (less than 7/20) are encouraged to reconsider their choice for engineering studies.

Analysis

The results of the positioning test (relation to secondary school education, gender, socio-economical background) has been extensively studied by an inter-university task force, concluding that non-pertinent factors have no significant impact on the candidate performance on the test. Also the predictive value of the test was assessed, and more particularly the relation between test score and the number of credits for which students passed during the following academic year (first bachelor year).

The results of this analysis are presented in the graphs below for both tests (Bachelor of Science in Engineering and Bachelor of Science in Engineering: Architecture), for students enrolled in the first bachelor year in the academic year 2019-2020, who have taken the test in July and/or August 2019. One clearly observes a strong relation between test score and performance in the first bachelor year, indicating the validity and predictive value of taking the test.

As for any test, reaching 100% prediction accuracy is not achievable (and should perhaps not be pursued, as students can indeed be motivated by the test to adapt their study attitude). Unfortunately, we see it is easier to predict failure than to predict success, which is partly caused by the intrinsic limits of a mathematics oriented, 4-hour test. Other factors key to success, such as motivation, adaptation to the university context and ability to handle increased responsibility intelligently, are difficult to assess through a positioning test.

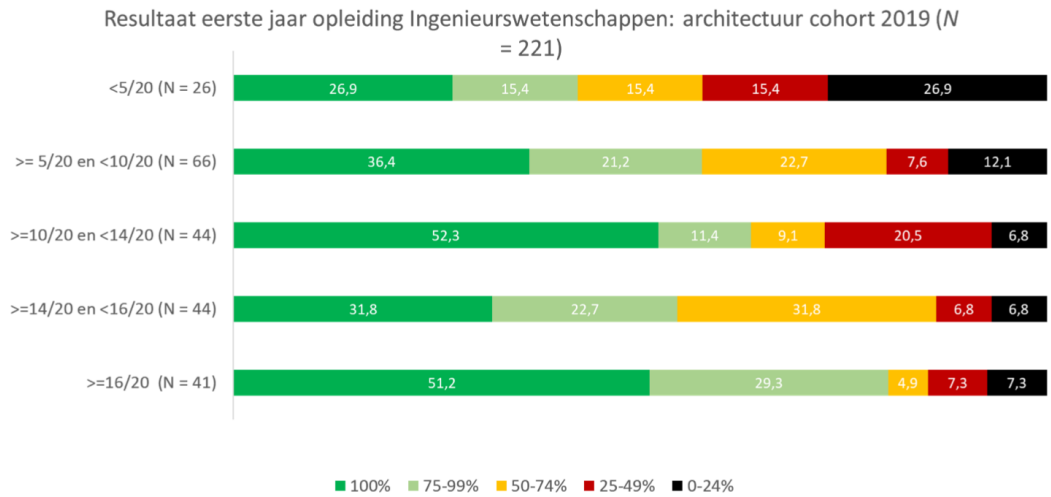


Figure 1: Bachelor of Science in Engineering: Architecture. Relation of positioning test to study success in the first bachelor year, for students that took the positioning test in 2019 and enrolled in academic year 2019-2020. Graph reproduced from "Validiteitsrapport ijkingstoetsen 2020, Lot Fonteyne, Anna Marconato, Bart Tambuyzer, Tinne De Laet, Mieke Adriaens, Isabelle Melis February 2021".

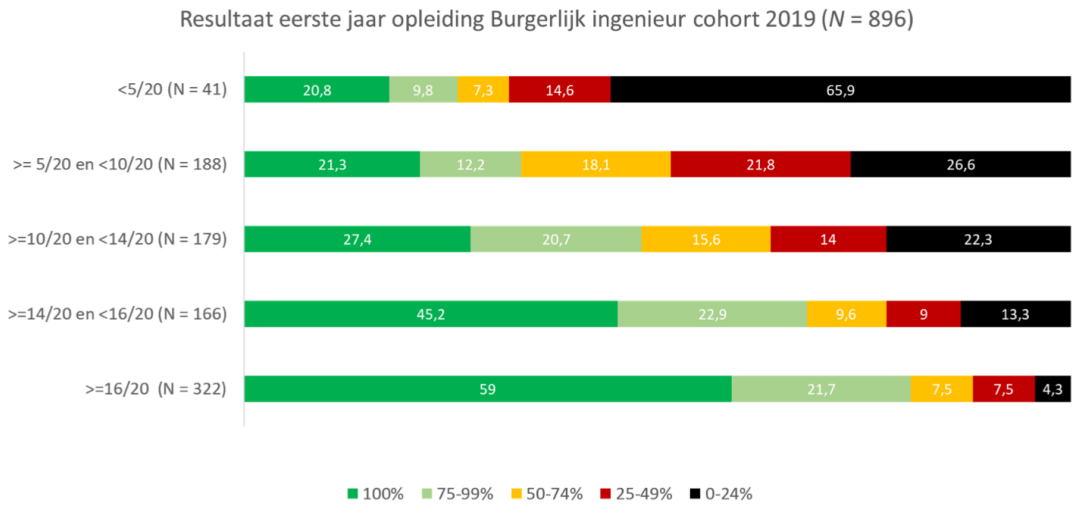


Figure 2: Bachelor of Science in Engineering. Relation of positioning test to study success in the first bachelor year, for students that took the positioning test in 2019 and enrolled in academic year 2019-2020. Graph reproduced from "Validiteitsrapport ijkingstoetsen 2020, Lot Fonteyne, Anna Marconato, Bart Tambuyzer, Tinne De Laet, Mieke Adriaens, Isabelle Melis February 2021".

ANNEX A.16 Graduate employment survey
Graduate employability and employers satisfaction survey

1. Graduate employment survey (discussion of results)

The survey was organised in Spring 2021, and alumni graduated in the years 2015 – 2021 were contacted. In total 255 responses were received, and the detailed results will be shared with the SPC's for discussion and to identify suitable follow-up actions if appropriate.

In Table 1 the respondents are grouped according to the diplomas issued by the FEA. The large differences in number of respondents are in particular due to the fact that some diploma degrees are quite new (e.g. photonics versus electrical engineering) or that some diploma degrees only count a few graduates (e.g. the interuniversity nuclear engineering master). Figure 1 shows the number of respondents grouped according to their graduation year.

Engineering Discipline (diploma degree granted)	% of total	Number
Architecture (architectuur)	10,6%	27
Civil Engineering (bouwkunde)	11,8%	30
Electromechanical Engineering (werktuigkunde - elektrotechniek)	22,4%	57
Chemical Engineering (chemische technologie)	9,0%	23
Sustainable Materials Engineering (materiaalkunde, metallurgie)	2,4%	6
Textile Engineering (textielkunde)	1,6%	4
Electrical Engineering (elektrotechniek)	9,4%	24
Bioinformatics (bio-informatica)	0,0%	0
Photonics Engineering (fotonica)	1,2%	3
Engineering Physics (toegepaste natuurkunde)	3,5%	9
Nuclear Fusion and Engineering Physics	0,0%	0
Computer Science Engineering (computerwetenschappen)	20,8%	53
Industrial Engineering and Operations Research (bedrijfskundige systeemtechnieken en operationeel onderzoek, industrieel beheer)	1,6%	4
Biomedical Engineering (biomedische ingenieurstechnieken)	3,9%	10
Fire Safety Engineering	2,0%	5
Nuclear Engineering	0,0%	0
Total	100,0%	**255**

Table 1: Number of respondents versus engineering discipline.

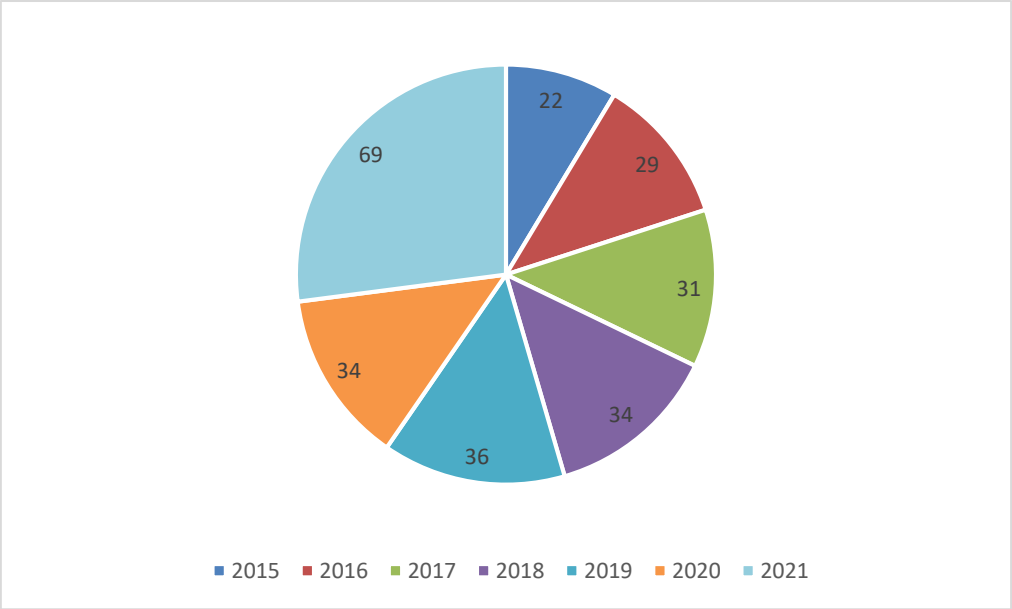


Figure 1: Number of respondents versus graduation year.

Question 3 of the survey asks for the amount of time it took to get a first job. The data in Table 2 clearly shows that the engineering (and engineering-architecture) profession is highly asked for in industry and society. With the exception of the graduation year 2020 (possibly due to the pandemic situation), typically 60% of the graduates already secured a job before graduation. The last column provides cumulative data showing the large majority of the graduates have a first job within six months of graduation (remark: when this report was written, the data of the graduates of 2021 were still incomplete). Hence, the employability is excellent. Note that for the last column, students that are not pursuing a job (continuing studies or other reasons) were not considered for calculating the reported fraction.

Graduation year	Number of respondents	Continuing studies	Not looking for job for other reasons	Job before graduation	Job <1 month after graduation	Job between 1 and 3 months after graduation	Job between 4 and 6 months after graduation	job > 6 months after graduation	Still looking for a job	**Cumulative < 6 months**
2015	22	4,5%	4,5%	68,2%	9,1%	9,1%	0,0%	4,5%	0,0%	95,0%
2016	29	0,0%	0,0%	69,0%	13,8%	13,8%	3,4%	0,0%	0,0%	100,0%
2017	31	6,5%	9,7%	64,5%	3,2%	12,9%	3,2%	0,0%	0,0%	100,0%
2018	34	8,8%	2,9%	61,8%	14,7%	8,8%	2,9%	0,0%	0,0%	100,0%
2019	36	8,3%	2,8%	55,6%	5,6%	13,9%	8,3%	2,8%	2,8%	93,8%
2020	34	14,7%	5,9%	44,1%	17,6%	17,6%	0,0%	0,0%	0,0%	100,0%
2021	69	7,2%	7,2%	60,9%	5,8%	4,3%	0,0%	0,0%	14,5%	83,1%
Total	**255**	**7,5%**	**5,1%**	**60,0%**	**9,4%**	**10,6%**	**2,4%**	**0,8%**	**4,3%**	**94,2%**

Table 2: Time to first job versus graduation year.

As questions 4 – 11 all relate to the first or current employment, participants were offered the opportunity to skip these questions (particularly if they have no employment for any reason at the moment of the inquiry). In total, 57 respondents skipped these questions, and consequently the totals reported in questions 4 – 11 differ from the totals in questions 1 – 3.

Question 4 asks for the detailed employment sector (first job). Table 3 provides a general picture of the relative uptake of graduates in the various employment sectors.

Graduation year	Number resp.	2	5	6	7	10	11	13	Sum < 2%
2015	16	37,5%	0,0%	12,5%	12,5%	0,0%	18,8%	18,8%	0,0%
2016	28	35,7%	0,0%	10,7%	7,1%	3,6%	21,4%	10,7%	10,7%
2017	25	32,0%	4,0%	12,0%	12,0%	12,0%	16,0%	4,0%	8,0%
2018	29	10,3%	6,9%	17,2%	20,7%	6,9%	17,2%	13,8%	6,9%
2019	31	32,3%	0,0%	12,9%	9,7%	3,2%	16,1%	9,7%	16,1%
2020	26	19,2%	7,7%	23,1%	19,2%	11,5%	0,0%	11,5%	7,7%
2021	43	27,9%	9,3%	14,0%	14,0%	0,0%	11,6%	7,0%	16,3%
Total	**198**	**27,3%**	**4,5%**	**14,6%**	**13,6%**	**5,1%**	**14,1%**	**10,1%**	**10,6%**

1. Health sector, social services (1.5%)
2. Industry (27.3%)
3. Wholesale and retail sector, vehicle repair sector (0.0%)
4. Education (0.5%)
5. Research institute (4.5%)
6. University (14.6%)
7. Building industry (13.6%)
8. Public service, defense and social security (1.5%)
9. Transport and storage (2.0%)
10. Design agency/Study office (e.g. architectural design, structural design...) (5.1%)
11. Independent professionals, scientific and technical activities (incl. consultancy) (14.1%)
12. Administrative and support services (0.0%)
13. Information and communication (10.1%)
14. Accommodation and meal catering (0.0%)
15. Financial activities and insurances (1.0%)
16. Other services (0.5%)
17. Arts, amusement and recreation (0.0%)
18. Agriculture, forestry and fishery (0.0%)
19. Other sectors (3.5%)

Table 3: Employment sector of present job versus graduation year.

In this table, categories with overall relevance below 2% have been omitted, and these categories are aggregated in the column entitled “Sum < 2%”. For completeness, the relative uptake in each category, averaged over the years, is included between parentheses in the table legend.

We notice that, 90% our graduates find their first job in:

- Industry (categories 2, 7, 13): 50%
- Research (categories 5 and 6): 19%
- Independent professionals (category 11): 14%
- Design agency/Study office (category 10): 5% (mostly MSc in engineering: architecture graduates)

In question 5, the alumni are asked if they were ever employed abroad during their career. Results are summarized in Table 4. We notice that close to 30% of our young graduates were already employed in an international context.

Graduation year	Number of respondents	Yes	No
2015	16	56,3%	43,8%
2016	28	53,6%	46,4%
2017	25	28,0%	72,0%
2018	29	20,7%	79,3%
2019	31	22,6%	77,4%
2020	26	15,4%	84,6%
2021	42	19,0%	81,0%
Total	**197**	**28,4%**	**71,6%**

Table 4: Employment at an international level over the years.

Question 6 (results presented in Table 5) gives some further insight in the type of organization our graduates find their first job. Of course, this information also relates to the information provided in Table 3. We find that, 45% of our graduates find their first job in large industrial companies (mostly international/multinational), followed by employment in SME's (26%). Start-ups and spin-offs account for about 6% of employment.

Graduation year	Number of respondents	International/ multinational company	National company > 500 employees	Small to medium enterprise	Start-up	University spin-off	Public sector	University	Research centre	Education	Self-employed entrepreneur	Other
2015	22	50,0%	0,0%	9,1%	0,0%	0,0%	4,5%	9,1%	0,0%	0,0%	0,0%	0,0%
2016	29	44,8%	6,9%	27,6%	3,4%	0,0%	3,4%	3,4%	0,0%	0,0%	3,4%	3,4%
2017	31	22,6%	3,2%	32,3%	3,2%	0,0%	0,0%	16,1%	0,0%	0,0%	3,2%	0,0%
2018	34	23,5%	8,8%	17,6%	8,8%	2,9%	2,9%	17,6%	0,0%	0,0%	2,9%	0,0%
2019	36	44,4%	5,6%	22,2%	0,0%	0,0%	0,0%	11,1%	2,8%	0,0%	0,0%	0,0%
2020	34	20,6%	8,8%	20,6%	2,9%	0,0%	2,9%	17,6%	2,9%	0,0%	0,0%	0,0%
2021	69	21,7%	1,4%	15,9%	4,3%	1,4%	2,9%	10,1%	2,9%	0,0%	0,0%	1,4%
Total	**197**	**39,1%**	**6,1%**	**26,4%**	**4,6%**	**1,0%**	**3,0%**	**15,7%**	**2,0%**	**0,0%**	**1,5%**	**1,0%**

Table 5: Type of organization first employment.

When asked (Question 7, Table 6) whether they have a permanent contract, about 80% responds affirmatively. The majority of the 20% that do not have a permanent contract is self-employed.

Graduation year	Number of respondents	Permanent contract	No permanent contract
2015	16	93,8%	6,3%
2016	28	89,3%	10,7%
2017	25	76,0%	24,0%
2018	29	72,4%	27,6%
2019	31	83,9%	16,1%

2020	26	69,2%	30,8%
2021	43	81,4%	18,6%
Total	**198**	**80,3%**	**19,7%**

Table 6: Type of contract.

As Table 7 indicates (Question 8), over the years close to 20% of our graduates engages in a PhD-project following their engineering studies. As expected, this is consistent with the findings in Table 3, that about 19% of the graduates is either employed by a University or a Research Institute.

Graduation year	Number of respondents	Started PhD	Did not start PhD
2015	17	23,5%	76,5%
2016	28	14,3%	85,7%
2017	25	16,0%	84,0%
2018	29	20,7%	79,3%
2019	31	12,9%	87,1%
2020	26	26,9%	73,1%
2021	43	18,6%	81,4%
Total	**199**	**18,6%**	**81,4%**

Table 7: Master graduates started PhD after studies.

On the basis of 8 CTI job type descriptions, question 9 is intended to obtain a view of the evolution of this job description over time in the career of an engineer. In relation to this, using four very broad categories (junior/senior technical function and junior/senior management function), question 9 asks for the present position of the respondent while question 11 is intended to get a picture of the salary (gross amount in euros per month).
The results for question 6 are given in Table 8, 9 and 10 with categories as listed below:

#: number of respondents
1. Basic and applied research
2. Engineering studies, consulting and expertise
3. Production, operation, maintenance, testing, quality, safety
4. Information systems
5. Project management
6. Customer relations (marketing, sales, customer support)
7. Management, human resources
8. Training

The evolution of the career suggests that the engineers move from basic research towards more operational and management jobs. For the graduation years 2015-2021, about 60% of the alumni did not yet switch jobs. More specifically, for the graduation years 2015-2017, this number drops to around 30%, indicating that job rotation takes an average period of about 3 years. The current job description of our young graduates has a typical technical, engineering profile (research, design oriented take a share of about 65%).

Graduation year	Number of respondents (excluding None)	Basic and applied research	Design, engineering & consulting	Production, operation, maintenance, testing, quality, safety	Information systems	Project management	Customer relations (marketing, sales, customer support)	Management, human resources	Training	Other
2015	17	17,6%	29,4%	29,4%	17,6%	0,0%	5,9%	0,0%	0,0%	0,0%
2016	26	11,5%	46,2%	15,4%	3,8%	19,2%	0,0%	0,0%	0,0%	3,8%
2017	25	16,0%	40,0%	12,0%	12,0%	12,0%	8,0%	0,0%	0,0%	0,0%
2018	29	20,7%	37,9%	10,3%	20,7%	6,9%	0,0%	0,0%	0,0%	3,4%
2019	31	22,6%	41,9%	16,1%	12,9%	3,2%	0,0%	0,0%	0,0%	3,2%
2020	26	26,9%	46,2%	3,8%	3,8%	15,4%	0,0%	0,0%	0,0%	3,8%
2021	43	18,6%	53,5%	9,3%	2,3%	7,0%	2,3%	2,3%	0,0%	4,7%
Total	**197**	**19,3%**	**43,7%**	**12,7%**	**9,6%**	**9,1%**	**2,0%**	**0,5%**	**0,0%**	**3,0%**

Table 8: Job classification – current job (respondents without a job (N=2) not included in the table).

Graduation year	Number of respondents (excluding None)	Basic and applied research	Design, engineering & consulting	Production, operation, maintenance, testing, quality, safety	Information systems	Project management	Customer relations (marketing, sales, customer support)	Management, human resources	Training	Other
2015	11	18,2%	36,4%	27,3%	9,1%	9,1%	0,0%	0,0%	0,0%	0,0%
2016	17	23,5%	41,2%	17,6%	11,8%	5,9%	0,0%	0,0%	0,0%	0,0%
2017	11	0,0%	36,4%	0,0%	18,2%	36,4%	0,0%	0,0%	0,0%	9,1%
2018	9	11,1%	33,3%	11,1%	33,3%	11,1%	0,0%	0,0%	0,0%	0,0%
2019	8	0,0%	62,5%	12,5%	12,5%	12,5%	0,0%	0,0%	0,0%	0,0%
2020	3	0,0%	0,0%	33,3%	0,0%	33,3%	0,0%	0,0%	33,3%	0,0%
2021	6	16,7%	33,3%	50,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Total	**65**	**12,3%**	**38,5%**	**18,5%**	**13,8%**	**13,8%**	**0,0%**	**0,0%**	**1,5%**	**1,5%**

Table 9: Job classification – previous job (respondents without a job (N=91) not included in the table).

Graduation year	Number of respondents (excluding None)	Basic and applied research	Design, engineering & consulting	Production, operation, maintenance, testing, quality, safety	Information systems	Project management	Customer relations (marketing, sales, customer support)	Management, human resources	Training	Other
2015	6	0,0%	33,3%	16,7%	33,3%	0,0%	0,0%	0,0%	0,0%	16,7%
2016	8	0,0%	75,0%	25,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
2017	5	0,0%	40,0%	0,0%	20,0%	20,0%	0,0%	0,0%	0,0%	20,0%
2018	5	20,0%	20,0%	0,0%	60,0%	0,0%	0,0%	0,0%	0,0%	0,0%
2019	1	0,0%	100,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
2020	2	0,0%	0,0%	50,0%	0,0%	0,0%	50,0%	0,0%	0,0%	0,0%
2021	4	25,0%	25,0%	0,0%	0,0%	0,0%	25,0%	0,0%	25,0%	0,0%
Total	**31**	**6,5%**	**41,9%**	**12,9%**	**19,4%**	**3,2%**	**6,5%**	**0,0%**	**3,2%**	**6,5%**

Table 10: Job classification – job before previous job (respondents without a job (N=111) not included in the table).

The results for question 10 on job position are displayed in Table 11. The findings are consistent with the overview undertaken in 2015, indicating that over 90% of the young graduates start their career in a technical position. The survey conducted in 2015 (which covered a longer time frame) showed that management functions are taken up later in the career.

Graduation year	Number of respondents	Junior technical function	Senior technical function	Middle management	Higher management
2015	17	29,4%	58,8%	11,8%	0,0%
2016	27	14,8%	77,8%	7,4%	0,0%
2017	25	56,0%	28,0%	16,0%	0,0%
2018	29	69,0%	24,1%	6,9%	0,0%
2019	31	90,3%	3,2%	6,5%	0,0%
2020	26	92,3%	3,8%	3,8%	0,0%
2021	43	90,7%	0,0%	9,3%	0,0%
Total	**198**	**67,7%**	**23,7%**	**8,6%**	**0,0%**

Table 11: Present job position.

As indicated in Table 12, about 90% of the respondents has a gross monthly salary between 1500 and 4500 Euro. It should be noted that PhD students earn about 2000 Euro/month, under tax free conditions, which explains the first column of the table (interpreted as a gross amount on which income tax is due, would be a rather low salary for an engineering degree). Two respondents report an exceptionally high salary (between 8500 and 9500 Euro).

Graduation year	Number of respondents	Between 1500 and 2500 Euro	Between 2500 and 3500 Euro	Between 3500 and 4500 Euro	Between 4500 and 5500 Euro	Between 5500 and 6500 Euro	Between 6500 and 7500 Euro	Between 7500 and 8500 Euro	Between 8500 and 9500 Euro
2015	17	5,9%	47,1%	29,4%	11,8%	0,0%	0,0%	0,0%	5,9%
2016	27	7,4%	7,4%	55,6%	18,5%	11,1%	0,0%	0,0%	0,0%
2017	25	24,0%	16,0%	36,0%	20,0%	4,0%	0,0%	0,0%	0,0%
2018	29	20,7%	34,5%	34,5%	3,4%	3,4%	0,0%	0,0%	3,4%
2019	31	22,6%	54,8%	19,4%	3,2%	0,0%	0,0%	0,0%	0,0%
2020	26	34,6%	50,0%	11,5%	0,0%	3,8%	0,0%	0,0%	0,0%
2021	43	25,6%	62,8%	9,3%	2,3%	0,0%	0,0%	0,0%	0,0%
Total	**198**	**21,2%**	**40,9%**	**26,3%**	**7,6%**	**3,0%**	**0,0%**	**0,0%**	**1,0%**

Table 12: Salary - gross amount in euro per month (all percentages, except second column in data).

According to StatBel (statistics collected by the Belgian Federal Government) the average gross salary for a full-time employed individual amounts to 3758 Euro/month in 2019. 10% of the employees earn more than 5886 Euro/month. For employees with a 2-4 year career, the average monthly wage amounts to 3519 Euro/month. The data collected in the survey indicates a similar average starting wage. However, one should note that these figures should be interpreted with care in the inquiry:

- the respondents were asked to report about the gross monthly salary which is perhaps less known by the alumni;
- Specifically for architecture, there is a 2 year internship period, where wages are typically on the low end of the spectrum;
- PhD-students are paid through scholarships, implying that no taxes have to be paid (so gross and net salary are identical for this category);
- Extra-legal benefits (car, phone, …) are not collected in our survey (but are taken into account in the statistics provided by StatBel.

Finally, Table 13 presents the global opinion of the respondents on the FEA engineering education and the obtained degree. Results are consistent with the very positive results obtained in the 2015 survey. The positive scores amount to 90% or more.

Graduation year	Number of respondents	Very positive	Rather positive	Neutral	Rather negative	Very negative
2015	19	52,6%	42,1%	5,3%	0,0%	0,0%
2016	28	57,1%	42,9%	0,0%	0,0%	0,0%
2017	30	53,3%	33,3%	13,3%	0,0%	0,0%
2018	33	54,5%	42,4%	3,0%	0,0%	0,0%
2019	35	45,7%	34,3%	11,4%	8,6%	0,0%
2020	33	54,5%	42,4%	3,0%	0,0%	0,0%
2021	60	51,7%	40,0%	5,0%	1,7%	1,7%
Total	**238**	52,5%	39,5%	5,9%	1,7%	0,4%

Table 13: Global opinion on FEA engineering education and obtained degree.

2. Graduate employability and employer satisfaction survey (discussion of results)

The questionnaire (in Dutch) is given at the end of this annex. Of the fourteen questions, questions one to nine address the *CTI conception for an engineering degree*:

Q1. How would you assess the ability of our alumni to adapt to the professional environment and the engineering context?
Q2. How would you assess the analytical intellectual capacities of our alumni?
Q3. The attitude of our alumni w.r.t. long-term adaptability ("life-long learning") is…
Q4. How well are the graduated engineers prepared to perform research activities?
Q5. How well are they able to translate research results and innovative findings in their engineering activities?
Q6. How do you assess the ability of our young graduates to communicate effectively (both on a national and international level)?
Q7. How do you assess their ability to collaborate within a team?
Q8. How would you assess their understanding of their professional context (e.g. industrial environment)?
Q9. How well are the young graduates aware of the economic, social, ethical and ecological context?

The five additional questions are:

Q10. What is your opinion on the general quality of engineers and engineer-architects graduated at Ghent University?
Q11. In which sector does your organization (company, institute, public service, …) operate?
Q12. Give a rough estimate of the number of engineers and engineer-architects employed by your organization: …
Q13. Give a rough estimate of the number of employees in your organization: …
Q14. What is your general feedback on the engineering curriculum offered at Ghent University?

For questions one to ten the following answers could be given: very good, good, neutral, bad, very bad. Question 11 provided a drop-down list of domains (same list was used as for 4 of the alumni survey). For question 12, a choice was given between: less than 5, 5 to 10, 11 to 20, more than 20, no estimate. The overall results for Q1-Q10 are summarized in Table 14.

	very good	good	neutral	bad	very bad
Q1. Adapt to professional environment and engineering context	37,6%	55,9%	4,3%	2,2%	0,0%
Q2. Analytical intellectual capacities	52,1%	40,4%	7,5%	0,0%	0,0%
Q3. Attitude w.r.t. long-term adaptability is…	33,0%	54,2%	11,7%	1,1%	0,0%
Q4. Able to perform research activities?	27,7%	45,7%	24,5%	2,1%	0,0%
Q5. Translate research results/innovative findings in engineering activities?	16,0%	56,4%	22,3%	5,3%	0,0%
Q6. Communicate effectively (both on a national and international level)?	15,9%	41,5%	36,2%	5,3%	1,1%
Q7. Ability to collaborate within a team?	25,5%	56,4%	17,0%	1,1%	0,0%
Q8. Understanding of their professional context (e.g. industrial environment)?	16,0%	45,7%	33,0%	5,3%	0,0%
Q9. Awareness of the economic, social, ethical and ecological context?	6,4%	31,9%	50,0%	10,6%	1,1%
Q10. General quality of graduated from FEA?	52,1%	39,4%	7,4%	1,1%	0,0%

Table 14: Employer satisfaction w.r.t. CTI conception of the engineering degree (responses in percentages).

Both the short and long term adaptability score very high, together with the intrinsic intellectual and analytical capabilities (Q1-3). Translating research to actual applications in an engineering context and to perform relevant research independently (Q4 and 5) score lower, indicating that there is still effort needed to train our graduates after recruitment. The excellent ability w.r.t. live-long learning are very encouraging in this respect.
Less satisfactory is the persistent concern regarding soft-skills (Q6 – Q7). This remark was already articulated in the 2015 survey, and the FEA took action to remedy this shortcoming, mainly by putting more focus on project work (project line), where communication is essential. This remains a point of attention for the FEA.
Also the understanding of the more general context, less technology focused aspects of the profession, need further attention. The introduction of the new courses "Sustainability, Entrepreneurship and Ethics" (D.O.E. in Dutch) and "Sustainable Business Operations", as well as the initiative to further develop the sustainability track in the FEA programmes are expected to remedy this. In general, the quality of our graduates is highly appreciated by the employers.

Questions 11 – 13 address the type of company that responded to the survey. Table 15 shows that the majority of the respondents are industrial employers. Tables 16 and 17 show the number of engineers and engineer-architects employed and the total number of employees of each organization. These tables show a good representation from the various types of companies in the survey.

Company sector	Number of respondents	Percentage
Health sector, social services	7	7,5%
Industry	33	35,1%
Wholesale and retail sector, vehicle repair sector	1	1,1%
Education	0	0,0%
Research Institute	4	4,3%
Building industry	13	13,8%
Public service, defence and social security	4	4,3%
Transport and storage	2	2,1%
Design agency/Study office (e.g. architectural design, structural design, …)	5	5,3%
Independent professionals, scientific and technical activities (incl. consultancy)	7	7,5%
Administrative and support services	0	0,0%
Information and communication	13	13,8%
Accommodation and meal catering	0	0,0%
Financial activities and insurances	0	0,0%
Other services	1	1,1%
Arts, amusement and recreation	0	0,0%
Agriculture, forestry and fishery	1	1,1%
Other sectors	3	3,2%
Total	**94**	**100,0%**

Table 15: Company sector breakdown.

Number of engineers employed	Number of respondents	Percentage
less than 5	12	12,8%
5-10	14	14,9%
11-20	11	11,7%
more than 20	56	59,6%
no estimate	1	1,1%
Total	**94**	**100,0%**

Table 16: Number of engineers (-architects) employed by respondent's company.

Number of employees	Number of respondents	Percentage
less than 10	7	7,5%
10-50	17	18,1%
50-100	8	8,5%
100-500	13	13,8%
more than 500	48	51,1%
no estimate	1	1,1%
Total	**94**	**100,0%**

Table 17: Number of employees in respondent's company.

3. Graduate employment/alumni survey (questionnaire via SurveyMonkey)

1. In which engineering domain did you obtain a degree?

(*Drop-down list*)

Architecture (architectuur)
Civil Engineering (bouwkunde)
Electromechanical Engineering (werktuigkunde-elektrotechniek)
Chemical Engineering (chemische technologie)
Sustainable Materials Engineering (materiaalkunde, metallurgie)
Textile Engineering (textielkunde)
Electrical Engineering (elektrotechniek)
Bioinformatics (bio-informatica)
Photonics (fotonica)
Engineering Physics (toegepaste natuurkunde)
Nuclear Fusion and Engineering Physics
Computer Science Engineering (computerwetenschappen)
Industrial Engineering and Operations Research (bedrijfskundige systeemtechnieken en operationeel onderzoek, industrieel beheer)
Biomedical Engineering (biomedische ingenieurstechnieken)
Fire Safety Engineering
Nuclear Engineering
Urbanism and Spatial Planning (ruimtelijke planning en stedenbouw)

2. In what year did you graduate? (YYYY-format, e.g. 2002)

yyyy

3. How long did it take you to apply for your first job (e.g. in industry, as a PhD researcher, …)

- I did not look for a job because I am continuing my studies after my graduation as an engineer (***proceed to question 12***)
- I did not look for a job immediately following my studies because of other reasons (world trip, sabbatical, …) (***proceed to question 12***)
- I am still looking for a job (***proceed to question 12***)
- I already had a job before graduating
- Less than 1 month after graduating
- Between 1 and 3 months after graduating
- Between 4 and 6 months after graduating
- More than 6 months after graduating

4. In which sector did your first employer operate? (First employer refers to your main first professional experience after graduation, which may include self-employment.)

(*Drop-down list*)

Health sector, social services
Industry
Wholesale and retail sector, vehicle repair sector
Education
Research Institute
Building industry
Public service, defence and social security
Transport and storage
Design agency/Study office (e.g. architectural design, structural design, …)
Independent professionals, scientific and technical activities (incl. consultancy)
Administrative and support services
Information and communication
Accommodation and meal catering
Financial activities and insurances
Other services
Arts, amusement and recreation
Agriculture, forestry and fishery
Other sectors

5. Do you work abroad, or did you ever work abroad in the course of your professional career?

- Yes
- No

6. In which sector is your present employer situated? (Present employer refers to your current, main professional activity, which may include self-employment)

- International/multinational company
- National company > 500 employees
- Small to Medium Enterprise

- Start-up
- University spin-off
- Public sector
- University
- Research centre
- Education
- Self-employed entrepreneur
- Other

7. Do you have a permanent contract?

- Yes
- No

8. Did you start a PhD after your studies?

- Yes
- No

9. How would you classify your (main) current and past jobs (if applicable)? In the following boxes, we have specified eight engineering domains (based on CTI's classification). Choose one domain per job experience. We are interested in your current job, your job before that, and your job that preceded that one.

- **Current Job**

(*Drop-down list)*

None
Basic and applied research
Engineering studies, consulting and expertise
Production, operation, maintenance, testing, quality, safety
Information systems
Project management
Customer relations (marketing, sales, customer support)
Management, human resources
Training

- **Previous Job**

(*Drop-down list)*

None
Basic and applied research
Engineering studies, consulting and expertise
Production, operation, maintenance, testing, quality, safety
Information systems
Project management
Customer relations (marketing, sales, customer support)
Management, human resources
Training

- **Job before that**

(*Drop-down list)*

None
Basic and applied research
Engineering studies, consulting and expertise
Production, operation, maintenance, testing, quality, safety
Information systems
Project management
Customer relations (marketing, sales, customer support)
Management, human resources
Training

10. How would you qualify your present job position (main activity)?

- Junior technical function
- Senior technical function
- Middle management
- Higher management

11. What is your current salary (gross salary in euro, per month)? (Please be as specific as possible, as CTI explicitly asks this information.)

- Between 1500 and 2500 Euro
- Between 2500 and 3500 Euro
- Between 3500 and 4500 Euro
- Between 4500 and 5500 Euro
- Between 5500 and 6500 Euro
- Between 6500 and 7500 Euro
- Between 7500 and 8500 Euro
- Between 8500 and 9500 Euro
- More

12. What is your personal overall opinion on the engineering education and degree you obtained at Ghent University?

- Very positive
- Rather positive
- Neutral
- Rather negative
- Very negative

13. If you have any other comments or feedback on your engineering education at Ghent University, we are happy to receive them in the boxes below.

- Strongest points of the curriculum *(Text field)*
- Weakest points of the curriculum *(Text field)*
- Suggestions for curriculum improvement *(Text field)*
- Other feedback *(Text field)*

4. Graduate employability and employer satisfaction survey (questionnaire via SurveyMonkey)

1. **How would you assess the ability of our alumni to adapt to the professional environment and the engineering context?**

   - very good
   - good
   - neutral
   - bad
   - very bad

2. **How would you assess the analytical intellectual capacities of our alumni?**

   - very good
   - good
   - neutral
   - bad
   - very bad

3. **The attitude of our alumni w.r.t. long-term adaptability ("life-long learning") is…**

   - very good
   - good
   - neutral
   - bad
   - very bad

4. **How well are the graduated engineers prepared to perform research activities?**

   - very well
   - well
   - neutral
   - badly
   - very badly

5. **How well are they able to translate research results and innovative findings in their engineering activities?**

   - very well
   - well
   - neutral
   - badly
   - very badly

6. **How do you assess the ability of our young graduates to communicate effectively (both on a national and international level)?**

- very good
- good
- neutral
- bad
- very bad

7. How do you assess their ability to collaborate within a team?

- very good
- good
- neutral
- bad
- very bad

8. How would you assess their understanding of their professional context (e.g. industrial environment) ?

- very good
- good
- neutral
- bad
- very bad

9. How well are the young graduates aware of the economic, social, ethical and ecological context?

- very well
- well
- neutral
- badly
- very badly

10. What is your opinion on the general quality of engineers and engineer-architects graduated at Ghent University?

- very good
- good
- neutral
- bad
- very bad

11. In which sector does your organization (company, institute, public service,…) operate?

(*Drop-down list*)

Health sector, social services
Industry
Wholesale and retail sector, vehicle repair sector
Education

Research Institute
Building industry
Public service, defence and social security
Transport and storage
Design agency/Study office (e.g. architectural design, structural design, …)
Independent professionals, scientific and technical activities (incl. consultancy)
Administrative and support services
Information and communication
Accommodation and meal catering
Financial activities and insurances
Other services
Arts, amusement and recreation
Agriculture, forestry and fishery
Other sectors

12. Give a rough estimate of the number of engineers and engineer-architects employed by your organization:

- < 5
- 5-10
- 11-20
- > 20
- no estimate

13. Give a rough estimate of the number of employees in your organization:

- < 10
- 10-50
- 50-100
- 100 – 500
- > 500
- no estimate

14. What is your general feedback on the engineering curriculum offered at Ghent University?
(*Text field*)

ANNEX A.17 Programme-specific operational objectives

These operational objectives were defined by the central administration, in line with the Standards and Guidelines for Quality Assurance in the European Higher Education Area (programme-specific content (learning outcomes/programme competencies, curriculum, exit level); and the quality culture in each study programme).

It is carefully monitored to which extend the study programmes implement the HEI's education policy. For Ghent University specifically, this means monitoring and guaranteeing that all study programmes live up to Six Strategic Objectives.
https://www.ugent.be/en/ghentuniv/principles/educational-strategy/strategischedoelen_eng.pdf

DS-0001	The study programme has a clear and endorsed mission and vision that reflect the study programme's specificity and characterisation. This mission and vision are in keeping with Ghent University's mission, vision, and strategic educational objectives, and with Ghent University's educational concept of 'creative knowledge development'.
DS-0002	The study programme has a set of programme-specific competencies that embodies the vision and mission, strategic choices, specificity, and characterisation of the programme as well as Ghent University's competence model. These predetermined competencies are up to date and topical, and form a clear and coherent whole.
DS-0003	The programme-specific competencies comply with the Flemish Qualifications Framework requirements, and with the existing domain-specific learning outcomes (Dutch: DLR) with regard to level, content and orientation. They are also in accordance with the current occupational demands as they aspire to prepare students for future occupational profiles. In addition, programme-specific competencies meet international standards.
DS-0004	The programme-specific competencies are endorsed by and known to all the relevant stakeholders.
DS-0005	The study programme adequately implements its programme-specific competencies through several different course units (competence matrix).
DS-0006	The study programme has a logical setup, based on the principle of 'constructive alignment'. The study programme forms a consistent whole (e.g. by means of learning pathways), in which lecturers make sure that the various course units are both horizontally and vertically aligned. The study programma also ensures a well-balanced planning for the students in terms of deadlines and work density.
DS-0007	The study programme is aimed at allowing students to acquire the predetermined exit level, which guarantees the students' optimal chances at a continuation course or introduction into the professional world.
DS-0008	The study programme uses a variety of teaching methods that is attuned to the programme-specific competencies.
DS-0009	The study programme integrates active teaching methods, allowing students to take responsibility in their individual learning process.
DS-0010	The study programme pursues a transparent and efficient policy with regard to the master's dissertation. This policy guarantees that every student (a) is granted the opportunity to write a high-quality master's dissertation that is linked to the programme, and (b) receives high-quality coaching throughout the process.
DS-0011	The study programme has a transparent and efficient work placement policy, which guarantees that every student (a) is granted the opportunity to undertake a high-

	quality work placement that is linked to the programme, and (b) receives high-quality coaching throughout the process.
DS-0012	The study programme pursues an assessment policy that is up to date, endorsed and in accordance with Ghent University's assessment concept, assessment model, and the 17 assessment principles, as well as with the faculty's assessment strategy. Within this framework, the study programme is free to place idiosyncratic emphases.
DS-0013	The assessment methods are varied and adapted to the learning process and the teaching methods. If necessary, the study programme schedules interim feedback and/or integrates other active assessment methods. Throughout the study programme, the various programme-specific competencies are assessed in several different course units (competence matrix).
DS-0014	The study programme ensures the quality of assessment down to the level of each individual course unit. This means that the programme ensures that lecturers use clear assessment criteria to evaluate the various teaching methods, and that they give appropriate feedback. The study programme also makes sure that lecturers apply the four-eyes principle when drawing up exam papers and assignments.
DS-0015	The study programme regularly collects feedback from a broad range of external stakeholders (peers, occupational field, alumni, collective industrial organizations, …) at least covering (a) the study programme competencies (including programme profile), (b) curriculum content and curriculum design, (c) assessment and exit level. In addition, the study programme consults (at least) three international academic peers to gauge programme quality at least every four years or in the run-up to important curricular revisions.
DS-0016	The study programme committee discusses external feedback and, if necessary, translates this feedback into improvement measurements.
DS-0017	The study programme committee is composed, and functions in accordance with Ghent University's education and examination code. The SPC meets regularly and uses as its working tools the SPC team site and the study programme monitor. In this set-up, the SPC team site is the SPCs operational working tool. The study programme monitor is the SPCs (education) policy instrument. SPC reports are included in Ghent University's Document Management System.
DS-0018	The SPC analyses and discusses the results of the study programme quality measurements and other forms of evaluation on a regular basis. It goes without saying that the SPC respects the confidentiality of personal results.
DS-0019	The study programme regularly draws up a quality improvement plan. This plan is based on checking the study programme objectives and indicators on the one hand, and analyzing other (programme-specific) evaluations on the other hand. The quality improvement plan can be automatically generated by the monitor. It sets out actions, determines priorities, allocates responsibilities and timelines. The study programme sees to the implementation of that plan. Ultimately, the programme should be able to prove that quality improvement plans result in permanent quality improvement.
DS-0020	The study programme sheet and course sheets are topical, complete, and informative for the student, and available in both Dutch and English.
DS-0021	The students, lecturers, education support staff and other stakeholders all have access to complete and clear information about every phase of the curriculum, such as the available teaching and learning materials, the possibilities for education services, and the organisation of the study programme.
DS-0022	The study programme actively communicates about all aspects of the educational strategy and the educational quality assurance, thereby informing all students, lecturers, educational supporters and external stakeholders. The study programme also makes educational quality information available to the general public, as is

	requested by the Educational Quality Office.
DS-0023	A critical mind-set, different perspectives, open-mindedness, pluralism, and tolerance of other opinions are key elements in the study programme's educational policy and practice.
DS-0024	The study programme stimulates multi-, inter-, and transdisciplinarity. It also encourages (service) education in the study programme, either sourced from other faculties, or from other study programmes within the same faculty. The study programme sees to the integration of sustainability issues into the (service) education it offers.
DS-0025	The study programme's educational practice is at all times based on innovative research and the most recent academic insights in the field.
DS-0026	In the allocation of teaching assignments, the faculty ensures an adequate match between the lecturers' expertise and the course units they teach.
DS-0027	The study programme makes sure that all students are granted the best opportunities to develop their research competences.
DS-0028	The study programme promotes scientific and academic integrity.
DS-0029	The study programme analyses and optimizes the inflow, the outflow (employability), and the study progress with special attention to the student population's diversity.
DS-0030	The study programme grants students the possibility to choose from different curricular options with regard to elective course units, elective modules, minors, work placement, dissertation topics, etc.
DS-0031	The study programme offers its students and staff opportunities to develop their talents in relation to Ghent University's core topics of 'sustainability, entrepreneurship, and social engagement'.
DS-0032	The study programme adequately allocates its lecturers to the various course units, thereby taking into account the lecturers' experience, profile, and expertise in order to grant its students the best opportunities to acquire the intended programme-specific competencies.
DS-0033	The study programme pursues a professional development policy. It encourages lecturers to take part in professional development initiatives and it stimulates educational innovation in the teaching practice. Active learning methods merit special attention.
DS-0034	The study programme actively involves students in various commissions and boards, whereby students have a true impact on educational policy and quality assurance. The study programme stimulates these students to act as 'representatives' and encourages them to be in close contact with their fellow students. The students also help determine the study programme monitor and assist in defining and executing the quality improvement plan. The study programme committee discusses the results of student reflections that are carried out at least every three years in the presence of student representatives. This is recorded in the monitor.
DS-0035	The study programme involves all its lecturers in its educational and quality assurance policy. The study programme committee regularly surveys their concerns and makes an active effort to meet their wishes.
DS-0036	The study programme communicates with external stakeholders (e.g. professional field, alumni, policy makers, (inter)national experts, etc...) about its vision, mission, specificity, and characterisation. This ensures that stakeholders are able to inform the study programme about new developments in the field, about the professional field itself, and about the study programme's social relevance.
DS-0037	The study programme pursues an internationalisation policy that is clearly and visibly embedded in the programme's vision, mission, programme-specific competencies, and the curriculum.

DS-0038	The study programme specifically realizes internationalisation by means of incoming and outgoing student mobility and additionally ensures the development of international and intercultural competencies of all students via internationalisation@home initiatives.
DS-0039	Lecturers and other staff members within the study programme participate in staff mobility and make use of internationalization opportunities for professional development purposes.

ANNEX A.18 Questionnaire course evaluation

5-point scale: strongly disagree – disagree – neutral – agree – strongly agree

LEARNING EFFECT

- I found the subject matter intellectually challenging and stimulating.
- The course unit offered me useful knowledge or skills.
- The course unit familiarized me with key concepts in the discipline.
- The course unit taught me broadly applicable skills (such as self-management, the ability to think analytically, the ability to work together, leadership abilities and/or communicative skills).
- The course unit stimulated me to think critically or to critically apply newly acquired knowledge.
- The course unit taught me to put theoretical knowledge into practice.
- The course unit used authentic examples and/or was in tune with current affairs to explain key concepts.
- The course unit introduced me to international and/or intercultural aspects of the discipline.

ACTIVE LEARNING

- The course unit elicited students' active participation.
- Throughout the course unit I was stimulated to actively engage with the course content.
- I was stimulated to set to work with the subject matter in interaction with fellow students.
- The didactic approach in this course unit added value to processing the learning contents.
- Lecture recordings (video clips, presentations, …) or live streams provided high-quality contents.
- The didactic approach in this course unit motivated me to participate in the online lectures/teaching activities.
- With their handling of the (online) didactic tools (Ufora learning pathways, Zoom, Bongo Virtual Classroom, Assignments, Discussion Forum, Chat, etc…) the lecturer encouraged Interaction with other students, and with the lecturer.
- The didactic methods and tools used in this course unit sufficiently captured my attention.

ASSESSMENT

- The assessment methods were correct and transparent.
- The assessments (exams, assignments, …) assessed the course content as emphasized by the lecturer.
- I was well-informed about the form and content of assessments.
- The amenities for interim feedback were ample and timely.
- Feedback (individual feedback, group feedback, …) about the assessments was useful and relevant.

LEARNING MATERIAL

- The learning materials (video clips, slides, presentations, other course materials, …) were made available in a timely fashion.
- The course unit had useful and qualitative underlying learning materials.

EXCERCISES (IF APPLICABLE)

- The exercises/practicals were a useful part of, or addition to, the subject matter.
- The exercises/practicals were adequately supervised.

MISCELLANEOUS ITEMS

- I was well-informed about what was expected of me during this course unit.
- There was a clear structure throughout the learning activities.
- How do you estimate the workload in comparison with the course accreditation?
  [too light – light – about right – heavy – too heavy]
- For each part of the course unit (learning pathways, assignments, tasks, exercises, …), the lecturer made accurate estimates of the required investment of time (by students).
- The lecturer's teaching pace was…
  [too slow - slow - about right - fast - too fast]
- What is your general appreciation of this course unit?

ITEMS PERTAINING TO THE INDIVIDUAL LECTURER

- The lecturer's comportment towards students was correct.
- The lecturer was sufficiently approachable.
- The lecturer taught with enthusiasm.
- The lecturer was well-suited to deal with differences between students and to respond appropriately to the student group's heterogeneity.
- The lecturer was sufficiently prepared to set up (part-time) distance teaching.

OPEN COMMENT FIELD

Use the comments field to formulate suggestions, positive comments or points for improvement. Your comments are sent directly to the lecturer(s).

ANNEX A.19 Questionnaire programme evaluation (Master)

5-point scale: strongly disagree – disagree – neutral – agree – strongly agree

GENERAL SATISFACTION

- The study programme content met your expectations.
- The study programme has prepared you well for your future career.
- Generally speaking, you consider the quality of the study programme to be high.

STRUCTURE

- The contents of the course units were properly sequenced.
- The course units were sufficiently aligned in terms of content.
- The study programme guaranteed that tasks and assignments were well-arranged in terms of scheduling, organisation and deadlines.

ORGANIZATION

- The study programme was well-organized.
- There was ample opportunity for student counselling, study track counselling, tutorial service or other forms of counselling/advice for those who needed it.
- Student facilities were easily accessible (library, IT-infrastructure, classrooms/lecturing halls,…).
- The student representatives involved in the study programme's organisation and quality assurance were known to you.

ACTIVE LEARNING

- There was ample opportunity to put knowledge into practice.
- There was ample opportunity to practice skills.
- Several course units integrated cooperative learning.
- The majority of course units stimulated you to actively engage with the course content.
- The study programme stimulated critical insight.

ASSESSMENT

- The assessment methods in all course units were properly aligned with the course content.
- You were well-informed about the form and content of assessments.
- Assessments were focused on essential aspects of the study programme.
- You received sufficient feedback on assignments and papers.
- The study programme provided ample and timely feedback on (final) assessments.

INTERNATIONALISATION

- You were stimulated to embark on a foreign study experience.
- In the course of the study programme, you were brought into contact with foreign (guest) lecturers and foreign students.
- In the course of the study programme, you became familiar with the intercultural and international aspects of your discipline.

LEARNING EFFECT

- You acquired knowledge and skills that were more complex than those of your previous study programme.
- The study programme stimulated creativity in the development or application of knowledge.

- The study programme taught you scholarly ways of thinking
- The study programme taught you sufficient theoretical knowledge, skills and attitudes within your discipline.
- The study programme trained you to be competent in communicating and collaborating with others.
- The study programme has adequately prepared you to function independently within your discipline.

ENTREPRENEURSHIP

- The study programme stimulated you to develop entrepreneurial skills (like e.g. starting up a project, (financial) planning and management, market analysis, project quality assurance, leadership, innovation,…).

SUSTAINABILITY

- The study programme stimulated you to think about ecologically sustainable and/or socially equitable solutions to problems.

SOCIAL COMMITMENT

- The study programme stimulated you to think about societal challenges.
- The study programme taught you how to apply yourself to social engagement within the context of your discipline.

RESEARCH

- The study programme has adequately prepared you to autonomously conduct academic research.
- The study programme contributed to your knowledge of research methods.
- You came into contact with recent research findings and academic insights.
- In the course of the study programme, you became acquainted with the principles of academic integrity. In other words, ethical principles and principles pertaining to the quality and reliability of academic research.

DIVERSITY

- In the course of the study programme, you were introduced to the idea of diversity, or inclusive education (education focused on diversity).

ACADEMIC LANGUAGE SKILLS

- In the course of the study programme, you honed and perfected your academic language proficiency.

WORKLOAD

- How would you describe the workload required to complete the study programme? [too light – light – about right – heavy – too heavy]

OPEN COMMENT FIELD

Use the comments field to formulate suggestions, positive comments or points for improvement.

UNIVERSITEIT GENT

GHENT UNIVERSITY QUALITY CONDUCT 2.0

QUALITY ASSURANCE AND QUALITY SUPPORT

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This memo outlines the history of **Ghent University's Quality Assurance Conduct**: a system of **internal quality assurance and its concomitant education support services for teaching staff and study programmes**. This history can be divided into three phases: from the system's inception, first implementation and thorough review, over a period of adjustment and reflection, looking ahead at the future. These phases are respectively known as Quality Assurance Conduct 1.0 (2015-2019), Quality Assurance Conduct 2.0 (2020-2023), and Quality Assurance Conduct 3.0 (2024 and onwards)[1].

Changing legislative contours in Flanders[2] in combination with the results of a thorough internal systems review gave Ghent University policy makers a window of opportunity to take significant and daring steps towards a structural quality culture in education. In so doing, Ghent University boldly departed from models and procedures aimed at momentarily controlling educational practice and providing for subsequent intensive but short-lived periods of quality improvement. Living up to the university credo "Dare to Think", the new system is intended to **evolve into a fully-fledged university-wide quality *culture***, "in which all stakeholders naturally strive for *continuous* quality assurance as well as quality enhancement".[3]

The present memo mainly focuses on the Quality Assurance Conduct 2.0, though not without duly looking back at its antecedents and looking ahead at what the future might have in store.

1 INTRODUCTION

Installing a fully-fledged university-wide quality culture implies a framework containing a growth path with short-term and long-term goals. This is exactly what the new quality assurance model provides. In the period 2020-2023, Ghent University aims at instilling in its study programmes an attitude of data-driven critical reflection and systematic follow-up of improvement actions. This is the phase of the **Ghent University Quality Assurance Conduct 2.0** (hereafter QA Conduct 2.0). This phase marks (1) the implementation of monitoring instruments that will enhance quality reflection, and (2) the launch of coaching sessions on education policy(-making) and quality culture for faculties and study programmes. During that period of time (2020-2023), the Education Quality Board (in Dutch: Onderwijskwaliteitsbureau - OKB) will screen and ensure the quality assurance process of our 200 study programmes.

The new quality assurance system is built on the following basic principles:

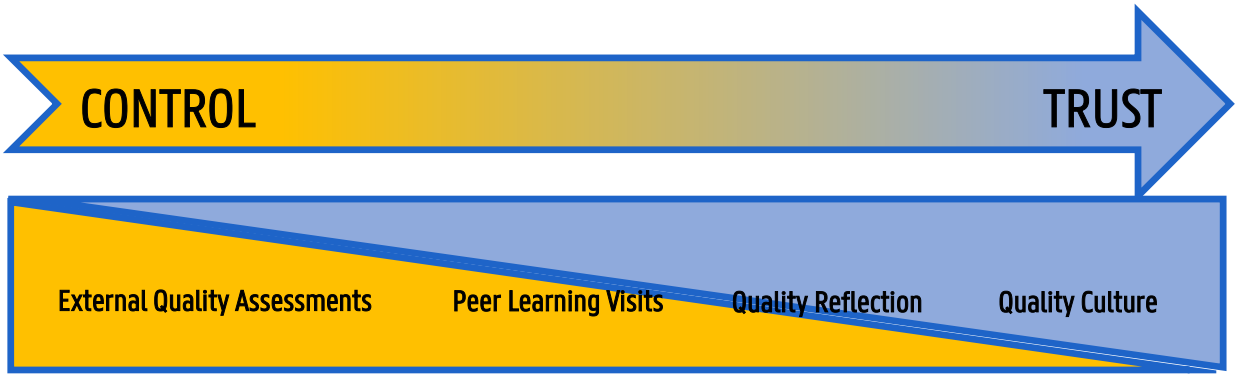
- ***trust***: the new approach is premised on trust in the expertise held by study programmes and faculties;
- ***shared ownership***: the new approach aims at facilitating and stimulating self-management. After all, the study programmes and faculties are the principal engine for generating and monitoring quality;
- ***continuous improvement***: the new approach aims at furthering a positive quality culture, in which faculties and study programmes are stimulated to continuously improve (the quality of) their education;

[1] Ghent University Quality Assurance Conduct - hereafter: QA Conduct 1.0, 2.0, 3.0
[2] The new Quality Code for Higher Education came into effect in 2018
[3] https://www.nvao.net/nl/procedures/vlaanderen/instellingsreview

- ***efficient tools***: the new approach offers a set of "quality performance tools" to support existing quality assurance procedures, and to substantiate policy-making in faculties and study programmes;

- ***Enlightened University (Dutch: UGent Verlicht)***: where possible, administrative processes are being simplified, reducing reporting and documentation requirements and overhead to an absolute minimum;

In a next phase, from 2024 onwards, faculties' and study programmes' self-management will have been sufficiently boosted: they will be able to refer to the varied education support services at their own discretion in order to ensure a **continuous and *continual* monitoring and improvement of education. This phase will be Ghent University's Quality Assurance Conduct 3.0** (hereafter QA Conduct 3.0).



The following section contains a brief retrospective of Ghent University's Q.A. Conduct 1.0 (2015-2019), including the comprehensive and critical systems review that was carried out (2018-2019). Subsequent sections will discuss the development of the Q.A. Conduct 2.0, and look ahead at the future of quality assurance at Ghent University (Q.A. Conduct 3.0).

2 QUALITY ASSURANCE: TOWARDS QUALITY ASSURANCE CONDUCT 2.0

2.1 Quality Assurance Conduct 1.0 (2015 – 2019): Focus on Peer Learning Visits

2.1.1 Introducing Peer Learning Visits

Legislative changes in Flanders (2014), gave higher education institutions (HEI) the opportunity to take quality assurance of study programmes into their own hands. A transitional decree suspended the external quality assessments (in Dutch: onderwijsvisitaties) that had been customary up until then, and in its place introduced the **institutional review.** Supervised by the Accreditation Organisation of the Netherlands and Flanders[4] (hereafter NVAO), the institutional review and its concomitant procedures aim at gauging the HEI's policy and so-called quality assurance conduct. These changing legislative contours provided the incentive for the development and implementation of Ghent University's first internal quality assurance system. In the period

[4] Dutch: Nederlands-Vlaamse Accreditatieorganisatie – NVAO

between 2015-2019, the new system put into place monitoring processes on all levels of policy-making: the individual study programmes, the faculties, and the institution.

At the **level of the study programmes**, the new system introduced **digital portfolios**[5] and **peer learning visits**[6] as part of a continuous approach to quality assurance. An online repository in which study programmes outline their day-to-day operation, the portfolios included all underlying (quality assurance) processes and practices. A crucial information feed in those portfolios was the data made available through **UGI**[7], **Ghent University's business intelligence system**, and the study programme's **critical analysis** of that data. The information in the portfolio, then, was the starting point for the peer learning visits, the aim of which was twofold: (1) to promote and exchange good/best practices between study programmes and across disciplinary boundaries, and (2) to learn from each other's challenges and difficulties. Every peer learning visit resulted in a written report that was brought before the **Education Quality Board**[8] (hereafter EQB; ut infra), containing recommendations and advice.

Parallel to the processes for study programmes, the new system also introduced various monitoring processes at **faculty level**, including a **digital portfolio** and an **annual quality meeting**. The faculty portfolio logically focused on faculty-specific policy lines and actions, and faculty-specific quality assurance processes. **Every faculty** also **takes part in the Annual Quality Meeting,** involving the following parties: the Dean and Director of Studies, the Director of Education, the Head of the Quality Assurance Office and their immediate staff. Main subject of these meetings are the principal policy and quality assurance developments.

At **institutional level**, a specialized committee was installed to **monitor the efficiency of quality assurance processes, and to guarantee the quality** Ghent University's 200 study programmes. The Education Quality Board (EQB) operates under supervision of the Board of Governors and the Executive Board, but has been granted decision-making power in all matters related to education policy and quality assurance.

2.1.2 The First Institutional Review: Outcome

In the years 2015-2017, the NVAO conducted a first round of institutional reviews in Flanders by way of baseline measurement. As such, the outcome had no legal effect but resulted in an advisory report with specific recommendations. Ghent University's advisory report –delivered after the site visit in May 2016 - emphasized the QA Conduct's clear stimulus towards self-reflection on quality assurance. Additionally, the report commended, among other things, the **thorough process-based check** that was built into the peer learning concept; the **focus on reciprocal learning** between study programmes, and the **strong student engagement** on all levels of the new quality assurance model. At the same time, however, the report advised **further investment in international benchmarking**, and a **strengthened check on study programme content.**

2.1.3 Quality Assurance Conduct 1.0: Internal Review

In the immediate aftermath of the institutional review, Ghent University took measures to evaluate the peer learning concept. In the course of the academic year 2016-2017, meetings were arranged with the eleven

[5] the portfolios were incorporated into Ghent University's electronic learning environment (ELE) "Minerva"
[6] a typical peer learning visit takes up an entire day, in the course of which a six-member team visited a specific Ghent University study programme, engaging in group discussions with programme committee members, with a representative group of lecturers, a representative group of students, and with alumni. Teams consist of three Ghent University programme committee chairs, an external independent expert, and a student representative. Peer learning visits were coordinated and overseen by Quality Assurance Office staff members.
[7] UGI is the Dutch acronym for "UGent Geïntegreerd Beleidsinformatiesysteem". In English, this translates into Ghent University Integrated Business Intelligence System.
[8] Dutch: Onderwijskwaliteitsbureau – OKB

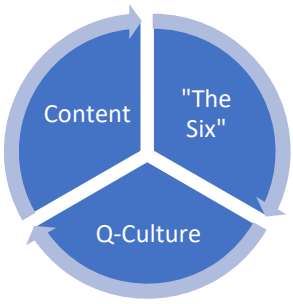
faculties' Directors of Studies and quality assurance staff. Among other things, the ensuing talks established that the digital portfolio was considered to be too passive an instrument for integration into the study programmes' day-to-day workings. Performing a systematic check on all 55 processes and the more than 100 indicators that lie at the heart of the portfolio had turned out to be a highly complex exercise, not in the least because study programmes had to delve into UGI themselves to uncover the relevant data. Though promising in their initial concept, the digital portfolios, in other words, raised (too) many impediments to systematic, data-driven decision-making and quality assurance.

With the purpose of formulating specific improvement measures, the Education Department[9] launched a survey and organized focus group meetings in the spring of 2018, targeting every stakeholder group that had up until this point participated in the peer learning visits. Together with a **general appreciation** for the peer learning concept, this internal systems review uncovered a number of **positive aspects**, for instance: an outspoken interest in the development of support services, which would come into effect after the peer learning visit, and which would consist of tailor-made coaching initiatives. The responses **also** revealed several **points of improvement,** for instance: the fact that during peer learning visits, peers were asked to assess and score each other was found to be overly judgmental, and therefore too reminiscent of the external assessments of old. This approach might also unintendedly pave the way to more institutionalized window dressing. Moreover, for many respondents the focus of peer learning visits proved to be muddled, holding an ambiguous middle between process evaluation and content-specific evaluation. Finally, the peer learning visits were shown to bring about a considerable administrative burden, not in the least because the majority of "peer visited" study programmes was not expected to present any major problems – as was afterwards confirmed by 90% of the peer learning reports.

2.1.4 A New Quality Code for Higher Education: Implications

A review of the transitional decree by the appropriate government echelons resulted in a new Quality Code for Higher Education in May 2018. The Flemish legislators decided to **maintain the process of institutional reviews for Higher Education Institutions (HEI)**. The Quality Code lays down a six-year review cycle with two possible outcomes: a positive outcome entails an automatic renewal of study programme accreditation for the HEI; a negative outcome reverts the HEI to a system of external study programme accreditation.

The new Quality Code also lays down a set of **assessment criteria** for the institutional review, and a number of quality features which all study programmes are expected to meet. The HEI's own quality conduct must guarantee the following aspects:



- **programme-specific content** (learning outcomes/programme competencies, curriculum, exit level);
- the **quality culture** in each study programme;
- the extent to which study programmes implement **the HEI's education policy**. For Ghent University specifically, this means monitoring and guaranteeing that all study programmes live up to **Six Strategic Objectives**[10].

[9] Dutch: Directie Onderwijsaangelegenheden – DOWA

[10] Ghent University's Six Strategic Objectives are known in Dutch as "De Zes" - "The Six"

In addition, the Quality Code places strong emphasis on stakeholder engagement: HEI are expected to structurally involve **internal** (lecturing staff, students) **as well as external** (alumni, the occupational field, independent international peers) **stakeholder parties** in their quality assurance. Finally and crucially, the Quality Code explicitly holds HEI responsible for pronouncing a **formal quality assurance resolution** (hereafter QAR)[11] for every individual study programme, and for the publication and follow-up of those QARs as **"publicly available information"**.

2.2 Towards a Q.A Conduct 2.0 (2020 – 2023): Focus on Quality Reflection

The recent developments outlined above, prompted policy makers at Ghent University to bring its quality assurance model up to date, and in compliance with the new legislative guidelines. In the course of one year (late 2018 - end of 2019), a new system was developed in close consultation with internal stakeholders (faculties, Directors of Studies, quality assurance staff, study programme chairs, …), and external experts. In the new system's initial roll-out phase (QA Conduct 2.0), Ghent University will focus on systematic **quality reflection** about its education policy. **Conform the PDCA principle**, this reflection will result in appropriate improvement measures on all levels, from individual lecturers and study programme (committees), over faculties to the institution.

2.2.1 PDCA-based Quality Reflection on 4 Levels

2.2.1.1 The Lecturer

Ghent University lecturers are inspired and enthusiastic teachers with a self-reflective attitude to their teaching and assessment practice. To stimulate and encourage such self-reflection, (newly appointed) lecturers have at their disposal a wide offer of **professional development initiatives**, all of them ensuing from and contributing to the university-wide principles of "what constitutes good teaching". A more "institutionalized" incentive for self-reflection is provided by the annual **course feedback by students.** These surveys are used as a quality assurance tool within the context of the new career path for professorial staff.

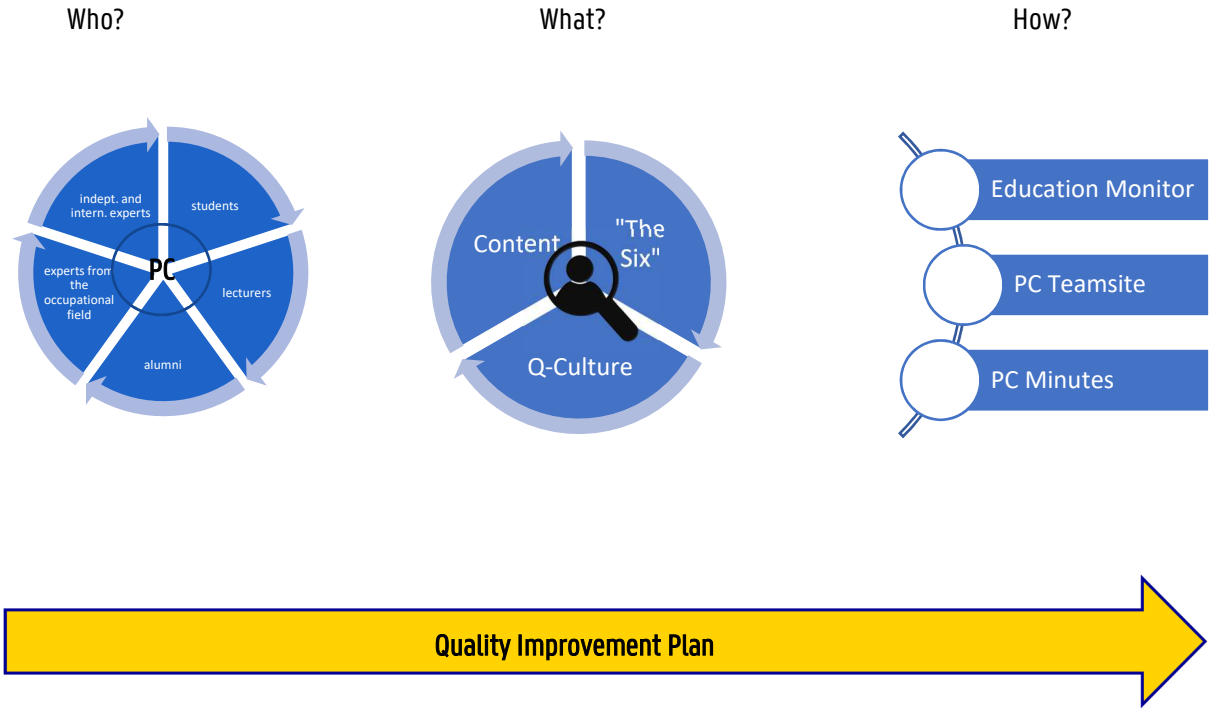
2.2.1.2 The Study Programme

At Ghent University, every study programme **regularly (at the least annually)** carries out a critical self-reflection on the three features laid down by the Quality Code, i.e. programme-specific content, quality culture, and the implementation of Ghent University's "Six". Responsibility for this process lies with the **programme committee**, which is also in charge of generating and cultivating the engagement of all the relevant stakeholder parties: students, lecturing staff, professional field, alumni, international peers and experts. Since the new system places great store by the **check on programme-specific content**, the university is developing a clear set of guidelines to facilitate embedding the external perspective.

Quality performance tools are essential to promoting a qualitative and systematic reflection process. For that purpose, Ghent University offers its study programmes, among other things, an education monitor, a team site for programme committees and a document management system. The **education monitor** is the highly improved successor to the old digital portfolios, in which the plethora of "checkable" processes has been replaced by a manageable set of programme-specific operational objectives. These objectives have been integrated into the monitor, are easy to assess and are linked to specific UGI data. The education monitor, in other words, is now

[11] Dutch: "borgingsbesluit"

truly data-driven and has a proper **dashboard function**. Taken together, the above-mentioned quality performance tools enable the programme committees to draw up an **annual quality improvement plan**.



2.2.1.3 The Faculty

The faculty fulfils an **essential part in education support and quality assurance of its study programmes:** it translates (institutional) policy lines into faculty- and programme-specific measures and guidelines, and actively promotes professional development and exchanging good practices. Since efficient policy presupposes a healthy amount of introspection, faculties are also expected to **regularly (at least annually) carry out a critical self-reflection** on their education policy, internal quality culture and the implementation of Ghent University's "Six". The underlying processes and quality performance tools are analogous to those on study programme level (see 2.2.1.2). The format of the **Annual Quality Meeting** (see 2.1.1) continues to exist and strengthens the partnership between the Education Department and the faculties.

2.2.1.4 The Education Department

Last but not least, Ghent University's critical attitude is highlighted at the institutional level as well: the administration carries out a **critical reflection** at least annually, scrutinizing the university's education policy, the general quality culture and its own operational objectives. Here, too, the exercise is supported by a central education monitor, a team site and a document management system.

2.2.2 Quality Assurance

2.2.2.1 The Role of the Education Quality Board (EQB)

In the new QA Conduct, the EQB will continue to monitor and guarantee the quality culture in every study programme. The EQB, in other words, needs to check whether the study programmes are able to efficiently

pursue a shared education policy and perform quality assurance processes. In this light, the EQB will carry out **a one-time screening** of all Ghent University study programmes in the years 2021-2023. The screening is based on trust: the EQB does not aim at evaluating programme-specific contents – after all that aspect is covered by the external perspective, but rather at gaining clear insight into the study programmes' quality culture and improvement capacity. In the phase of QA Conduct 1.0, the peer learning visits were an intermediate step in the final assessment of study programme quality. For the screening purposes described above, the next phase (QA Conduct 2.0), will grant the EQB unmediated access to the monitors. Considering the scale of our university, this will prove to be an elaborate exercise, with which the **composition and role of the EQB will have to be aligned**.

2.2.2.2 EQB Screening Exercise

The screening is envisaged as:
- being a uniform procedure with the same set of criteria for every study programme;
- yielding an accurate and nuanced picture of each study programme's prevailing quality culture;
- being carried out smoothly and efficiently;
- being transparent and traceable.

In adherence to the criteria outlined above, the EQB will use a uniform and user-friendly template. This template will focus on a check of the following domains/criteria:
- **data congruence** between information in UGI (among other things) and the information in the monitor (e.g. the self-reflection);
- embedding the **external perspective;**
- **quality culture**

2.2.2.3 Quality Assurance Resolution (QAR)

Based on the screening, the EQB will pass a **quality assurance resolution** (QAR) for every study programme's quality and quality culture.

There are three types of quality assurance resolution:
(1) **basic (education) quality is guaranteed, with confidence in the study programme's policy-making capacity: positive QAR.** In a partnership with DOWA, the study programme might be invited to share one or more good practices with other study programmes and/or faculties. The study programme is made aware of DOWA's **professional development catalogue**. The EQB can advise to follow up on certain improvement actions, and to participate in specific education support initiatives.

(2) **basic (education) quality is guaranteed, though immediate improvement actions are needed: positive QAR** with a compulsory referral to specific coaching tailored to the identified points of concern. The study programme delivers a three-monthly progress report to the EQB. In addition, the study programme is free to participate in specific education support initiatives.

(3) **basic (education) quality is not guaranteed: negative QAR** with urgent measures, and if necessary**,** immediate discontinuation of the study programme.

A **screening calendar** has been drawn up, allowing the EQB to systematically screen and pass a QAR for every study programme (monitor) in the years 2021-2023.

The new system also provides an **appeal procedure**, which in principle can only be invoked in the case of a negative Quality Assurance Resolution. Should study programmes wish to appeal against a QAR, this will be handled by a panel (with either internal or external members, e.g. former vice-chancellors or former deputy vice-chancellors).

2.2.3 International Study Programmes

International study programmes, jointly organized with one or more foreign partner institution(s) and leading to a joint degree, will preferably follow the **European Approach for Quality Assurance of Joint Programmes**[12], which was adopted by the European ministers of Education in May 2015. The European Approach offers one single framework containing standards and an assessment procedure for international joint programme. This framework allows all quality assurance agencies in the European Quality Assurance Register to assess joint programmes. At this point in time, however, the operationalisation of this approach is in need of further clarification. As a consequence, the role of Ghent University's QA Conduct in the European Approach will have to be specified at a later stage.

2.2.4 Public Information

Every Ghent University study programme, including the international ones, is expected to render account to the general public about the quality (assurance) of their education. The information provided by each of the study programmes contains an honest self-reflection on education quality (assurance) and policy, i.e. specific strengths and/or points of improvement they wish to communicate.

After every QAR passed by the Education Quality Board, the faculty and the study programme concerned will be asked to update their public information and include that update into their education monitor. This text contains an overview of the **main strengths and points of improvement together with a feasible timing** for addressing the latter. This overview will be open for consultation by the general public on a **separate education policy and quality assurance webpage** on the Ghent University homepage. From there, it will be possible to link to the **Study Guide.**

For study programmes who have demonstrably dealt with one or more points of improvement, it will be possible to formally apply with the Education Quality Board for publication of an updated version of their public information **on a two-yearly basis**. Based on the study programme's motivation and data in the education monitor, the EQB will consider this update for approval.

2.3 Q.A. Conduct 3.0 (2024 and onwards): Continuous Quality Culture

As previously indicated, the Q.A. Conduct 2.0 phase forms a necessary step towards the next phase, in which education (policy) and quality assurance processes will be further developed within a fully-fledged quality *culture.*

[12] https://www.nvao.net/nl/european-approach-for-quality-assurance-of-joint-programmes consulted on 1 December 2019.

Through a continued promotion of systematic critical reflection on the objectives in the education monitor and a variety of support initiatives organized by the Education Department, **the faculties' and study programmes' policy-making capacity will be honed further**. **Faculties** will have an increasingly important role to fulfil in monitoring their study programmes' education: our faculties must **gradually grow in this role** in order to become **self-managing entities** with 'primary care services' as far as continuous quality monitoring and quality improvement are concerned. In this context, the Education Department becomes a 'secondary care' partner, offering support to study programmes and faculties. From 2024 onwards, the Education Quality Board will carry out its tasks based on processes and procedures that enable continuous monitoring, e.g. based on permanent random checks of the education monitors (instead of a cyclical calendar). That way Ghent University will continuously keep a finger on the pulse with regard to its study programmes' quality of education.

3 EDUCATION SUPPORT: TOWARDS EDUCATION SUPPORT SERVICES 2.0

3.1 History (1998-2019): Focus on Professional Development

Ghent University's strong tradition of professional development initiatives for teaching staff (members of the professorial staff as well as academic assistants) dates back to 1998. Since that time, the initiatives for individual lecturers have greatly evolved and further developed. They have known quite some success as well: on 1 July 2019, 60 percent of the senior full professors had taken the Introductory Teacher Training.

In the spring of 2019, the existing initiatives were thoroughly reviewed. **User insights** have revealed that the needs of different teaching staff groups differ greatly according to their specific teaching assignments. **Research literature on professional development in education contexts** shows that professional development initiatives succeed best when they are offered as a learning track, and when they are directly applicable to the target group's teaching practice. Precisely these two aspects were difficult to realize with the 'old style' initiatives. In light of the **Q.A. Conduct 2.0**, it became clear that support services for study programmes and faculties needed to be enhanced. In a context in which study programmes and faculties will be asked to systematically reflect on their own education (policy) and quality assurance performance, a continuous offer of varied support services will be necessary.

Ghent University will address this need by developing high-quality and efficient support services aimed at **professional development** with regard to **education (policy) competencies and quality assurance processes and strengthening mutual learning.** This way, Ghent University wishes to facilitate and stimulate self-managing capacities and cooperation between lectures, and within study programmes and faculties.

3.2 Education Support Services 2.0: Basic Principles

3.2.1 Well-founded, Contextualized and Future-oriented

The Education Support Services 2.0 are offered within an academic setting and based on recent **academic, practice- and data-oriented evidence**. Teaching materials, educational/pedagogical concepts and training initiatives are always developed based on analysis, research and co-creation. Each type of support aims at, and explicitly focuses on alignment with university **policy**, the broader (international) education context, and society at large. In line with the university credo 'Dare to Think', the support services deal with new developments in a **critical** and well-considered manner.

3.2.2 Ownership for Lecturers, Study Programmes and Faculties

The Education Support Services 2.0 aim **at individual lecturers** as well as **study programmes and faculties**. Ownership of the learning and innovation processes, however, will always firmly remain with the different target groups. Participation in professional development initiatives is **registered** and **built into UGI as an indicator** for integration into the **monitor**. This process supports study programmes' and faculties' policy-making with regard to education support.

3.2.3 Supply- and Demand-driven

The Education Support Services 2.0 will be shaped in a **supply-driven** manner in the sense that they will dovetail with the didactic competencies for Ghent University lecturers, and with the **operational objectives in the education monitor**. We will combine this supply-driven approach with a **demand-driven** approach in the sense that there will be a yearly update of the course offer. This update will be carried out based on the ever-changing needs pointed out by lecturers, and based on yearly needs assessments carried out by the Education Department among the faculties and their quality assurance staff. The Education Support Services 2.0 will be communicated in a timely, recurrent and transparent manner, allowing lecturers, study programmes and faculties sufficient time to plan when to participate. Popular initiatives will be scheduled multiple times in the course of the academic year.

3.2.4 Once-Only Initiatives and Learning Tracks

Depending on the purpose and the intended impact, we either choose **brief peer supervisions** or **learning tracks**. Once-only initiatives usually have an informative character (e.g. how to operate the education monitor). A learning track consists of multiple learning moments and offers the opportunity to differentiate pursuant to the initial situation, to put newly acquired knowledge into practice, and to learn from, and together with peers (e.g. the professional development path for professorial staff, cf. 3.2.7). The different initiatives will be shaped **efficiently**, meaning that didactic methods will always be adapted to the intended objectives and the time that is available.

3.2.5 Blending Online and Face2Face Contacts

Face2face initiatives like holding discussions, exchanging of ideas and experiences, giving feedback, … are a great way to enhance interaction. In addition, these initiatives contribute to a growing **community** spirit among lecturers and education support staff. With room for dialogue and discussion, we create an **open learning culture** focused on knowledge sharing and mutual learning. **Online initiatives** are used mainly to share basic information, and to support our teaching community anytime, anywhere. Education Tips, Ghent University's online repository of didactic and other education-related information, will become an important online information channel for teaching staff, study programmes, and faculties.

3.2.6 Expert Learning and Peer Learning

The Education Support Services 2.0 will contain a mix of **expert learning** (new learning contents brought by an expert) and **peer learning** (learning from each other by exchanging experiences and practices among colleagues). The Education Department plays a mediating role by disseminating good practices and experiences across study programme and faculty boundaries. Different information channels (e.g. Education Tips, train the trainer sessions, learning tracks for the professorial staff, learning networks, etc…) are available for that purpose.

3.2.7 Basic and In-depth Course Offer

We have a basic and an in-depth course offer. The *basic course offer* focuses on **essential didactic competencies** of lecturers and the **education monitor objectives** for study programmes and faculties. The *in-depth course offer* focuses on lecturers', study programmes' and faculties' **specific needs or interests**.

Basic Offer

From September 2020 onwards, **newly appointed members of the professorial staff** will participate in a *mandatory blended learning track* on 'Lecturing at Ghent University'. This learning track consists of a kick-off event, online modules, peer supervisions, a possible peer observation and a practice assignment. The learning track continues throughout **one academic year**. Newly appointed members of the professorial staff participate in the kick-off event before the start of the academic year. The peer observations take place **a year after being appointed**. If members of the professorial staff are unable to participate, they complete the learning track within two years after being appointed. This way, the learning track is brought into alignment with the follow-up moments in the new professorial staff career path. The basic learning track is offered both in Dutch and in English. Time of investment (contact moments and self-study taken together) is estimated at 50 hours. This constitutes the *basic learning track for members of the professorial staff* (and replaces the current mandatory introductory teacher training).

Longer appointed members of the professorial staff, post-doctoral assistants, and post-doctoral research assistants will be able to participate in an *elective blended basic learning track* on 'Lecturing at Ghent University'. This learning track consists of a kick-off, online modules, and two moments of peer supervision. Time of investment (contact moments and self-study taken together) is estimated at 24 hours. This constitutes the *basic learning track for lecturers*. In addition, there will be an elective **professional development track on education (policy) and education management** for members of the professorial staff who are part of a study programme committee. This learning track will be organized in cooperation with and/or complementary to the 'Leadership' course offered by the Personnel Department. The course is interesting for members of the

professorial staff who wish to become chair of a study programme committee, and/or for strengthening the study programme committee in general.

For academic assistants, tutors and teaching assistants online modules and an elective moment of peer supervision will be organized on 'Lecturing at Ghent University'. Time of investment (self-study) is estimated at 8 hours. This constitutes the *basic assistant learning track*.

The **online modules** 'Lecturing at Ghent University' will be available continuously for all Ghent University staff members in Dutch and in English. This way we wish to offer support them in their teaching practice anytime, anywhere. The online modules will be accessible via Education Tips.

A **basic course offer** is being developed for **study programmes and faculties** as well. This course offer will focus on *enhancing the policy-making capacity and implementing processes of change* in study programmes and faculties. Among other things, a strong emphasis will be placed on installing **structural consultation** between study programme committee chairs and quality assurance staff, and on setting up **learning networks** between these two groups.

In-depth Course Offer

In addition to the basic course offer mentioned above, there will be **an in-depth course offer with thematic workshops for lecturers** (e.g. how to lecture to large groups, how to coach writing assignments, how to use lecture recordings, etc...) and **learning networks** (e.g. internships). Lecturers and education support staff will be able to browse this offer and participate in the initiatives according to their own needs and interests. Moreover, it is an offer that will be adjusted and complemented based on user experiences.

The **in-depth course offer for study programmes and faculties** is aligned with possible *content-related questions* in the context of education policy (e.g. curriculum design, assessment policy, etc...), quality assurance and Ghent University's strategic education objectives in the monitor. For study programmes and faculties the offer will be built on a **train the trainer model**. This means that programme committees or faculty managements can use the monitor (self-reflection) to determine which objective(s), topic or monitor chapter needs improvement or extra focus, and which staff members are most suited to be delegated to the chosen session(s). This delegation of staff members can consist of lecturers as well as support staff. The aim is to train and coach groups of staff members with complementary profiles (content experts, process experts, policy experts) and enable them to implement and follow up sustainable processes of change and/or improvement. The train the trainer sessions offer participating study programmes and faculties useful frameworks, and facilitate mutual learning.

By way of conclusion, we wish to emphasize the **crucial supportive role** that is and will be played by the **administrative and technical staff members** of the Faculty Education Services and the Education Department. Mutual and accessible dialogue between Ghent University's central and decentral services will be crucial in the implementation and the success of the Q.A. Conduct 2.0, together with continuous professional development of all the stakeholders involved.

3.3 Education Support Services 3.0 (2024 and onwards): a Complementary Partnership

From 2024 onwards, the Education Support Services will be unfurled by means of a **complementary partnership.** Together we provide excellent education. Based on mutual trust, lecturers, study programmes, faculties and the Education Department work together towards the development of a powerful learning environment. In the period between 2020-2023 we will focus on the professional development of didactic and education policy competencies, quality assurance, mutual learning, and enhancing autonomy and trust. In a next phase, from 2024 onwards, the faculty education services will be strengthened and will be able to support and coach their study programmes and lecturers in a proactive and self-managing manner. As a secondary care partner, the Education Department will focus on proactive policy work, education development and innovation, coaching (new) decentral education support staff.

4 CREATING SUPPORT AND LAUNCHING A COMMUNICATIONS PLAN

The success of the Q.A. Conduct 2.0 – and afterwards, the Q.A. Conduct 3.0 – will strongly depend on **the base of support and participation** of all stakeholders within and without the Ghent University community. **The new Quality Assurance Conduct and Education Support Services for lecturers and study programmes** were developed in close consultation with the study programmes and faculties. In so doing, we laid an important foundation in terms of creating a base of support and trust. The coming years will be an important implementation phase. In order to ensure active participation from all stakeholders a promotional **communications and professional development plan** will be set up. The plan will take into account the different stakeholders' information needs, the gradual planning of activities and the accessibility of information. In addition, we will continue to invest in consultation and interim assessment using the existing participation councils and advisory bodies.

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FACULTY OF ENGINEERING AND ARCHITECTURE

Intermediate Report

CTI-visitation

Faculty of Engineering and Architecture

Ghent University

September 2019

GHENT UNIVERSITY

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Introduction

In April 2016, the CTI visited the Faculty of Engineering an Architecture of Ghent University, resulting in an evaluation report, advising to attribute the "admission par l'État" for a period of 6 years for the following degrees:

- *Master of Science in de ingenieurswetenschappen: architectuur - Master of Science in Engineering: Architecture*
- *Master of Science in de ingenieurswetenschappen: bouwkunde - Master of Science in Civil Engineering*
- *Master of Science in de ingenieurswetenschappen: elektrotechniek - Master of Science in Electrical Engineering*
- *European Master of Science in Photonics, jointly offered with "Vrije Universiteit Brussel" [VUB]*
- *Master of Science in de ingenieurswetenschappen: biomedische ingenieurstechnieken - Master of Science in Biomedical Engineering*
- *Master of Science in de ingenieurswetenschappen: werktuigkunde-elektrotechniek - Master of Science in Electromechanical Engineering*
- *Master of Science in de ingenieurswetenschappen: bedrijfskundige systeemtechnieken en operationeel onderzoek - Master of Science in Industrial Engineering and Operations Research*
- *Master of Science in de ingenieurswetenschappen: computerwetenschappen - Master of Science in Computer Science Engineering*
- *Master of Science in de ingenieurswetenschappen: materiaalkunde - Master of Science in Sustainable Materials Engineering*

This advice was accompanied by a set of generic recommendations for the faculty as a whole, as well as by master-specific recommendations. The faculty was asked to report on the follow-up on these recommendations and on action plans by September 15, 2019.

All master's study programme committees were invited by the faculty to reflect on the recommendations by the CTI, and propose follow-up actions. The current document (part II) presents a comprehensive view on the result of this reflection process. In addition, the faculty reports on the evolutions and actions since the CTI-visit in part I of this document. Although the *Master of Science in de ingenieurswetenschappen: scheikunde – Master of Science in Chemical Engineering* did not obtain the "admission par l'Etat", the faculty invited the programme committee of this master to also report on actions taken as a consequence of the CTI visit and comments. This report is included as Appendix A.

Part I: Faculty-wide evolutions and action plan

- *Renforcer les moyens de la direction de la faculté pour lui permettre de mener des actions transversales et de coordonner des initiatives sectorielles.*
- *Poursuivre l'excellent travail accompli pour préparer le rapport d'auto-évaluation et définir un plan d'action précis mué par une vision globale de l'avenir de la faculté.*
- *Traduire dans les faits l'énoncé de mission de l'université relatif à l'interaction avec les anciens élèves.*
- *Développer l'échange de bonnes pratiques et la mutualisation des initiatives entre les formations.*
- *Œuvrer, au niveau de l'université, à mettre au point des outils communs de marketing et de sélection des étudiants.*

(Source, CTI Avis n° 2016/09-10)

The recommendations articulated at the faculty level by the CTI in its report dated August 2016, are:

1. Reinforce the means of the faculty board to facilitate actions across the different programmes and to coordinate initiatives
2. Continue the excellent work in preparing the auto-evaluation report, and define a detailed action plan, guided by a global vision on the faculty's future
3. Translate the University policy with respect to maintaining relations with alumni of the faculty in action points
4. Develop the exchange of ideas, best practices, and initiatives between the different master programmes
5. Take action, at the University level to fine-tune common marketing tools and approaches for student selection

1. Reinforce the means of the faculty board

Since the CTI-visit, the faculty board (formerly consisting of the Dean and the Academic Secretary), has been extended to also include the Director of Studies (University policy). To further strengthen its management structure, the Faculty has chosen to install an "Extended Board", which also includes the representative of the permanent staff at the University Council (strengthening the link between the Faculty management and the University management structures), as well as the heads of administration of the Dean's Office and the Education administration (strengthening the link to the implementation level).

A second initiative in this respect was to bring together the support team of all campuses on a single location, allowing to optimize the effectiveness of this support team through exploiting synergies.

2. Define a detailed action plan

The global vision of the Faculty remains to provide a high-quality education to its students to guarantee them a successful engineering career in a wide variety of domains and profiles. This is only possible to achieve through a tight coupling between education and research, as such, the inclusion of new evolutions in the various programmes comes (almost) automatically. To realize this vision, the Faculty remains committed to research oriented master programmes, built upon bachelor programmes providing strong scientific and engineering foundations.

To maintain its strong position in delivering high-profile alumni to industry, research centra and academia, the faculty needs to judiciously update its study programmes according to the ecosystem it operates in. The faculty is currently reforming its bachelor programmes along the following lines:

- Reinforce the engineering project in the 1st bachelor year
- Strengthen the focus on Sustainability, Ethics and Entrepreneurship (a.o. in the context of this first year project)
- Review the topics in and the positioning of the math courses

Inspired by the same concern to continuously respond to emerging needs w.r.t. profiles, the faculty has decided to also organize a bachelor programme in biomedical engineering. This programme will start in the academic year 2019-2020.

To facilitate the development of shared views and approaches amongst different engineering programmes, the faculty has decided to manage all bachelor programmes through a single study programme committee (as of academic year 2019-2020).

The action plan conceived immediately after the CTI visit, and already partly deployed, is highlighted below:

1. Install a platform for all study programme committees to discuss issues of common interest, share ideas on course content, study approaches, … This platform is called VOC (standing for "Verenigde Opleidingscommissies" – "United Study Programme Committees"). (see further)
2. Prepare a restructuring of the six different bachelor in Engineering programmes into a single programme with main subjects.
3. Investigate needs and opportunities for a programme reform, focusing on the 1st bachelor year, taking into account
    a. University-wide viewpoint on sustainability and ethics
    b. The profile of incoming students
    c. Study effort required to succeed in the 1st bachelor year
    d. More emphasis on the engineering project
4. Investigate the opportunity to organize a bachelor programme in biomedical engineering.

Meanwhile, the University Board has proposed a set of five University-wide objectives, expecting the Faculty to subscribe to at least 2 of these objectives, and to also devise an action plan in accordance with the faculty's goals and vision. The Faculty has chosen to invest in the objectives concerning:

1. Active Learning
2. Diversity and talent development
3. Sustainability

For all three areas, specific actions and metrics to monitor progress have been defined.

3. Relation with FEA-Alumni

The Faculty pursues its efforts to organise events to strengthen its relation w.r.t. alumni of the Faculty. These initiatives include TechBOOST, visits to companies, update@campus lectures, the Engineer of the Year competition as well as other non-academic social activities (bbq, reunion,…).

Furthermore, a portfolio of brief witness statements (on video) by alumni is used in communication to students and prospective students.

4. Exchange across study programmes

The recommendation to more actively share information, viewpoints and best practices between the various study programmes of the faculty has been taken into account by the installation of the "Verenigde

Opleidingscommissies" [VOC, "United Study Programme Committees"]. This is a platform conceived as a meeting of all programme directors of the Faculty together with the Director of Studies.
The VOC meets every two months, and typical discussion points addressed during the meeting are:

- Presentation of a particular study programme (highlighting structure, teaching methods and common practices)
- Feedback from the Educational Board of the University
- Discuss results of study programme evaluations

5. Student recruitment

Local recruitment:

- strong and active involvement in UGent initiatives to recruit students (SID-ins, open lectures, information days, …)
- active presence on social media: Twitter, Facebook, Instagram, …
- participation to initiatives relating to STEM-awareness (Kinderuniversiteit, WeGoSTEM, Virgo-project)
- leading role in positioning test for high school students (and sharing experience with other faculties)

International recruitment (see also below)

- Erasmus collaboration: each study programme committee has a member focusing on selecting/admitting foreign students to the Faculty's study programmes
- China/India - platform : leading role w.r.t. China platform (co-ordinated by Prof. L. Taerwe, former dean)

Selection tools and support tools for incoming international students

The Internationalisation Committee of the faculty has discussed a number of initiatives with respect to student mobility for master programmes and takes the initiative to further deploy these initiatives throughout the faculty. Following topics are addressed:

- How to better screen applications (in particular with respect to the required knowledge to start a master education).
- Organisation of a preparatory study programme to allow applicants to remedy knowledge shortcomings. This initiative is in line with an overall university initiative involving beta faculties and economic sciences.
- How to better support starting students by a buddy system. This buddy system will be organised in cooperation with the student organisation and will be modelled on the already successful buddy system for first year bachelor students.

Future Strategy for international collaboration

All present Erasmus agreements expire in 2020. The beyond 2020 strategy consists in the critical evaluation of existing agreements and the selection of a smaller but more qualitative network.
Central to this strategy is the selections of partners that offer added value and allow student exchange on the basis of comparable competences. A good balance between outgoing and incoming students is also highly desirable.
Hence, all programme committees are asked to evaluate their existing partnerships and on the basis of the evaluations faculty wide partners will be identified and selected. For 2020, agreements with these partners will be negotiated.

Part II: Programme-specific evolutions and action plan

Master en sciences de l'ingénieur: Architecture - Master of Science in de ingenieurswetenschappen: architectuur - Master of Science in Engineering: Architecture

- *Le département ingénieurs-architectes rassemble des enseignants dévoués et des étudiants enthousiastes, formant un groupe étroitement soudé.*
- *On pourrait dire que la tendance chez les étudiants de UGent est d'être davantage architectes-ingénieurs qu'ingénieurs-architectes.*
- *Les relations avec Sint Lucas devraient être renforcées.*
- *L'internationalisation devrait faire partie des préoccupations du personnel.*

(Source, CTI Avis n° 2016/09-10)

The programme committee has chosen to write their report in French.

Dans sa réunion du 23 octobre 2018, la Commission de formation d'architecture (CFA) a pris connaissance des observations de la Commission des Titres d'Ingénieur (CTI) suite à la visitation de 2016.
Ci-après vous trouvez les réactions de la CFA concernant ces observations.
Au préalable, il est nécessaire de mentionner plusieurs modifications importantes dans la programmation de la formation en Architecture qui ont eu lieu, ou qui sont en cours de réalisation. Elles devraient permettre une meilleure organisation et un approfondissement du programme existant :

- À partir de l'année académique 2018-2019, la programmation des séminaires thématiques ('Bijzondere Vraagstukken' / 'Advanced Topics') du master a été réorganisée suivant les conclusions d'une concertation entre enseignants et étudiants : désormais, plusieurs thèmes sont regroupés par champ de connaissance : (1) Architecture, (2) Physique et technique du bâtiment, (3) Théorie, méthodologie et outils du projet, (4) Urbanisme et paysage, (5) Théorie, histoire et critique de l'architecture. Ce regroupement permet plus de flexibilité dans l'organisation et, notamment, dans l'emploi du personnel enseignant, et offre une plus grande liberté dans la définition des sujets et thématiques. En outre, il permet de relever plus rapidement des sujets d'actualité et de bénéficier d'opportunités particulières qui se présentent (comme le passage ou la présence plus longue de professeurs invités au département). Cette nouvelle organisation veille aussi à ce que les étudiants gardent une grande flexibilité dans le choix des séminaires.

- Alors que précédemment les séminaires étaient accrédités de 3 crédits uniquement, la possibilité a été créée d'organiser des séminaires thématiques de 3 ou 6 crédits, suivant les sujets ou des nécessités particulières. Cette décision doit stimuler l'introduction de thèmes trans- ou interdisciplinaires, notamment en combinant recherches en histoire ou technologie et studio de projet, en correspondance avec la charge de travail plus élevée. Cette possibilité combinatoire est, en outre, une invitation à la coopération entre enseignants et à des échanges allant au-delà des expertises individuelles. Aussi, cette stratégie renforcera le dialogue entre les trois piliers de la formation d'Architecture : conception architecturale ; sciences architecturales (histoire, théorie, …) ; et sciences appliquées et technologie.

Plusieurs initiatives ont été prises pour limiter la charge de travail des étudiants, principalement dans l'enseignement du projet : un dialogue entre enseignants a été entamé concernant les échéances des travaux pratiques, afin d'éviter les conflits de calendrier ; une analyse comparative des contenus pédagogiques, surtout au niveau du Bachelor, afin d'éliminer les doublons.

Réactions à partir des observations:

"Le département ingénieurs-architectes rassemble des enseignants dévoués et des étudiants enthousiastes, formant un groupe étroitement soudé."

La formation des ingénieurs-architectes part de la conviction qu'elle ne se réalise pas seulement par les cours et les studios de projet, mais aussi à travers la création de conditions pédagogiques laissant de la place aux discussions, aux moments de recherche, et aux actions qui incitent à la curiosité, allant au-delà des strictes limites du programme des enseignements. Nous sommes persuadés que le contexte et les occasions pour entamer un dialogue entre tous ceux qui participent à la formation (professeurs, assistants, chercheurs, et étudiants), sont indispensable afin de stimuler toutes et tous à travailler ensemble, à se surpasser et à évoluer. Cette conviction est portée par tous les membres du département et de la formation. Cette ambiance d'enthousiasme et de dévouement est à sauvegarder à tout prix.

L'importance de ce « travailler ensemble » est confrontée à beaucoup de défis, entre autre à cause du cadre administratif devenu pas mal restrictif, et demande un effort continu. C'est pourquoi il est important de communiquer ce modèle de travailler de façon claire et franche, car s'il crée de la liberté, il ne peut fonctionner que si tout le monde – personnel enseignant aussi bien qu'étudiants et cadre administratif (au niveau du département, de la faculté en de l'université) – prenne sa responsabilité. Le rôle de l'association des étudiants des ingénieurs-architectes '*De Loeiende Koe*' (DLK) est ici crucial. DLK est un partenaire essentiel du chef du Département ainsi que du président de la Commission de la formation d'architecture. La publication du *Koerant*, sous la supervision de DLK et financé le Département, joue un rôle primordial dans la communication des ambitions pédagogiques du Département, ainsi que dans la présentation des travaux d'étudiants tout le long de leur curriculum. Afin d'améliorer la communication, DLK en collaboration avec le personnel enseignant, publie au début de chaque année académique un *Bachelorkrant*, dans lequel sont reprises toutes les informations concernant les cours les plus importants liés au pilier du projet architectural en Bachelor (description des sujets qui seront traités en studio, ou les cours de représentation architecturale ; présentation des voyages d'études et du programme des conférences d'architectes et chercheurs invités ; etc.). Le *Bachelorkrant* est distribué gratuitement en début d'année à tous les étudiants des 3 premières années et facilite en large mesure le dialogue entre enseignants. La CFA envisage la publication d'un journal similaire pour les masters.

Pour la collaboration avec les étudiants, le *Jokerweek* est le moment-clé de l'année. Cette période du curriculum constitue une réelle co-production et le fruit d'un intense dialogue entre enseignants et étudiants. Le Département et la CFA sont très fiers que ce modèle pédagogique suscite de plus en plus d'intérêt, non seulement au sein de la Faculté, mais aussi auprès d'autres sections de l'Université. En 2017-2018, par exemple, la collaboration entre nos étudiants et ceux en Histoire de l'art a été un grand succès et a suscité beaucoup d'intérêt).

"On pourrait dire que la tendance chez les étudiants de UGent est d'être davantage architectes-ingénieurs qu'ingénieurs-architectes."

Il est important de souligner tout d'abord que le curriculum est organisé autour de trois piliers entre lesquels le programme essayons de créer un équilibre : le projet architectural, les sciences architecturales (théorie et histoire), et les sciences appliquées. Cet équilibre est important pour la formation des ingénieurs-architectes qui devront confronter un monde professionnel toujours en évolution ; il constitue l'identité du programme d'enseignement. Grâce au programme suffisamment étendu et profond, le but du curriculum est, d'abord, de former des ingénieurs-architectes ayant une formation apte à assumer le rôle d'acteur principal dans les processus de conception et de réalisation architecturales/urbanistiques. Or, grâce au large éventail de choix que le programme lui permet de faire, l'étudiant a aussi la possibilité de se développer dans plusieurs domaines plus spécialisés tout en gardant l'attitude du *creative designer.*

Il est clair que le programme porte beaucoup d'attention à l'enseignement du projet et de la théorie d'architecture en d'urbanisme, surtout en égard d'autres formations universitaires en Flandre. Cependant, il est aussi évidant que l'enseignement technique n'est point négligé et est d'un très haut niveau. D'autant plus que bon nombre de ces cours sont donnés par des professeurs appartenant au département de génie civil, ce qui constitue une garantie de qualité au niveau technique. Cet accent mis sur la technique est confirmé par les parcours professionnels suivis par de nombreux alumni, dont plusieurs sont actifs dans le domaine de la technique de construction ou dans celui de la physique du bâtiment. Il n'est pas sans intérêt de faire remarquer ici que la dimension technique est présente dans les cours de théorie et d'histoire de l'architecture et de l'urbanisme, même si le champ de recherche de la Construction History est moins visible que dans certains autres formations. Même si ce domaine ne se situe pas au centre de leur travaux, plusieurs chercheurs y sont actifs. C'est le cas, par exemple, d'un grand projet de recherche sur l'introduction de la technologie du béton au Congo. L'intention du Département sera d'investir dans ce domaine lorsqu'une partie importante du personnel enseignant sera remplacée dans la période de 2021-2022 (voir plus loin).

L'observation formulée par le CTI comme quoi le programme des enseignements se définit comme une formation plutôt d'architectes-ingénieurs que d'ingénieurs-architectes paraît donc avant tout une question de sémantique. La réponse dépend en large partie des accents mis par les étudiants eux-mêmes par rapport aux trois piliers du programme. Si certains ont choisi plutôt pour un profil d'architectes-ingénieurs, nombreux sont ceux parmi les étudiants qui se qualifient sans doute comme ingénieurs-architectes. C'est en leur accompagnant dans leur choix, que la formation leur offre la possibilité de se préparer pour un monde professionnel très diversifié et de leur garantir d'y trouver leur place.

"Les relations avec Sint Lucas devraient être renforcées."

Insistons d'abord sur le fait qu'au niveau des enseignants, il existe bel et bien des contacts entre les deux institutions. En effet, plusieurs de nos *alumni* sont enseignants à Sint Lucas. Actuellement, plusieurs formes de collaboration existent dans le cadre de projets de recherche ou de publications. Il arrive souvent que des doctorats ou des mémoires de master (master dissertations) sont co-supervisés ou co-évalués. Cela n'empêche qu'une coopération institutionnelle est plus délicate, étant donné que les deux institutions appartiennent à des universités différentes qui se trouvent, en quelque sorte, dans une position de concurrence. Il est indéniable que ceci constitue un réel obstacle.

Soulignons tout de même que le Département d'architecture et d'urbanisme est en partenariat, sur une base structurelle, avec un grand nombre d'acteurs dans le monde académique ainsi que, plus généralement,

dans la société. Depuis quelques années, la collaboration avec la Faculté des Arts et des Lettres de l'UGent a été renforcée. Qu'on se réfère ici, par exemple, au fait qu'à partir de 2018-2019 nos cours d'Histoire de l'architecture du 1er et 2ième Bachelor, ainsi que celui de Théorie architecturale sont incorporés dans le curriculum des étudiants en Histoire de l'art, option architecture. Les deux Facultés collaborent aussi au niveau des activités sur la relation entre art et architecture qui se déroulent au Pavillon Charles Vandenhove : conférences, expositions,… Un des enseignants de notre Département participe au programme de l'International Master of African Studies à l'UGent. En conséquence, son cours de master sur l'Histoire et la théorie de l'architecture et l'urbanisme non-Européenne est suivi par la majorité des d'étudiants de ce master. Dans le domaine important du *Sustainable Development (développement durable)*, un de nos professeurs en urbanisme co-dirige un cours sur Sustainable Cities qui vient d'être introduit depuis l'année 2018-2019. Il est également un des directeurs du *Stadsacademie*, un programme transversal de l'UGent, impliquant d'autres acteurs, comme la ville de Gand et son Musée de la ville, le STAM. La problématique de la migration est aussi une des préoccupations du Département. Elle a résulté à la fois dans des activités dans le domaine de l'éducation (séminaires, mémoires de licence, sujet traités dans un des cours au niveau master), ainsi que de la recherche (publications, expositions, …).
En somme, le Département d'Architecture et d'Urbanisme est bien ancré dans un contexte académique aussi bien que sociétale. Les étudiants en profitent alors que beaucoup d'efforts sont investis afin de rendre tout cela visible.

"L'internationalisation devrait faire partie des préoccupations du personnel."

Le personnel enseignant se rend compte que l'internationalisation demeure une dimension clé de la formation. Les dernières années, des efforts très importants ont été faits afin de stimuler la mobilité des étudiants vers l'étranger. Alors que ceci connaît pas mal de succès (voir plus bas), il reste des défis à assumer en termes de mobilité de la part des étudiants venant de l'extérieur, ainsi que de la part du personnel enseignant lui-même.
Le programme Erasmus est très populaire parmi les étudiants ingénieurs-architectes, comme le montrent les chiffres les plus récents : 31 (2016-2017) ; 22 (2017-2018) ; 31 (2018-2019). Presque 40 étudiants sont en train de préparer un dossier pour 2019-2020. Sur une population totale de ±150 étudiants, cela signifie une pourcentage de sortants de 20% et 25%. Il s'agit des pourcentages les plus importants au sein de la faculté. Il est rassurant de voir que nos étudiants s'intéressent de plus en plus à des échanges en dehors de l'Europe. Actuellement, 4 étudiants passeront un semestre à Tongji Université, Shanghai (Chine). D'autres possibilités sont en cours de négociations, en particulier avec des universités en Australie.
Ajoutons à cela un nombre d'étudiants qui font un stage à l'étranger (environs 5 par ans ; des efforts sont faits pour augmenter le nombre) ainsi que les étudiants qui passent un temps à l'étranger dans le cadre de leur mémoire de licence (depuis 2008-2009 environs 50 étudiants ont passé entre 1 à 4 mois à l'étranger, le plus souvent dans le Congo ou en Afrique du Sud, suite à des collaborations de recherche avec des partenaires sud).
Dans le cadre de l'action Internationalisation@Home, les étudiants sont confrontés à plusieurs voix de l'extérieur : chaque année sont organisées au Département des conférences, des séminaires ou des ateliers où sont invités architectes et chercheurs étrangers. Dans le cadre des studios de projet en Bachelor, les étudiants ont la possibilité de participer aux voyages d'étude en Europe, organisé par les enseignants

(France, Espagne, Angleterre,…). Néanmoins, il n'y a qu'un nombre limité d'étudiants qui choisissent ces opportunité, malgré les efforts afin de les promouvoir. L'offre d'un voyage plus ambitieux au niveau du master (Russie, Argentine, Israël-Palestine,…) est, par contre, très bien reçu.

Quant à la mobilité inverse, celle des étudiants venant de l'étranger pour suivre leur formation à Gand, il faut souligner que le Département a fait le choix délibéré de n'offrir qu'une partie de son programme en anglais. Cela implique qu'il n'y a pas de '*incoming degree mobility'.* Par contre, la stratégie consistant à offrir un nombre considérable de cours en anglais, permet aux étudiants étrangers de suivre sans problème une année à Gand, tout en leur laissant une possibilité de choix. Ceci a permis de tisser des accords avec des partenaires prestigieux. Cette piste est évolution croissante. Cependant, un déséquilibre existe entre le nombre des étudiants sortant et ceux qui viennent pour un échange à Gand. Dans l'avenir, le nombre de cours offerts en anglais augmentera. Il est encourageant d'avoir a réussi à attirer pour la première fois des étudiants venants de l'Australie, mais il y a certes encore une marge de manœuvre pour attirer plus de mobilité de plusieurs partenaires.

Finalement, il reste l'aspect de la mobilité du personnel enseignant. Plusieurs membres sont très actifs sur le plan international dans le domaine de la recherche, et cela a un impact direct sur l'éducation (conférences de chercheurs de passage, par exemple, ou encore, participation à des séminaires de recherche). En outre, chaque année un studio au niveau master est organisé incluant un échange de staff et d'étudiants. Quelques membres ont effectué des séjours de recherche à l'étranger de long terme (plus d'un mois), tandis que d'autres sont planifiés dans l'année qui suit (2 professeurs vont passer un semestre ailleurs, à l'University de California, Berkeley, Etats Unis, et à Paris, comme résident de l'Institut des Etudes Avancées). Les dernières années, plusieurs de nos professeurs ont reçu des collègues étrangers pour des séjours de recherche, ainsi que des chercheurs postdoc d'autres pays. Le nombre d'étudiants en doctorat venant de l'étranger est aussi en cours d'augmentation.

En somme, le département s'inscrit dans la démarche de la Faculté et de l'UGent, qui vise à mettre plus d'accent sur l'internationalisation. Les éléments apportés indiquent que des efforts importants sont menés dans ce domaine de la part du Département d'Architecture et d'Urbanisme et qui influent sur l'enseignement.

Concernant les actions futures:

L'amélioration de la formation est une préoccupation perpétuelle du Département en de la Faculté. Ceci doit s'effectuer non seulement au moyens de grandes réorganisations mais aussi à travers des mesures modestes à grand effet. Pour le moment, les mesures concrètes suivantes sont prévues :

- Accroître l'offre de cours en anglais afin augmenter le nombre d'étudiants étrangers qui suivent le programme. Cela permettra aussi de mieux préparer les propres étudiants pour un échange ou pour une carrière internationale. Un effort est aussi en préparation pour mieux communiquer le programme auprès des partenaires internationaux (ainsi que d'élargir le portefeuille d'accords bilatéraux)
- Garder une charge de travail en-deçà des limites raisonnables pour les étudiants, est une préoccupation majeure. Il s'agit ici de trouver un bon équilibre entre l'enthousiasme des étudiants qui les pousse à franchir parfois les limites du temps prévu pour chaque cours et un niveau suffisant de défi, afin qu'ils se sentent invités à donner de leur mieux. Ceci compte en particulier pour les ateliers de projet architectural, surtout au niveau du Bachelor.

- Continuer à adapter le curriculum aux défis actuels de la profession et de la société. Cela implique un monitoring permanent des contenus pédagogiques afin d'y intégrer des sujets d'actualité : le développement durable (compris dans un sens large) ; la numérisation des processus de conception (BIM) ; des méthodes de prédiction de la production ; de la construction et de la performance des bâtiments ; d'autres modèles d'aménagement du territoire nécessaire pour répondre aux questions de mobilité et de durabilité, etc..
- Le département sera confronté à une transformation majeure, plusieurs professeurs allant à la retraire à partir de 2021-2022. Afin de bien préparer cette transition, depuis un an des pourparlers ont été commencés afin de définir les profils qui devraient être attirés, à la fois pour continuer le programme tel qu'il existe aujourd'hui, pour répondre aux évolutions de la profession et pour garder la position spécifique de la formation à Gand dans le paysage universitaire flamand.

Master en sciences de l'ingénieur en génie civil - Master of Science in de ingenieurswetenschappen: bouwkunde - Master of Science in Civil Engineering

- *L'embauche des diplômés est exceptionnelle dans ce domaine.*
- *Des efforts devraient être faits pour augmenter le nombre d'étudiants effectuant des stages*
- *Il pourrait être utile de sélectionner certaines universités en vue d'une collaboration plus intense, afin de pouvoir sélectionner les meilleurs étudiants et de réduire le risque de décrochage.*
- *La charge de travail reste importante de même que le décrochage dans le cadre de ce master comme dans le cadre d'autres masters.*

(Source, CTI Avis n° 2016/09-10)

The recommendations articulated by CTI towards the Civil Engineering programme in its report dated August 2016, are:

- Graduate employment is outstanding for the domain
- An effort should be done to increase the number of students taking an internship
- 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 probability of drop-out
- The study load stays high and drop out during bachelor stays important as for the other bachelors

Feedback by the Civil Engineering programme

The number of students taking an internship is found to increase gradually during the last 5 years (Table 1).

Academic Year	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Internship (3 ECTS)	12	15	11	13	10
Internship (6 ECTS)	8	17	9	13	16
International internship (3 ECTS)	---	---	3	4	6
International internship (6 ECTS)	---	---	6	6	8
Total internships	**20**	**32**	**29**	**36**	**40**
Total students	**269**	**246**	**263**	**266**	**249**

Table 1: Evolution of number of internships taken by students BSc/MSc in Civil Engineering programme

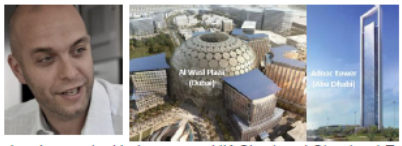
To stimulate students for outbound mobility during the study programme (as an exchange student, through an international internship or summer school) or after graduation, two guest speakers have given a testimonial on April 16, 2018 (Figure 1).

WORKING/STUDYING IN AN INTERNATIONAL CONTEXT:
TESTIMONIALS OF CIVIL ENGINEERING GRADUATES

SAVE THE DATE: Monday 16 April 2018, 5:30 p.m., Auditorium Magnel, Technologiepark 904, Zwijnaarde

The Program Steering Committee of Civil Engineering (Opleidingscommissie bouwkunde) cordially invites you to attend the following presentations by graduates of our university. These testimonials are aiming at increasing the student awareness for internationalisation, one of the Ghent University objectives to secure the quality of its educational programs.

ir. Koen Meert : Structural engineering opportunities around the world - a personal perspective



Koen Meert has 15 years of engineering experience spread between Europe and the Middle East. He graduated in 2003 as MSc in Civil Engineering at Ghent University. After spending 8 years designing various types of structures in his native Belgium, he moved to Dubai in 2011 to join an elite team of structural engineers at BESIX. Since 2016, he is working as Director Structural Design at Expo2020 (the world's biggest exposition) where he is responsible for all structural design. Koen Meert's experience is ranging from high-rise design over civil works (bridges, tunnels...) to major residential, industrial and commercial developments. He became a UK Chartered Structural Engineer (MIStructE) in 2015 and is part of the leadership Committee of the GCC Branch. He recently became a Chartered Structural Engineer in Australia as well. Koen Meert is also having unlimited license certificate for high-rise design in Dubai. In his presentation, he will give an account of his career path, the projects he worked on and the associated structural highlights. Moreover, he will share with us his opinions on possible international career directions in view of the current booming markets, the future opportunities for international recognition of Belgian degrees, the benefits of becoming a Chartered Engineer, and finally, he will make recommendations for upgrading our course program.

ir. Thomas Mertens: Life on the Ghent-Shanghai-Aalst express

Thomas Mertens graduated in 2016 as MSc in Civil Engineering at Ghent University. During his studies, he had internships associated to projects in Belgium, France and USA. Thomas spent his 2nd master year at Tongji University in Shanghai (P.R. China). At present, Thomas is Tender Engineer Civil and Marine Works at Jan De Nul Group. This job implies assessing project risks and pursuing opportunities in preparation of civil-marine projects worldwide. In his presentation, he will give a personal account of his experience as an exchange student at Tongji university. Moreover, he will briefly explain the international aspects in his present job.

Figure 1: Internationalisation event

Under the supervision of the Commission on Internationalisation at Faculty level (FCI), all programmes, including the BSc/MSc in Civil Engineering programme, have made a survey in 2018 of their international cooperations (Table 2). A reflection on optimization of these cooperations is on-going.

Aristotle University of Thessaloniki	Greece
École Spéciale des Travaux Publics, du Bâtiment et de l'Industrie	France
Federal University of Santa Catarina	Brazil
Gheorghe Asachi Technical University of Iasi	Romania
Harbin Engineering University	China
Norwegian University of Science and Technology	Norway
Queen's University Belfast	United Kingdom
RWTH Aachen University	Germany
Sichuan University	China
Technische Universität Carolo-Wilhelmina zu Braunschweig	Germany
Technische Universität München	Germany
Tongji University	China
Universidad Politecnica de Madrid	Spain
Universidad Politecnica de Valencia	Spain
Universidade de Lisboa	Portugal
Universitat Politècnica de Catalunya	Spain
University Politehnica of Bucharest	Romania
University of Architecture, Civil Engineering and Geodesy	Bulgaria
University of Natural Resources and Applied Life Sciences	Austria
University of Pardubice	Czechia
University of Tromso	Norway
Università Politecnica delle Marche	Italy
Università degli Studi Roma Tre	Italy

Università degli Studi di Trieste	Italy
Università di Bologna	Italy
Université de Cergy-Pontoise	France
Université de Liège	Belgium
Université de Kinshasa	Democratic Republic of the Congo
Zhejiang University	China

Table 2: List of cooperations MSc in Civil Engineering programme

The internal educational quality assurance system of Ghent University[1] organizes regular checks for each of its study programmes. On April 22, 2018 the Civil Engineering programme got a quality check by a commission consisting of 3 chairs of study programme committees from outside the faculty, an external professor on civil engineering and a student from outside the faculty. In the final report of the commission, approved by Ghent University's Educational Quality Board dd. 28 September 2018, the Civil Engineering programme was found to meet the expectations with respect to all 10 strategic and operational criteria of Ghent University (Table 3). Nevertheless, recommendations were given for further improvement, which are in line with the recommendations given by CTI in 2016.

Quality indicators	**Findings**
1. Education should focus on daring to think and promoting multiperspectivism	Satisfactory
2. Education is based on and invariably connected with research	Satisfactory
3. Education should contribute to the talent development of students and staff	Satisfactory
4. Education is fostered by the participation of stakeholders	Excellent
5. Internationalization is key	Satisfactory
6. Ghent University meets internationally recognized standards for reliable quality assurance	
6.1 The programme has a clear vision and strives for competences which are nationally and internationally verified and considered relevant, and which meet all requirements in terms of content, level and orientation.	Satisfactory
6.2 The structure of the programme is logical and there is a clear link between the learning results, the programme and the teaching methods.	Satisfactory
6.3 The test principles and policy applied in the programme are tailored to the learning results and the learning process.	Satisfactory
6.4 The programme has a culture of permanent quality assurance and improvement.	Satisfactory
6.5 The programme shares information and communicates with all the parties involved.	Satisfactory

Table 3: Outcome of Internal Ghent University Educational Quality check of BSc/MSc in Civil Engineering programme dd. 22 April 2018

With respect to study load, a new survey among the students has taken place in 2017-2018. For the BSc program, the load is still perceived to be too high, and certainly in comparison to most other programmes in the faculty (Figure 2). Also for the MSc programme the students perceive the study load as high, but the figures are lower than for most other programmes in the faculty (Figure 3). The study programme committee is, in close collaboration with the student representatives, in the process of analyzing how the study load of the (bachelor) programme can be reduced, without negatively affecting the learning outcomes and the quality level.

[1] https://www.ugent.be/en/ghentuniv/principles/educational-strategy/overview.htm

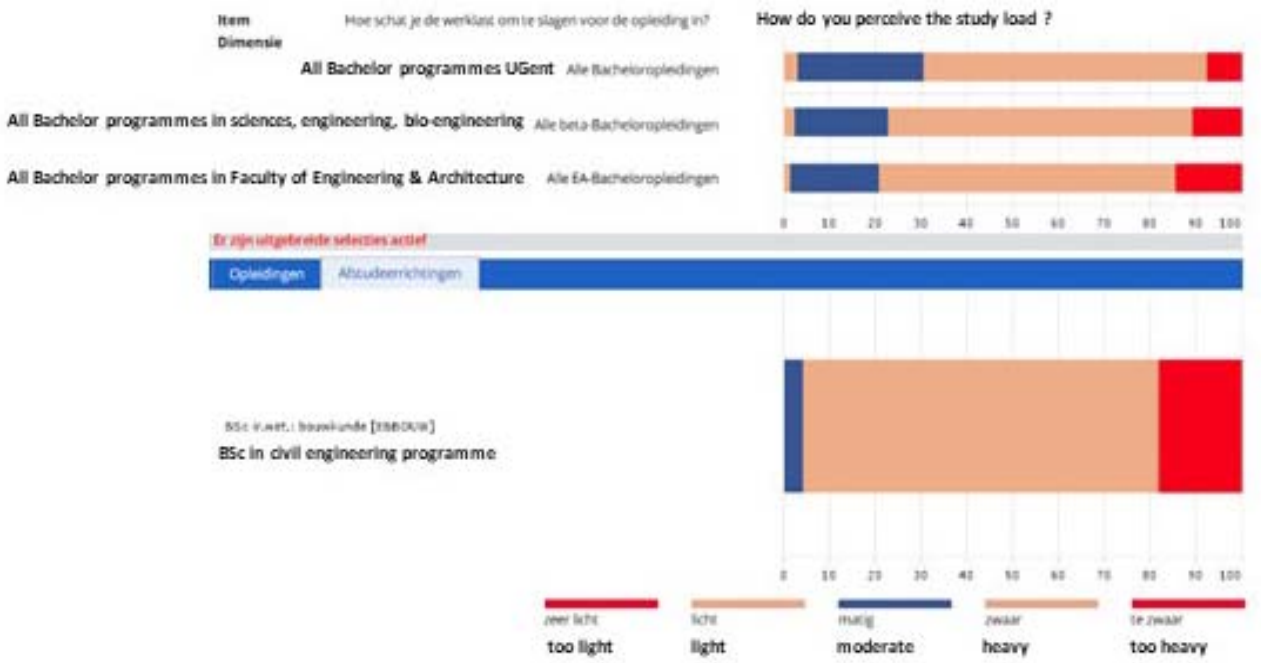


Figure 2: Appreciation of study load by BSc in Civil Engineering students (survey 2017-2018)

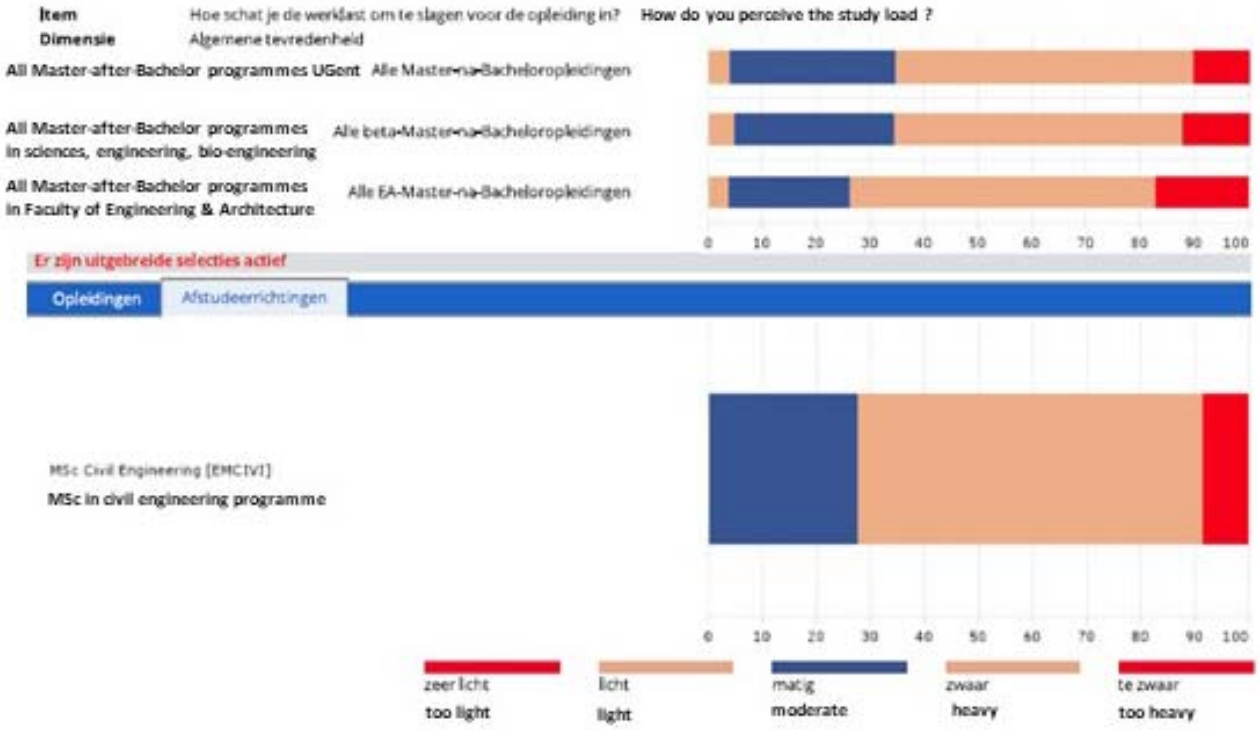


Figure 3: Appreciation of study load by MSc in Civil Engineering students (survey 2017-2018)

Evolutions

The MSc programme got an update of the list of technical elective courses. A new course on “Information Management in Architecture and Construction” is on the list as of 1 October 2018. This enables the students to get a stronger basis in Building information Modelling (BIM), a technique becoming ubiquitous in the civil engineering world.

The BSc/MSc in Civil Engineering programme has since long an Industrial Advisory Board with representatives from the industry, with whom regular meetings are held (last one took place in February 2018). In order to have a more balanced representation of the two majors in the MSc programme (i.e. Construction Design and Dredging & Offshore Engineering), two extra members in the board were appointed. As of 1 October 2018, the board is composed of 10 members.

Master en sciences de l'ingénieur en génie électrique - Master of Science in de ingenieurswetenschappen: elektrotechniek - Master of Science in Electrical Engineering

- *Un master attrayant permettant l'inscription de 80 étudiants par an.*
- *Des contenus très solides, en ligne avec les attentes des entreprises.*
- *Un personnel de bonne qualité doté d'une expertise générale et entretenant d'excellentes relations avec la recherche.*
- *L'analyse SWOT identifie correctement les forces et les faiblesses, les opportunités et les menaces.*
- *Dans la mesure où les cours sont dispensés en anglais, une première étape vers une stratégie d'internationalisation pourrait être mise en œuvre, afin de développer la mobilité internationale, d'attirer des étudiants de qualité du monde entier et de leur permettre de réussir dans ce master.*

(Source, CTI Avis n° 2016/09-10)

Main developments since the audit

Programme Changes

An internal evaluation of our programme around the time of the CTI audit had concluded that changes were needed in the programme option Communication and Information Technology (CIT) because:

- It did not have a hardware design project course as the ECS (Electronic Circuits and Systems) option already had for a long time;
- The software component in the CIT programme was too extensive compared to the more hardware related courses;
- We needed more coherency between the courses, with an emphasis on the hardware/software interface and embedded systems.

At the end of 2016 and in 2017 we have reformed our electrical engineering programme, first (slightly) in the bachelor and then (more extensively) in the master. This reform was based on:

- The above early evaluation
- The quality report for our master programme
- The vision text on the master programme developed early 2015
- The previous bachelor and master programmes
- The information of the CTI self-evaluation report
- The recommendations made by CTI
- The recommendations by the external advisory group from industry

The bachelor reform was in place in the academic year 2017-2018 and mainly consisted of the introduction of the course Design of Analog Circuits and Building Blocks in the last semester instead of an elective course on a more computer science related topic. Since this course was formerly part of the master, it has been slightly changed to better fit the bachelor level and prepare the students for the master in electrical engineering.

The reformed master in electrical engineering was introduced in the academic year 2018-2019. Students that already started in the old master programme could continue this programme.

To prepare this master reform, we installed a working group that started from an empty page and considered the following questions: What are the characteristics of the program that we want to offer (related to the vision)? What are the main themes we need in it (also referring to what other universities worldwide offer)? We then distributed the current courses over these themes to see where we have shortages and what courses are deemed not crucial in our programme.
This exercise has resulted in only slight changes in the ECS option (mainly in the elective courses) but some major changes in the CIT option. The courses “parallel software systems” and “design of multimedia applications” have been replaced by courses more on the interplay between HW and SW: “robotics” and the “hardware design project” which was still missing in the CIT option. In the ECS option, we also changed the course on sensors from an elective course to an obligatory course.
We also introduced some new themes: we wanted to stress energy consumption and sustainable development. However, we decided not to introduce a separate course on this but to include it in several courses and make it a common learning line throughout the courses. This has to be further discussed with all the teachers.
We now have 6 common courses (36 ECTS credits) for the two options: “Antennas and Propagation”, “Design Methodology for FPGAs”, “Electromagnetic-aware High Frequency Design”, “High Speed Electronics”, “Information Theory” and “Modulation and Detection.”
There are 3 courses specific for each option (18 ECTS credits) (for ECS these are “VLSI technology and Design”, “Sensors and Actuators in Electronic Systems”, and “Technology of Integrated Circuits and Microsystems”; for CIT these are “Robotics”, “Mobile and Wide Band Networks”, and “Queueing Theory and Simulation”). The “Hardware Design Project” (6 credits) and master thesis (24 credits) are also targeting different learning goals for the different options. This adds up to 48 credits that are option-specific.
Finally, 36 credits are elective with different lists of elective courses for the two options. We also removed some courses and added some others in these lists such that these courses better suit the vision of the chosen option.

Internationalisation

The internationalisation of our programme has improved year after year, mainly because of the increasing influx of foreign students. We still have a limited outgoing student mobility.
For the incoming students, the higher number of applications requires us to have more formal intake procedures in place. Currently, we mainly focus on the student files and a skype interview but we are working on a short online test to have additional information to guide us to the intake decision.
For outgoing students, a number of bilateral agreements with other universities are no longer active and we are currently revising these and setting up new collaborations with top universities worldwide to increase the possibilities for our own students to have a good international experience.
For ‘internationalisation@home’ we further stimulate teachers to invite top researchers to give guest lectures. We are also considering the organisation of summer schools, field trips, virtual mobility, etc.

Promotion of our programme

The University edits a brochure on ‘UGent for pupils and teachers’ that bundles the educational offer of the university to students in the primary and secondary schools. The activities of several of our teachers collaborating in this are listed there.

Each year, teachers and students from the electrical engineering programme organise the robot competition. This started over 10 years ago as a competition for our own students but has been opened up to several categories, with pupils as young as 9 years old competing with their school. The same group of teachers also is very active in promoting STEM (Science, Technology, Engineering, and Mathematics) in schools in Belgium as well as in developing countries.
Also several professors of our programme participate in the yearly Science Week, where secondary schools are invited to spend a week in a research group and perform scientific experiments.
We have put more effort into the promotion of electrical engineering to our first year students by providing them with a better view of what this study programme actually entails and this also seems to have a positive effect on the number of new students as we have seen an increase in new students for two years in a row now.
For promotion to international students, we have written a brochure on the new master programme in English. This brochure will be sent to the top universities worldwide to be distributed among their students.

Changes after student evaluations

Every year, several courses within the programme are evaluated by the students. Based on the results we discuss whether changes are needed in individual courses, the programme as a whole or the study load. Many small changes are made as such. We also have been informed by a student member of the programme board that students would prefer to have to do oral presentations of project work in every semester. We have seen that this is not the case in only two semesters and are currently discussing with the teachers of these courses what the possibilities are to let students do a presentation for at least one of these courses.

Follow-up on audit remarks and recommendations

Focus of the programme

The CTI panel made the remark that "*The programme has objectives of scientific and technical excellence, based on electronic area and complex systems.*"
Indeed, our programme focuses on electronic systems and on communication systems, which is reflected in the two options offered (Electronic Circuits and Systems – ECS – and Communication and Information Technology – CIT). We do not include power electronics, as this is the subject of another master programme (Master of Science in Electromechanical Engineering).

Pedagogical methods, soft skills and preparation for the job market

The CTI panel made the following remark: "*The programme management seems conservative in terms of pedagogical methods and of openness to soft skills and preparation to the job market (other than research) whereas the societal competences are superficially treated (and very differently by the 2 orientations).*"
It is true that the societal competences were treated differently by the 2 options before. This was mainly due to the fact that the ECS option included a Hardware Design Project course whereas the CIT option did not. This has been remedied in the new master structure with the introduction of a similar "Hardware Design Project" course in the CIT option as well.
The pedagogical methods already include several different methods for teaching, from classical lecture classes to guided exercises, practical lab exercises, and hands-on learning. This may lead to the impression that we focus more on the research and academic world than on the competences needed in industry.

However, industry is soliciting heavily for our students and our alumni tell us they do not have problems at all to adjust to the company setting. This has also been confirmed by the industrial advisory board. We thus believe our students are indeed well prepared for a job in industry.
Over the years, we have worked significantly on improving the soft skills of our students and this process of improvement is still ongoing. We feel we should not improve soft skills by introducing a separate course on this but we aim at better preparing our students for industry by introducing more of the soft skills needed in various courses. This can be by being stricter with deadlines, bringing more structure into the projects, making the projects more challenging, etc.
We have heavily focused on this in the project learning line that is now installed in all years of the programme (including the CIT option since the reformed master). We are now in the process of evaluating each course separately to see where we need to include more soft skills.
We will also continue to encourage experiments with innovative educational techniques (e.g. flipped classroom). The entire university and the faculty of engineering are investing heavily in this. It is important however to guarantee a sufficient diversity of the educational modes. The best way of teaching a course depends both on the contents of the course and on the talents of the teacher.
The programme in electrical engineering is also joining the efforts of Ghent University to increase the scientific eloquence of our students. This had been elaborately discussed in the programme board and we believe this can be done by focusing on providing specific feedback to the students on their scientific eloquence, rather than specifically assigning a score to this aspect (except in the project courses where the scoring rubric specifically has a presentation part as well).

The issue of post carbon economy

The CTI panel made the following recommendation: "*The issues of the global energy transition and of the post carbon economy should be dealt with. The power electrical engineering and energy sectors are not covered in the Master. All the domains relative to renewable energy production, smart grid, energy saving are not in the scope of the Master. In fact, the programme is more an electronic and telecommunication engineering Master than an electrical engineering Master.*"
First of all, we remind the panel that it has always been the goal of the electrical engineering study programme to focus on low power electronics as the high power electronics, electrical motors and the energy sectors are the subject of the Master of Science in Electromechanical Engineering at Ghent University. The programme name may not fully reflect this but it is decided upon by the Flemish Government and is not easily changed. We also clarify this distinction in the new brochure for the master that we wrote so our students are well aware of this. With this background information, the power electrical engineering and energy sectors should not be covered in the Master on electrical engineering. All the domains relative to renewable energy production, smart grid, energy saving are indeed not in the scope of the Master.
Having said this, we agree that also for low power electrical engineering the issue of global energy transition, sustainable energy consumption and renewable energy sources is important. We thoroughly discussed this during our master reform and we decided that it would not be wise to limit such issues to be the content of a single additional course (although we do offer an elective course on such issues) but that these issues should be included in all related courses. We therefore are currently evaluating all courses separately to see where sustainable energy is already focused upon, where we need to put more effort in

this and how the courses can be more adjusted to one another related to this issue. We also consider to introduce more boundary conditions to project assignments on power management issues, as well as on the use of resources. New trade-offs will therefore have to be investigated by the students in the projects.
As we believe that a strong technical education is not sufficient for future engineers, we want to spend more time and effort to highlight the societal impact of electrical engineering decisions. We shall encourage teachers to address the societal aspects in their courses.

Attractiveness of the Master

The CTI panel made the following recommendation: "*The attractiveness of the Master must be worked out, in connection with a strategic analysis of the future of the programme to be done with all the stakeholders. The programme management should consider to improve the attractiveness of the curriculum.*"
This was exactly the intention of the master reform that we have explained in the first part of this document. After a thorough analysis of the previous programme, we found that especially the CIT programme was not consistent enough and we significantly improved it. Also other improvements have made the vision behind the programme more clear in the programme structure and contents. This increased the attractiveness significantly and also makes it much easier to demonstrate our programme's vision to prospective students. We have indeed seen an increase in the number of students by almost 50% compared to two years ago.

Future actions

Design the complete sustainable energy learning line within the courses

As stated before, we have decided in the master reform to not add a specific course on sustainable energy to the programme but to include this as a learning line throughout the programme. We are currently evaluating all courses on this aspect (as well as on the soft skills aspects). Based on this evaluation, the programme management will decide where additional effort could be put into courses on sustainable energy issues and the management will discuss this with the teachers. In these discussions, we will also focus on making the relations between the different aspects of sustainable energy that will occur in the different courses, clear to the students.

More emphasis on soft skills and new learning methods

The programme management actively supports the introduction of more soft skills into the curriculum and advocates the step by step introduction of new learning methods, starting with those courses that are best fit for such methods and where the teachers are open to these methods. Again, discussions on this will start after the evaluation of all courses in the programme on this aspect has been finished.

Increase international student participation

We want to ensure that international students that want to study here have a good chance of succeeding. Therefore, we will test their abilities before they come and we have installed a working group that is currently investigating how we can easily put in place a short online test to check basic knowledge and skills prospective students must have in order to be allowed to study here.
For outgoing international mobility, we are currently evaluating all bilateral agreements with universities around the world. We want to focus on agreements with top universities that have similar bachelor programs as ours so that both incoming and outgoing students are better prepared for their master studies.

Analysis of the study progress

Last year, Ghent University has started a program to analyse the study progress to see if the study length has been increasing since the introduction of the credit system. All programme managers have been asked what information they deemed necessary to allow easy tracking of the study progress and this information is currently being collected. We will analyse this information specifically for the electrical engineering programme and see if measures are needed to shorten the study length for our students. Current figures on the number of resubscriptions do not indicate a major problem in our programme but we will follow up on this.

Master européen en sciences de la photonique - European Master of Science in Photonics (jointly offered with Vrije Universiteit Brussel – VUB)

- *Le master vise l'excellence scientifique et technique dans le domaine de la photonique, en mettant davantage l'accent sur les dispositifs et les systèmes que sur les utilisations et les applications.*
- *Le personnel est compétent et dévoué, et entretient de bonnes relations avec l'industrie.*
- *La formation bénéficie d'une bonne visibilité internationale, mais elle apparaît comme spécialisée par rapport à d'autres domaines tels que le génie électrique ou mécanique.*

(Source, CTI Avis n° 2016/09-10)

Most important changes since 2016

Since 2016, there have been a few changes in the programme, also addressing some concerns and remarks raised in the visitation report.

A first change relates to the explicit introduction of a number of so-called **clusters of elective courses** in the programme. These clusters are:

- Electronics and Information Technology
- Physics and Materials
- Life Sciences
- Business Engineering
- Modeling, Measuring and Control Systems (only at VUB)

Students can take 18 credits from an indicative list of courses in each of these clusters, as well as other courses thematically linked to them, subject to approval by the faculty.

The aim of this change was to broaden the scope and the appeal of the master, especially for students that might consider the field of photonics to be too narrow.

This change explicitly addresses the following comment raised in the original report: "*The programme has a good international visibility, but appears more specialized when compared to other domains as electrical or mechanical engineering.*"

A second change relates to **more flexibility when implementing the international track** of the master programme. The options for this now are the following:

- Courses (30 credits) and/or the master thesis (30 credits) taken at a European partner institute.
- A long internship (>10 weeks, 10 credits) at a company or research institute abroad.
- If it is difficult to travel for a longer time: carrying out a master's dissertation at UGent or VUB, with a strong international component or an international research exchange of at least 6 credit units.

Although we still strongly believe in the value of an international exchange, the introduction of the last option accommodates the case of students for which it is difficult to go abroad for a long time because of their personal or family situation. Students facing financial problems are encouraged to apply for Erasmus+ exchange scholarships through UGent or VUB. When this latter funding is not granted, the last option of an international experience of 6 ECTS is an excellent alternative for getting international experience.

Reactions to comments made in the report

"The programme has objectives of scientific and technical excellence in the field of photonics, with a focus on the devices and the systems more than on the uses and applications."

Even though devices and systems play an important role in our programme, we do try to give sufficient weight to real-world uses and applications, not only in the context of different subtopics in our courses, but also in a case-based course specifically targeted to entrepreneurship in photonics.

"The staff is competent and dedicated, with good links with industry."

We take note of this comment.

"As the continuation of an Erasmus Mundus programme, the Master has a strong international orientation and offers the students opportunities of international mobility in a network of high quality partners."

We take note of this comment and reaffirm our belief and commitment in the value of an international experience.

"This organization may be a source of difficulties for the diploma delivery and for the management of the curriculum."

Given that we have been running this program for many year now, our staff is well-qualified to efficiently tackle any organisational problems that may arise. Within our programme students go on an international exchange to either European institutes or companies abroad, however the diploma they get is only issued by UGent and VUB. Therefore we do not experience any problems for the diploma delivery. For the management of the curriculum we have an exchange and internship coordinator who carefully monitor the choices students make abroad as well as their progress. The grading for courses taken abroad is jointly evaluated by the host partner and the local UGent/VUB responsible professor.

"The programme has a good international visibility, but appears more specialized when compared to other domains as electrical or mechanical engineering."

The explicit introduction of clusters has been implemented as a direct consequence of this remark.

"As in all Erasmus Mundus program, the quality of the course and the teaching in the partner universities is mutually recognized but for CTI It is difficult to certify that all graduates of this European Master achieve the expected outcomes, as they may spend a very significant part of their studies in a very broad network of partners."

We do agree that this is an important aspect, and we keep a constant watch on the experiences from our students that travel abroad, such that we can monitor the academic excellence of our partner institutes.

Plans for the future

We will continue to monitor the quality of our program, based on feedback from the students as well as from industry. We will keep on improving on our core strengths, e.g. by extending our network of high-quality academic partners. We will try to attract students as widely as possible, not only from abroad but also from our own Belgian Bachelor students.

Master en sciences de l'ingénieur en génie biomédical - Master of Science in de ingenieurswetenschappen: biomedische ingenieurstechnieken - Master of Science in Biomedical Engineering

- *La création du comité directeur pour développer la vision stratégique est positive et l'analyse formelle et minutieuse des compétences générales acquises au cours du projet de master 2 mérite d'être soulignée.*
- *L'objectif d'un stage obligatoire à court terme doit être encouragé.*
- *La visibilité du génie biomédical doit être renforcée :*

(1) Il ne fait aucun doute que la création d'une filière dédiée dont il est actuellement question au sein du comité directeur aura une influence positive.
(2) Les initiatives des étudiants en direction des établissements secondaires méritent d'être appuyées.
(3) Les initiatives visant à améliorer la visibilité au sein de l'industrie et à mieux comprendre les besoins du secteur doivent être renforcées.
(4) Depuis sa création il y a moins de 10 ans, le master s'est rapidement adapté au fil des années : la vision stratégique doit délimiter les spécificités de la formation à vendre aux différentes parties prenantes (hôpitaux, entreprises, étudiants, etc.) à l'avenir.

- *La visibilité internationale (au-delà des partenaires du master international) et les recrutements à l'étranger méritent d'être améliorés dans le cadre d'une politique renforcée de la FEA dans ce sens.*

(Source, CTI Avis n° 2016/09-10)

Evolutions since the CTI visitation in 2016

Implementation of a BSc in Biomedical Engineering starting 2019-2020 - principles

The major evolution since 2016 is the formal decision by the Faculties of Engineering (and Architecture) at UGent and VUB to formally start with a BSc in Biomedical Engineering from the academic year 2019-2020 on.

Given, however, that all engineering bachelor programs have a common track for about 3 (UGent) and 4 semesters (VUB), the practical repercussion of this decision is that students who are now (academic year 2018-2019) enrolled in the 2nd bachelor will have the option to switch to the BSc in Biomedical Engineering in 2019-2020 and continue in a revised MSc in Biomedical Engineering in the academic year 2020-2021.

The final bachelor and master curriculum has been the result of a process of about 1.5 years, where the program board worked closely together with the students and in consultation with our advisory board. Specific considerations were:

- we maximally account for the recurrent remark of visitation committees that the basis of life sciences and broadening engineering subjects such as biomaterials, bio-electronics and biomechanics, should be included in a bachelor program;
- projects in the bachelor (engineering project II and the cross-curricular project) get a biomedical engineering focus;
- data analysis techniques have become an important engineering skill that should be included in the curriculum of the biomedical engineer. These skills are ideally acquired via a practically oriented course

with hands-on use of python/matlab in the bachelor. Students should also get an introduction in modern statistical methods.
- students should be prepared during the bachelor program for the possible majors in the master (neuro-engineering, mechanics and materials, sensors and devices, radiation physics);
- where possible, we make maximal use of existing courses from the existing bachelor programs in engineering;
- given the large overlap with other bachelor programs in engineering, it is logistically impossible to organize a joint UGent-VUB bachelor program in biomedical engineering. The bachelor program will therefore be organized separately (in parallel) at UGent and VUB, yet ensuring that students acquire similar competences and skills so that they can enrol in the joint UGent-VUB MSc in Biomedical Engineering.

BSc in Biomedical Engineering: program @ UGent

Table 1 gives the overview of the curriculum of the BSc in Biomedical Engineering at Ghent University. The curriculum has 9 credits domain-specific courses in year 2, and 27 credits in year 3. Together with domain-specific project courses in year 2 (6 credits) and 3 (6 credits), the bachelor curriculum contains 48 credits of domain specific courses.

Course	credits	MT	sem
Discrete mathematics I	4	1	1
Basis Mathematics Tools	3	1	1
Mathematical Analysis I: Functions of One Variable	5	1	1
Engineering Project I	6	1	1
General Chemistry	6	1	1
Informatics	6	1	1
Physics I	6	1	2
Probability and Statistics	4	1	2
Business Administration	3	1	2
Mathematical Analysis II: Functions of Several Variables	4	1	2
Materials Technology: Basic Concepts and Project	5	1	2
Geometry and Linear Algebra	8	1	2
Transport Phenomena	6	2	1
Mathematical Analysis III: Applications of Analysis and Vector Analysis	6	2	1
Physics II	6	2	1
Electrical Circuits and Networks	6	2	1
Elective Course	3	2	1
From genome to Organism [E]	**3**	2	1
Statistical Physics and Molecular Structure	6	2	2
Modeling of Physiological Systems [E]	**6**	2	2
Engineering Project II	6	2	2
Introduction to Numerical Mathematics	3	2	2
Organic Chemistry	6	2	2
Statistical Data Processing	3	2	2
Analysis of Systems and Signals	6	3	1
Electromagnetism I	6	3	1
Quantitative Cell and Tissue Analysis [E]	**6**	3	1
Mechanics of Materials	6	3	1
Biomechanics [E]	**6**	3	1
Modelling and Control of Dynamic Systems	6	3	2
Electronic Systems and Instrumentation for Biomedical Engineers	**6**	3	2
Biomedical Polymers	3	3	2
Medical Physics [E]	**6**	3	2
Cross-course Project	6	3	2
Medical Signal Processing and Statistics [E]	**3**	3	2

Table 1. Three year (180 credits) curriculum BSc in Biomedical Engineering. Courses in bold are domain-specific courses. [E] indicates that courses are taught in English. MT: model track year (1/2/3); sem: semester.

We also got the support from the Faculty of Engineering and Architecture to include 6 courses (for a total of 30 credits) in English. This decision is motivated by a.o. the following arguments:

- we want to highlight the international profile of the program already at the bachelor level
- all terminology and literature in biomedical engineering is in English
- international students applying for the MSc in Biomedical Engineering may lack background in certain domains. We now have a small portfolio of courses in English that we can offer to these students.

As mentioned above, we will implement the bachelor program in 2019-2020, yet immediately in the 2nd and 3rd year. Students who are now (academic year 2018-2019) in the 1st bachelor can directly enrol in the new program in the 2nd year in 2019-2020. The situation is a little different for students who are now enrolled in one of our 6 bachelor programs. We have outlined transition programs for these students such that they can already take up courses from our curriculum in the 2nd semester of 2018-2019, and then formally enrol in the BSc in Biomedical Engineering in 2019-2020. This is possible because of the very large overlap that exists between all bachelor programs in engineering up to the 3rd semester. All bachelor programs have a perfect overlap with the biomedical engineering bachelor program for 30 credits, with exception of students in the BSc in Engineering Physics where the overlap is 24 credits. As such, the vast majority with an interest in biomedical engineering can make the transition without any extra credit cost.

BSc in Biomedical Engineering: program @ VUB

At VUB, the engineering bachelor programs overlap during the first 2 years, and only differ in the 3rd bachelor year. As such, no specific transition measures are needed at VUB, as students currently in the 2nd bachelor can simply enrol in the biomedical engineering program in 2019-2020.

The VUB-curriculum is displayed in Table 2.

Course	credits
Engineering Skills	5
Environmental Aspects of Engineering	3
Informatics	7
Waves and Electromagnetism	9
Chemistry: Structure and Transformations of Matter	7
Mechanics: Forces and Motion	7
Linear Algebra: Systems, Matrices and Projections	6
Analysis: Differentiation, Integration and Mathematical Software	14
Complex Analysis: Residue Calculus and Integral Transformation	5
Economics and Industry	3
Basic Skills for Computer Simulation	5
Applied Statistics	3
Thermodynamics	5
Mechanics and Design Project	6
Solid Matter and Radiation Physics	5
Applied Electricity	7
Materials Science	4
Mechanics of Materials, Fluids and Constructions	5
Technology Project in Civil Engineering	3
Technology Project in Informatics and Communication Technology	3
Technology Project in Environmental Technology and Sustainable Materials	3
Technology Project in Electromechanical Engineering	3
Modeling of Physiological Systems [E]	**6**
Quantitative Cell and Tissue Biology [E]	**5**
From Genome to Organism [E]	**3**
Biomechanics [E]	**5**
Biomedical Signal Processing [E]	**3**
Medical Physics – Physical Imaging [E]	**6**
Biomaterials [E]	**5**
System Programming	3
Introduction into Electro-technical Engineering	5
System and Control Theory	6
Electronics	6
Continuum Mechanics	4
Heat and Mass Transport	3

Table 2. Three year (180 credits) curriculum BSc in Biomedical Engineering at VUB. Courses in bold are domain-specific courses and are taught in English.

Interuniversity MSc in Biomedical Engineering @ UGent and VUB starting 2020-2021

Clearly, the introduction of the BSc in Biomedical Engineering also implies quite drastic changes in the master program.

Courses disappearing from the current master program (27 credits) and shifted to the bachelor program:

	credits	MT	semester
Modelling of Physiological Systems	6	1	1
From Genome to Organism	6	1	1
Quantitative Cell Biology	3	1	1
Bioelectronics	3	1	1
Biomechanics	6	1	2
Medical Physics	3	1	2

The freed 27 credits will be filled in as follows:

- 6 extra credits elective courses so that students have a window of 30 credits that will allow them, even more than now, to define their own curriculum either at UGent and/or VUB, either as part of an Erasmus exchange with a partner university. With 30 credits of elective courses, it will be easier to take up a complete semester abroad.
- Introduction of a number of new compulsory courses (22 credits) to meet recent evolutions in biomedical engineering and better prepare the students for the job market. Some existing elective courses will become part of the compulsory curriculum, but we also introduce new courses
    - Micro- and Nanotechnologies for Medical Device Design and Fabrication (5 credits)
    - Computational Course (6 credits; students can opt for Computational neurophysiology (new course), Computational Biomechanics or From Medical Image to Computer Model
    - Data Analytics in Biomedical Engineering (6 credits; new course)
    - Biomedical Robotics and Assistive Technologies (5 credits)
- The course “Human and Environment, Safety and Regulations (4 credits) disappears, but some of the contents is added to other courses. The partim “Human and Environment” will be covered in Medical Physics (bachelor program), while the Safety and Regulations aspects will be integrated in Medical Equipment, which changes name and becomes Medical Equipment, Safety and Regulations.
- Biomaterials will be extended to also cover principles of Tissue Engineering.
- Hospital project is increased in credit weight (from 3 to 5 credits), so that students can finalize a meaningful project together with a medical doctor.
- The weight (credits) of a few other courses is slightly tweaked to better match the effective study load.

Table 3 provides an overview of the compulsory courses in the new curriculum and a brief description of their contents. Compulsory courses account for 66 of the 120 credits; 30 credits is available for elective courses, and the remaining 24 credits are taken by the master thesis.

Course	Credits	MT	sem	description
Biomedical Product Development	6	1	J	The aim of the course is to present students an overview of all steps required to solve a biomedical problem by designing a product prototype. Students are taught how to apply a methodical way of designing a product, which should lead to enhanced product quality. By creating several possible solutions to a problem the chance to find the optimal solution is enlarged. All parts of the methodical design process are practiced as group assignments (groups of 5 to 6 students). Since group work is very important part of product development, this will also be taught and practiced. In addition, lectures will be given on aspects of intellectual property rights (patenting), quality assessment and assurance, patient safety regulations, business development, green product developments. Lectures also include presentations and testimonials from biomedical engineers in SME startup companies.
Artificial Organs	5	1	1	This course provides the students with insight in the technology and design of artificial organ systems with specific attention to the rheology of blood, electro-mechanics, biocompatibility and material choice.
Neuro-engineering Science	3	1	1	This course aims to give the students insight into the functioning of the healthy brain and how this is affected in most common neurological disorders. Different techniques to measure the signals of the brain and to modulate the function of specific brain areas are described.
Medical Imaging	6	1	1	The goal of this course is to make the students familiar with medical imaging and image processing techniques. The course extends on working principles of medical imaging techniques as covered in Medical Physics and focuses on image formation and image processing of the most relevant medical imaging modalities, advantages and disadvantages, their applications and recent technical developments.
Micro- and Nanotechnologies for Medical Device Design and Fabrication	5	1	1	The purpose of this course is to acquaint students with the various technologies for the realization of integrated circuits, printed circuit boards, microfluidic systems and microelectromechanical systems (MEMS). First, the different

				fabrication technologies are described that serve as the basis for any advanced micro-and nanotechnology (deposition, lithography, etching ...), followed by the realization of different microsystem components (cmos chips, microfluidic components, MEMS and chip packages) and interconnection systems (printed circuit boards, flexible and stretchable electronics)
Biomaterials and Tissue Engineering	5	1	1	The student is provided with knowledge and insights about the development, the properties, the design and the possibilities/limitations of polymers, ceramic and metallic materials and combinations which are being applied for the preservation, restoration and/or replacement of affected or damaged tissues or organ. In a second part, tissue growth and repair through engineering of cells into functional tissue is covered.
Computational Course	6	1	2	All students will have a 6 credit computational course in their curriculum, but students will have the choice to either opt for a biomechanics oriented course (Computational Biomechanics/From Medical Image to Computer Model) either for a computational neurology course (Computational Neurophysiology). In both cases, the starting point will be the derivation of the relevant sets of differential equations and computational methods to solve these equations. The major component, however, will be a hands-on project.
Data Analytics in Biomedical Engineering	6	1	2	The purpose of this course is to give students a detailed overview of how data from medical devices, wearables and databases can be acquired, processed and visualized, in order to provide insights for medical doctors, nurses and paramedics. Focus will be on distributed applications that combine software technologies, network technologies, semantic technologies and/or machine learning for usage in hospitals, nursing homes, but also in residential context for healthy living applications. The students will learn the technologies during the lectures and will gain hands-on experience during the specific lab sessions using real-life data sets.
Biomedical Robotics and Assistive Technologies	5	1	2	This course provides the students with technical background into the kinematics, dynamics and control of robotics in the medical environment, and the role of robotics as an assistive technology in rehabilitation (active

				prostheses, exoskeletons, …).
Medical Equipment, Safety and Regulations	5	1	2	In this course, students get acquainted with medical technology and equipment in the broad sense from the health care practitioner's viewpoint. The course covers the most relevant medical specializations with site visits to the hospital and practical demos, including a visit to the robotic surgery training facility. The role of the biomedical engineer in ensuring compliance with safety and regulations is covered.
Hospital Project	5	2	1	Biomedical engineering students need to be trained in communication with medical professionals and have to become familiar with daily life in a medical department of a hospital. In this project course, students work in small groups on a practical assignment initiated and supervised by a medical doctor or health care professional, in a health care environment.
Clinical Study Design and Biostatistics	3	2	1	This course aims to provide students with a thorough understanding of statistical methods commonly used in medicine and biomedical research. By means of practical examples, students get aware of considerations in clinical study design for medical devices.
Leadership in Health Care	3	2	2	This course prepares biomedical engineering students for leadership roles in health care organisations (government, health care institutions, hospitals, MedTech companies.
Clinical Decision Support Systems	3	2	2	The aim of the course is to introduce the principal information and decision support systems used in health care. Attention is given to a wide range of information sources, including upcoming trends such as e-health and m-health. The student will be given insight in the data analysis techniques required for the development of novel clinical decision support or computer-aided diagnosis systems
Elective courses	30			
Master thesis	24			

Table 3. Overview of the new curriculum of the inter-university MSc in Biomedical Engineering, effective as of 2020-2021.

Students have a window of 30 credits for electives. Mainly based on the suggestion of the students in the program board, we opted for the introduction of specialization tracks. Students get a mention of the specialization on the diploma supplement if (a) they take up 18 credits or more of elective courses from within a certain cluster, and (b) they do a master thesis topic within the same domain. When these conditions are not fulfilled, students graduate under a "general track" without any explicit specialization. Figure 1 provides an overview of courses offered within the specialist tracks.

Radiation physics	Neuro	Mechanics and Materials	Sensors and Devices	General track
Measurement Techniques in Nuclear Science	Nuclear Magnetic Resorance Imaging Technology	Computational Fluid Dynamics	Microphotonics	
Nuclear Physics	Neuro-physiological Signal Processing and Network Analysis	From Medical Image to Computer Model	Biophotonics	
Technology of Radiotherapy	Translational Neuroscience	Computational Biomechanics	Sensors and Actuators	
Medical Dosimetry	Neural Interfaces, Neuromodulation and Minimally Invasive Neurotechnology	Tissue Engineering	Photonics	
Radiologic Techniques	Auditory Computation, Modelling and Devices	Surface activation and modification techniques	Micro and Nanobiotechnology	
Radioprotection and Regulations	Advanced Image and Signal Processing	Physics and Chemistry of Nanostructures	Technology of Integrated Circuits and Microsystems	
Radiochemistry	Contrast Agents and Biomarkers for Imaging and Therapy		Technological Processes for Photonics and Electronics	
Radiobiology and Radiopathology			Embedded Bioelectronics Systems	
Master thesis (domain specific)	Master thesis (domain specific)	Master thesis (domain specific)	Master thesis (domain specific)	Master thesis

Figure 1. Overview of specializations offered to the students through elective courses and the master thesis.

CEMACUBE program has received EIT label

With respect to the International MSc in Biomedical Engineering (the CEMACUBE program), the major evolution is the fact that an entrepreneur track of the CEMACUBE program has been endorsed by the European Institute of Technology (EIT) and received the EIT Health label in 2018[ii].

With this label, we expect to drastically increase the international visibility of the international program (and with it the local program) as we will benefit of the EIT communication and PR departments. Together with the EIT label, the program will receive substantial funds that will mainly be invested into scholarships for students. We hope to see the first positive effects of this important evolution in 2019, where we hope to drastically increase the number of students applying for the program (this had dropped to 35-40 applicants in 2018-2019) and become appealing for international top students, similar to the situation that existed when the program was running as an Erasmus Mundus master with the associated scholarship program (with close to 400 applications/year).

[ii] https://www.eithealth.eu/cemacube

Answers to specific comments from CTI

"The creation of the Steering Committee in order to develop the strategic vision is positive."

The Steering Committee has played an important role in the development of the curriculum of the new BSc and revised MSc in Biomedical engineering and will continue to play an important role. It is essential to have a close and permanent interaction with stakeholders from industry, the university hospitals and the directors of the faculties of engineering (and architecture) and medicine from UGent and VUB.

"The formal and thorough analysis of the soft skills developed during the Master 2 project is to be outlined."

The course weight of Hospital Project has been increased from 3 to 5 credits. During this project, students work together with medical doctors on an assignment that has been defined by the medical team and based on true medical needs. With the increase in credits, students will spend more time in the hospital in a direct interaction with the clinical staff. Students are thus introduced into the specific setting of a hospital where they interact with the medical team, which leads to the development of novel social skills. Students get also particular training in communication with a multidisciplinary and non-expert audience through frequent reporting to the medical team and the project coordinator.

"The objective to go for a mandatory internship soon is to be encouraged."

To align ourselves with the other master programs, we decided to maintain internship as an elective course in the curriculum. At the same time, however, Hospital project was increased from 3 to 5 credits so that students effectively spend more time in the hospital. In parallel, internships are highly stimulated and promoted to the students.

"The visibility of the Biomed programme needs to be improved :
(1) The creation of a dedicated track at the Bachelor level currently discussed within the Steering Committee would for sure contribute"

The bachelor program will formally take an onset in 2019-2020. All info brochures of the faculties of engineering and architecture have been updated accordingly, and will become publicly available in spring 2019. The faculty will vividly promote the new bachelor program via all available channels, including study info days all over Flanders, info moments and open days at the university. Thanks to the recognition of the international MSc in Biomedical Engineering by EIT-health.

"(2) Students initiatives towards High Schools deserve support"

With the implementation of our bachelor program and the availability of brochures listing the bachelor program, we now have much better communication tools towards students in high (secondary) school. Initiatives are taken to inform secondary school teachers about the new bachelor program via the communication channels of the university and at Flemish level (e.g. communication in *Klasse*, a magazine widely circulated to all individuals involved in teaching and education at all levels in Flanders). This is done in collaboration with colleagues from the Vrije Universiteit Brussel and KU Leuven, as all universities start a BSc in Biomedical Engineering. Since a few years, we also offer a workshop for secondary school students that is organized twice/year. In addition, we participate to dedicated events and workshop aiming to attract more female students in STEM (Science/Technology/Engineering/Mathematics) education.

"(3) Initiatives to get more visibility within industry, to better understand Industry needs, have to be strengthened"

Until now, our very successful and yearly organized Biomedical Industry Day has been our main liaison with industry, together with the installation of an industry advisory board. Companies who already confirmed their participation to the Biomedical Industry Day are GE healthcare, Siemens healthineers, Abbott, Möbius, Cochlear and HiCT.

Over the past 2 years, our student organization (BEAM) has maturated, and more and more plays the role of interface between the program and industry. This academic year (2018-2019), they a.o. organize 2 workshops in collaboration with industry on

- how to write a CV, your LinkedIn profile and personal branding.
- interviewing techniques en assessments

"(4) Programme courses have been adapting swiftly over the years since its creation less than 10 years ago ; the strategic vision shall delineate the programme signature to be sold to the different stakeholders (hospitals, companies, students, …) in the future."

We have constructed an appealing bachelor and master program that will be the backbone of the biomedical engineering program for many years to come.

"International visibility (beyond the International Master partners) and foreign recruitment deserve to be improved in the frame of a FEA reinforced policy in that direction."

We expect that, thanks to the EIT-labeling of the International MSc in Biomedical Engineering, the international visibility of Ghent University and its biomedical engineering programs will improve. We now also have a package of 30 credits of English taught biomedical engineering courses in the bachelor program. This will provide us with more flexibility in the admission of international students in our MSc in Biomedical Engineering, and design dedicated admission programs tailored to the background of the students.

Master en sciences de l'ingénieur en génie électromécanique - Master of Science in de ingenieurswetenschappen: werktuigkunde-elektrotechniek - Master of Science in Electromechanical Engineering

- *Un master attrayant permettant l'inscription de 80 étudiants par an.*
- *Des contenus très solides, en ligne avec les attentes des entreprises.*
- *Un personnel de bonne qualité doté d'une expertise générale et entretenant d'excellentes relations avec la recherche.*
- *L'analyse SWOT identifie correctement les forces et les faiblesses, les opportunités et les menaces.*
- *Dans la mesure où les cours sont dispensés en anglais, une première étape vers une stratégie d'internationalisation pourrait être mise en œuvre, afin de développer la mobilité internationale, d'attirer des étudiants de qualité du monde entier et de leur permettre de réussir dans ce master.*

(Source, CTI Avis n° 2016/09-10)

The Master of Science in Electromechanical Engineering offers training in all aspects of Electromechanical Engineering and their economic and social implications. Five main topics are offered to students (36 credits) « Mechanical Energy Engineering », « Electrical Power Engineering », « Mechanical construction », « Control Engineering and automation », « Maritime engineering ». The current programme was introduced in 2014 and is taught in English, it attracts about 80 students each year.

The CTI-report mentioned the following opinion:

- An attractive programme that allows the enrolment of 80 students per year
- A very strong and balanced content and in line with expectations of companies
- Good quality staff with broad expertise and excellent relationship with research
- The SWOT analysis correctly identifies strengths and weaknesses, opportunities and threats
- The workload remains rather heavy
- Students and teaching staff should be encouraged to mobility

Evolution since May 2016

No major changes were made to the program since the visitation of CTI. As stated in the panel opinion the program has matured and was optimized. Several lecturers have updated their courses and minor issues reported by the students on unbalanced work load were solved by shifting content between different subjects. There is a follow up this year on the effect of the measures.

A very important step for the program was the selection as a pilot project (out of 2) for the Sustainable Education Program of Ghent University. Ghent University wants to be a leading knowledge institute for a future that is ecologically, socially and economically sustainable within a local and global context. To start up the transition to sustainable education two pilot projects were selected to experiment with how and what sustainability within a master program could be. A series of workshops and seminars and 2 training courses resulted in a training-specific vision text about the integration of sustainability, as well as an action plan for its implementation. These pilot studies provide inspiration and insights into the methodology to be used for future roll-out. The pilots were supported by specialist of the Centre for Sustainable Development of Ghent University.

The project is now in its third year. The first year information was gathered on how students, lecturers and the industrial advisory board looked at sustainable electromechanical engineering education.
Interesting findings were:

- Students identified several courses in the current program where (to a smaller or larger extent) attention was already given to sustainability.
- Students wanted to see a more structured approach in the curriculum
- A limited amount of lecturers indicated that they treated aspects of sustainability in their courses.
- Lecturers pointed out that they had little experience in what exactly sustainability and its aspects were
- Almost all lecturers confirmed that their research deals with topics which contribute to sustainable development in electromechanical engineering.
- All industrial partners gave the feedback that sustainability is a necessary future aspect in electromechanical engineering education.
- Industrial partners stated that sustainability is already part of their business and they need engineers who are aware of the broad aspects of sustainability.

In the second year several workshops were organised. In 3 workshops, experts from abroad were invited to give information to the lecturers about sustainability (UN SDGs) and about examples of sustainable engineering programs at other universities. A second set of workshops was set up with lecturers and students, under supervision of the staff of the Centre for Sustainable Development, to create an action plan for the transition of the Electromechanical Engineering program to a program including all aspects of sustainability.
The main strategy that was developed is summarized as follows:

- We will not introduce a separate course on sustainability.
- We will include in each relevant subject of the program sustainability, as such creating a full inclusion of sustainability in the overall program. We will create an educational line on sustainability in order to realise this.
- The 3rd Bachelor Design Project (VOP – Vakoverschrijdend Project) will be transformed into a project on sustainable technology design. From there on we will trickle the sustainability concepts both down to the first bachelor years and up to the master years.

During the third year the chair of the program set up a task force of lectures and students to reorganise the 3rd Bach Design Project. In February 2019 the new project format is being implemented for the first time.
The project is organised as follows:

- The students select a sustainable design subject out the topics offered by the lecturers, e.g., making a wind mill or a solar boiler.
- An introductory lecture by the Centre for Sustainable Development on SDGs for the students
- The students have the first 6 weeks to make a multilevel analysis on the societal system in which their technology will function, looking for the standard technology, niche trends, …. This analysis is reported in a paper and a presentation.
- The first six weeks are also used for getting into the subject, making a project plan, doing pre-design calculations etc.
- In the final six weeks of the semester the design is built and demonstrated in a final workshop for all students.

In 2019 the chair will talk to all lecturers and make an inventory of adjustments to be made to subjects and the program to create an educational line. This line is to be implemented by the end of 2019.

Actions taken based on the recommendations of CTI

Work load: as stated above a continuous monitoring on the work load of the program is in place. The reorganisation of the Bachelor Design Project also included a further restructuring of the tasks within the project in order to balance the additional work load caused by the multilevel analysis.

International mobility: International mobility is organised by Ghent University and by the faculty. The master program has very little influence on international mobility. On the Ghent University level new regulations were adopted for sabbaticals of professors. The faculty of Engineering and Architecture provides funding support for international mobility. This funding is continuously available and lecturers are informed.

CTI indicated that the master should take action for attracting international students. This was discussed in the committee. A problem was detected with the admission of foreign students. Our program requires both knowledge in electrical and mechanical engineering. A lot of foreign programs only offer power (electrical) engineering or mechanical engineering separately. Students coming from these programs are not allowed to enter the master. All bachelor courses offered at Ghent University are taught in Dutch. As such creating a bridging program for foreign students is impossible. In order to create such a program a reform of the bachelor is necessary. This is now being studied.
In order to better promote the program abroad, forces are joined with other masters in the faculty. The master program has no financial means, and as such cooperating within the faculty is the only way to go. We support international efforts of the faculty.

Master en sciences de l'ingénieur en génie industriel et recherche opérationnelle - Master of Science in de ingenieurswetenschappen: bedrijfskundige systeemtechnieken en operationeel onderzoek - Master of Science in Industrial Engineering and Operations Research

- *Formation bien supervisée par le comité des programmes d'études (Study Programme Committee ou SPC) et faisant l'objet de révisions fréquentes, conseil consultatif efficace.*
- *Cours dispensés à la fois par des enseignants ayant des contrats à temps partiel et des professeurs d'université.*
- *Difficultés pour les étudiants étrangers car le niveau scientifique de ce master est élevé.*
- *Nécessité de faire mieux connaître et comprendre ce master et sa spécificité scientifique aux entreprises.*
- *Embauche exceptionnelle dans ce secteur.*

(Source, CTI Avis n° 2016/09-10)

Main changes

- An Engineering Economy offered in English was created and is now a compulsory course in both the regular programme and the bridging programme.
- To deal with the heterogeneity of incoming students, a new module was added to the programme. This module contains two bachelor courses, one on Algorithms and Data Structures that is relevant for Operations Research and one on Control Theory that is relevant for Industrial Engineering. None of the incoming students have had both courses before, so as part of the master, they must take one of them (i.e., the one that was not in their bachelor programme). As such, the heterogeneity of competences of the incoming students is reduced.
- The model trajectory has been reorganized such that more of the compulsory courses are in the first year. This leaves more room for electives and for working on the master thesis in the second year.
- The bridging programme henceforth only allows M.Sc. Engineering Technology students. All other students that are not directly allowed into the regular programme now must go through the preparatory programme. This includes students with a M.Sc. Business Engineering.
- Since 2018, the SPC organises a yearly IEOR Industry Day. During this day, students and staff of the IEOR programme meet with representatives of companies (some of them alumni of the IEOR programme) that have interesting opportunities for IEOR engineers (internships and master theses for the students as well as jobs for graduating students).
- The admission criteria for foreign students are now more stringent than before. A more thorough check is performed of competences w.r.t. mathematics, probability, statistics and programming literacy. Applicants are only admitted if the SPC believes they have a fair chance of succeeding.

Remarks from CTI

"Difficultés pour les étudiants étrangers car le niveau scientifique de ce master est élevé."

- ⇨ More stringent in admitting international students, see above

"Nécessité de faire mieux connaître et comprendre ce master et sa spécificité scientifique aux entreprises"

- ⇨ IEOR Industry Day, see above
- ⇨ The graduates of our relatively young programme are spreading into the job market and proving their worth, so little by little, more and more companies are getting to know and appreciate this master through its alumni.

Further action plans

After many years of programme revisions and curriculum tweaking, we believe the programme is now mature and should not be further adjusted.

Focus of the SPC can now shift more to its 'PR':

- o informing and attracting students by more clearly positioning the IEOR master among the other masters of the faculty
- o further inform companies/recruiters about the profile of an IEOR engineer
- o together with the faculty's and central internationalization offices, attract more and better students from abroad

Create better opportunities for interesting Erasmus exchanges for the IEOR students. There is some work left in identifying 'preferred' partners and finding corresponding course offerings that sufficiently fill in the specifics of the IEOR profile.

#

Master en sciences de l'ingénieur en génie informatique - Master of Science in de ingenieurswetenschappen: computerwetenschappen - Master of Science in Computer Science Engineering

- *L'analyse SWOT identifie correctement les forces et les faiblesses, les opportunités et les menaces.*
- *Il s'agit globalement d'une excellente formation proposée par des enseignants de bon niveau et véritablement motivés.*
- *L'efficacité du programme « étudiant entrepreneur » est très impressionnante.*
- *Les cours facultatifs sont nombreux. Les étudiants peuvent choisir leurs cours « à la carte ».*
- *Certains étudiants ont les idées très claires quant à leur choix de carrière, d'autres préfèrent un programme diversifié, et d'autres encore sont dans l'incertitude la plus totale. Il pourrait être judicieux d'accompagner les étudiants dans leur choix de carrière et de les aider à sélectionner les cours facultatifs dont les contenus leur seront nécessaires pour leur future carrière professionnelle.*
- *Développer l'internationalisation de la formation.*

(Source, CTI Avis n° 2016/09-10)

Main developments since the May 2016 audit

Introduction of major options

From the academic year 2019/2020 on we have decided to include two major options in the programme: Artificial Intelligence (AI) and Embedded Systems (ES). Each of these major options consists of a coherent packet of elective courses that students can choose within a specific domain of research (i.c. AI or ES).

The goal of this change in the elective course offering is double: giving greater visibility to some important domains in computer science, especially artificial intelligence, and bringing some structure in the large list of elective courses (cf. also the follow-up section).

We deem it important to highlight the AI offer in our programme as demand of both industry and research for this domain of expertise has strongly increased in recent years. Many other universities already have a specific AI centred programme. We already have a critical mass of courses and research in this domain, but these courses have not always been sufficiently visible within the large offer of elective courses. The new major option in AI will offer students a coherent package of AI-related courses.

There is also a large expertise in ES, at the crossroads of hardware and software, in the research departments involved in computer science engineering education. This is why we can, with minimal additional effort, also offer a coherent set of courses about this topic in the major option in ES.

Internationalisation

We have stepped up the efforts to increase the international experience for students in the programme.

On the one hand we have strengthened the collaboration with IAESTE to promote the offer of international internships, both inbound (for foreign students at Ghent University) and outbound (for Ghent University students abroad).

On the other hand we are negotiating bilateral agreements with foreign universities for the international exchange of students. We are quite selective in our choice of foreign institutions. Our

goal is that the added value of the exchange is not just the international experience but also the experience of a highly ranked research and education centre.
We also strongly support students who want to achieve an international experience at top universities abroad, even outside the framework of any bilateral agreement between institutions. Two of our (top) students have been admitted in recent years at Cambridge University for their last master year and one is applying for a graduate programme at a few top US universities.

Update of the elective course offering

We continuously monitor the (sometimes fast) evolutions in computer science and adapt the offer of elective courses to keep up with these changes. The great variety of research expertise available in the faculty of engineering and architecture allows us to select knowledgeable teachers in these new domains. A few examples of newly introduced elective courses are: computational challenges in bioinformatics / blockchain technologies and applications / recommender systems / deep learning (next academic year) / natural language processing (next academic year).

Communication to future students

Some colleagues have put a lot of effort in recent years to promote computer science education in secondary education (Coderdojo, lobbying for the introduction of computer science in secondary education, etc.).
It is uncertain whether the slight uptick in student admissions in computer science engineering and the small but significant improvement in the gender mix of the student population (from about 5% female students to more than 10%) are due to these efforts but we shall continue this promotion in future years.

Follow-up on audit remarks and recommendations

Maintaining the strong points of the programme

We remain focused on controlling the quality of the education. We regularly evaluate the quality of the teaching of the courses and we remain attentive to issues that are raised by students, whose representatives in the study programme committee play an essential role in this process. We also try to ensure the feasibility of the programme, suggesting corrections when we observe some imbalance in the load of a course and its actual weight in the programme.
We shall continue to promote the student entrepreneur programme, which remains quite popular with students and offers them a realistic opportunity at creating their own enterprise with limited risk. Not every enterprise created in this context will become successful (although we hope some will, as has been true until now), but the experience of the student will definitely be an added value, even if (s)he does not pursue a further entrepreneurial career.
We will continue to encourage experiments with innovative educational techniques (e.g. flipped classroom). It is important however to guarantee a sufficient diversity of the educational modes. The best way of teaching a course depends both on the contents of the course and on the talents of the teacher.
Ghent University has launched a programme to promote active learning. To a large extent the faculty of engineering and architecture in general, and the computer science engineering studies in particular, already apply many of the elements of an active learning strategy, with a large number of practical lab sessions, project courses throughout the entire programme, and practical assignments in many courses. We should however keep a watchful eye on the global load of this approach for

students. A better communication to students of deadlines of projects and assignments should make it easier for them to plan the work load during the year and avoid peak loads at some moments.

Structuring the large offer of elective courses

The large diversity of the elective course offering is a strong point of the computer science engineering programme. It allows for rapid updates of the programme when new technologies emerge (e.g. Blockchain, deep learning, etc.) and allows students to select a package of courses covering their field of interest for future work or research. Keeping this broad offering up-to-date is essential considering the diversity and the perpetual evolution of the research and employment domains for future students in computer science engineering. It is a useful add-on for the broad base of mandatory courses, which should cover the essential components of computer science.

However, we are aware of the fact that the list has become very long and somewhat unwieldy, which means some students have trouble selecting a coherent package of elective courses. This is why we have chosen from next academic year (2019/2020) to include two major options in the programme: Artificial Intelligence (AI) and Embedded Systems (ES). Each of these major options consists of a coherent packet of elective courses that students can choose within a specific domain of research (i.c. AI or ES, cf. also the previous section about the main developments).

We intend to go further with this structuring of the elective course offer. Although it will probably not be possible to define a major option for every topic covered, we think it should be possible to group the large number of elective courses in a more reasonable number of clusters, which will group courses with a somewhat similar research domain.

The goal of the major options and clusters is not to force students to select a single domain of research (they will still be able to pick elective courses from diverse major options and clusters), but to offer the opportunity to students to select a package within one specific domain, and also to facilitate the choice for all students. It should be easier to select potentially interesting courses within clusters of similar topics than finding a single course in a long list. The clusters will probably be a better indication of the fields of interest of the student than a course name, which might not be as descriptive as intended.

Internationalisation of the programme

We are fully aware that, although the quality of the study programme can withstand international scrutiny (which is demonstrated by the success of our outgoing international exchange students, who obtain excellent marks at top universities like EPFL), more could be done to promote the internationalisation of the education. Our goal is to give students the opportunity of an international experience, whether an international internship or a longer international exchange programme.

As mentioned in a previous section (cf. also the section about the main developments) we have initiated some actions to improve the offer of international experiences to our own students. We have already observed some results of the increased collaboration with IAESTE, with a larger number of students doing an internship in a company or institution abroad.

The negotiation of new bilateral agreements is a slower process, especially as we want to be sufficiently selective in our choice of foreign universities. The quality requirements abroad must meet our (admittedly rather high) standards. The effects will probably only be observed within a few years, but we will continue to put the necessary efforts in this process.

We should also mention that quite a few of our computer science engineering alumni have embraced an international career, often in major IT companies (e.g. DeepMind, where several UGent alumni are employed).

Future actions

Attention for societal implications

As we believe that a strong technical education is not sufficient for future engineers, we want to spend more time and effort to highlight the societal impact of (computer science) engineering decisions. We shall encourage teachers to address the societal aspects of computer science in their courses, both as application cases for IT solutions and as consequences of IT technologies.

Climate change is one of the major challenges of our present and future society. Students should be aware of the impact of some technical choices (e.g. the large power consumption for bitcoin proof-of-work in comparison to the societal usefulness of cryptocurrencies) but also how computer science technology may contribute to solutions (e.g. data science techniques in the balancing of future electrical networks with more local production).

Ghent University also (justly) celebrated in 2018 the 70th anniversary of the Universal Declaration of Human Rights. However, at the same time, the underlying societal model of liberal democracy is under threat even in Western countries. Social networks and AI have often been mentioned as having a detrimental impact on the democratic discourse in our societies. Students must be aware of the impact of IT on these issues.

New technologies (e.g. AI) are also having a disruptive impact on large swaths of the economy. We often consider these disruptions as important for technological progress. We should however keep in mind that these disruptions may negatively impact some people. We cannot allow ourselves to simply accept that technological innovation leaves some people behind. Otherwise we risk a large scale rejection of new technologies by the rest of society.

We understand that these goals are probably quite ambitious and maybe even slightly controversial as they stray from our strong scientific and technological foundations into a more political field, where we have less expertise. We deem them however important for future computer science engineers.

Structuring of the programme

This is a more practical and more easily achievable goal. As mentioned before we are aware that the large list of elective courses may make a coherent choice somewhat difficult for some students. We intend to proceed with the initiated process of clustering elective courses into either major options or cluster of courses. This should clarify the offer to our students.

Improving the offer of international experiences

This process has been initiated too (as mentioned before) but we want to continue to expand the offer of possible international experiences for our students, in the form of international internships, international exchanges, or even support for post-graduate experiences in foreign universities and research centres.

Reassessing the full programme

Our present programme has been very carefully elaborated. However we think it is important to reassess the full programme in light of the evolutions of the field of computer science since the programme has been first elaborated. In the context of a global reform of engineering studies at Ghent University we shall have to decide what shifts are necessary in the present programme, both for the bachelor and the master. A new balance will need to be struck between mandatory and elective courses: some courses, which are elective courses today should probably become mandatory

courses; this implies however that some mandatory courses will have to become elective courses in the future.

Master en sciences de l'ingénieur en génie des matériaux durables - Master of Science in de ingenieurswetenschappen: materiaalkunde - Master of Science in Sustainable Materials Engineering

- *La « durabilité » doit être davantage développée dans les cours obligatoires et devrait apparaître plus clairement dans le descriptif du master.*
- *Une plus grande cohérence entre les différents cours ainsi qu'entre les deux matières principales serait bénéfique pour l'attractivité du master.*
- *Selon le tableau Acquis d'apprentissage/Cours, les acquis du master sont bien répartis entre les différents cours ; il est important d'évaluer tous les acquis d'apprentissage.*
- *Les projets sont appréciés des étudiants ; ils pourraient être développés, notamment en introduisant une approche plus interdisciplinaire ou en associant des étudiants issus de différentes disciplines.*
- *Les cours de management, d'économie et de sciences sociales ne sont pas obligatoires, ce qui est regrettable pour ce domaine d'activité.*
- *Les échanges internationaux ne sont pas suffisants même si la mobilité via les programmes Erasmus est encouragée : un effort devrait être fait pour attirer les étudiants étrangers. La stratégie concernant la spécialisation textile de ce master doit être définie plus clairement par rapport au Master international en génie textile. Le nombre d'étudiants est trop faible. Tous les efforts visant à encourager les étudiants à venir doivent être poursuivis.*
- *Le terme « durables » a été ajouté au titre du Master, mais pour attirer les étudiants, il faudrait développer davantage ce concept dans le master.*
- *Les relations avec l'industrie sont étroites et l'environnement de recherche est de qualité.*
- *L'objectif en faveur des stages dans l'industrie doit être encouragé. L'offre de stages en entreprise est très bonne.*

(Source, CTI Avis n° 2016/09-10)

Follow-up on audit remarks and recommendations

"The "sustainability" has to be more developed in the compulsory lessons and should have a better highlight in the curricula description because as this notion has been added to the master name, one could think it is only to attract students."

Some courses are completely devoted to sustainability, e.g. "extractive metallurgy and recycling" or "corrosion and surface engineering". In other courses ("polymer processing") recycling is a significant part. Many courses however address various aspects of sustainability, such as proper design, material selection, increase of material durability, end of life, consumption of resources.

Currently the bachelor programmes in engineering are being revised. After finalisation of this process, the master programmes will be revised as well. This process has started already, but it can't be finished without the bachelor programmes being clear.

Participation in sustainability projects by various research groups of the department of Materials, Textiles and Chemical Technology (MaTCh) has led to the creation of the interfaculty platform "Centre for Sustainable Chemistry" [CSC[iii]]. CSC aims at supporting the transition towards an

[iii] https://www.csc.ugent.be/

ecological, social and economically sustainable society by joining relevant research activities in order to merge and develop the necessary expertise.

MaTCh actively contributes to the visibility of CSC to all stakeholders, including students. CSC is obviously an excellent platform that can contribute to the visibility of sustainability in education, as well as for bringing in expertise in education. The upcoming programme revision is a good occasion to address the following comments:

- More coherence between the different courses and between the 2 majors would be beneficial for the attractiveness of the Master
- Management, Economics and Social Courses are not compulsory; it is a pity for this field of activity

"International exchanges are not sufficient even if Erasmus mobility is encouraged: an effort should be made to attract foreign students."

The number of incoming students has increased:

- 2016-2017: 3 students (versus 1 outgoing)
- 2017-2018: 7 students (versus 5 outgoing)
- 2018-2019: 3 students (no outgoing)

"The strategy regarding the Textile Major of this Master has to be more clearly defined with respect to the International Master of Textile Engineering. The number of students is too low. To encourage students for coming, all the efforts have to be pursued."

The MSc sustainable material science engineering focuses on the basics of materials, of which textile is just one case. Textile engineering on the other hand focuses entirely on textiles (materials, manufacturing and applications).

This topic has been discussed with students and the difference is clear for them. Both programmes clearly attract students with different interests. The international master attracts students who really want to pursue a career in the textile industry and/or who are interested by the specific international character. Material science attracts students who want to learn in depth about various materials.

For Textile Engineering, the students always consider their international experiences as very valuable and explicitly refer to the truly international spirit of the programme. The international experience facilitates multicultural understanding, increases intercultural awareness and allows multiperspective thinking. Networking possibilities are limitless and offer added value.

Efforts are made to organize encounters between 'Textile Engineering students' and 'Sustainable Materials Engineering students' to comment on experiences, to increase interaction and to inspire each other towards future experiences abroad.

The E-TEAM programme is also being revised in view of an Erasmus mundus application.

"The objective to do an industrial internship is to be encouraged. There is a very good industrial placement."

An Memorandum of Understanding [MoU] has been signed with Fedustria, the Belgian textile federation. This initiative has led to a good list of offers for internships.

The department organizes joint meetings with representatives from industry and all stakeholders involved (lecturers, academia, students, alumni). At these events, internship offers can be discussed via direct contacts. Company visits as such can also contribute and facilitate interaction.

Appendix A

Below, as explained in the Introduction, the follow-up of the CTI-recommendations for the ***Master of Science in de ingenieurswetenschappen: scheikunde – Master of Science in Chemical Engineering*** did not obtain the "admission par l'Etat", the faculty invited the programme committee is presented.

General appreciation of the CTI report:

The programme committee for chemical engineering appreciates the efforts spent by CTI and carefully considered how to mitigate the recommendations made. It has resulted in numerous meetings in which plans have been drafted for concrete actions. The plans have subsequently been assessed by the various stakeholders of the programme, not only the internal ones such as students, teaching staff, support staff but also the external ones such as representatives from the industry. All these efforts resulted in the following replies to the remarks made by CTI. It deserves to be mentioned that the chemical engineering programme did not achieve the 'mention par l'état' on the occasion of the last evaluation. Even if the programme committee was convinced about the benefits of submitting separate files to obtain this 'mention par l'état', after a consultation with the other programmes that did not achieve this label, it was decided that none of these programmes would submit any files. As a result, the Chemical Engineering master programme at Ghent University, decided nevertheless to include a report on their activities since the last evaluation in this round.

Detailed explanation about the remarks:

Establish an ambitious vision for the future of the Chemical Engineering Master

A twofold answer to this remark is made. In the first instance, the ambitions or goals of the programme are explicitly discussed in the course catalogue of Ghent University. This text about the programme has been update to better situate the Ghent University programme in chemical engineering in a global view. The particular focus on reaction and reactor engineering, in which the Laboratory for Chemical Technology, i.e., the laboratory to which most of the teaching staff from the chemical engineering programme belongs, is explained. With, among others, 3 ERC grantees, a Methusalem grant holder, coordination of European large-scale integrated projects, the LCT at Ghent University hosts a set of world class scientists that also want to share their knowledge with students for them to be able to bring innovation to industry. The many bilateral collaborations, historical and recently developed, with industrial partners deserves to be mentioned in this respect.

In second instance, this remark may or may not have resulted from the following part of the CTI report:

"The number of students is decreasing despite numerous job opportunities in Belgium. It has been quite high for the past three years reaching 24-34 students but now the typical average is around 15-20 students/year. Increasing the number of students didn't appear to be a priority to the programme coordinators and the teaching staff for whom the quality of students enrolled was the first criteria. Some apprehension was even expressed that they may face difficulties to handle an increased number of students in terms of workload."

The chemical engineering programme committee wants to stress that it aims higher than the longstanding historical average. The faculty staff available at the time of the CTI visit was effectively able to handle the workload of an increased number of students to 24-34. The statement cited above was made to clarify that a further extension of the staff was a prerequisite prior to trying to further extend the number of students. Of course the ambition of the programme committee was to at least

maintain these higher number of students as compared to the historical average. With time now, some new faculty staff has been hired, , such that a further increase of the number of students can be envisaged.

Clarify students recruitment strategy

Currently the foreign students recruitment strategy is shared between the central services from the faculty and the Programme Committee of Chemical Engineering. The roles and expectations from both parties have been agreed upon. This results in a standard process from application till approval or rejection. The following steps have been implemented:

1. Central services receive an application
2. Central services prepare initial documents to summarize all data in the application
3. Central services give a motivated suggestion of approval/rejection
4. Programme committee receives all documents, summary and motivated suggestion
5. Programme committee performs first screening. If negative, the procedure stops, a negative advice is given to the central department, after which the applicant receives a rejection e-mail. If positive, the following step is taken.
6. A skype interview is done with all suitable candidates. In this interview, the student's knowledge and motivation is tested.
7. Based on the skype interview, the programme committee gives a positive or negative advice to the central services.
8. Central services send approval/rejection to the applicant.
9. In some cases, scholarships can be granted to exceptional students. A suggestion is given by the programme committee, but the final decision is taken by the central administration of Ghent University or in some scholarships a part of the Flemish or Belgian government.
10. Applicant applies or does not apply for the MSc of Chemical Engineering.

To promote the programme also a few steps have been taken, which are described in the next paragraph.

Actively promote the programme both in Belgium and abroad

To promote the programme in Belgium and abroad, a series of flyers and posters have been made. These are shown and distributed in Belgium at student recruitment events at Ghent University and beyond, e.g., SIDin information days organized by the government. Also during open days, these flyers are distributed among the visitors to the lab. During these events, professors, PhD students and master students are present to be able to provide all potentially required information to possible students that want to enroll for the master of chemical engineering. Interested students and their family have access to the lab on such days and get to see working installations on which students perform exercises or their master thesis. A series of posters, made for international conferences but also by students themselves as part of the evaluation of the cross-course project (3rd bachelor year) are on display within the lab to clearly demonstrate what kind of activities are performed as well as their societal relevance.

One of the faculty members within the Laboratory for Chemical Technology devotes part of his time to internationalization of the programme and research in chemical engineering at Ghent University. Currently, the first foreign students completed their masters in chemical engineering at Ghent University and more foreign students apply for a full masters programme instead of just one semester.

Further develop outbound mobility

Currently, outbound mobility is limited due to the fact that students can only go abroad in the first semester of the first master year. This obliges students to apply for e.g. an Erasmus exchange a year in advance, when they are still in their final bachelor year. Hence, students that have not yet decided which master programme they want to follow, are automatically not able to go abroad to study.

Currently the programme committee is working on adaptations in the study programme which, among others, should more easily allow students to go abroad in other semesters of the master in chemical engineering to be able to provide more flexibility in the outbound mobility timing during the master programme.

It deserves to be mentioned that, apart from studying abroad for a semester, it is also possible to perform an international internship at a company or a university abroad. This possibility is taken by a few students, but most students tend to prefer internships in Belgium, as the chemical industry is quite well developed and contributes to about 10% of the gross annual turnover.

Increase the awareness of process safety throughout this programme

At the time of the evaluation by the CTI, the mandatory course covering safety was taught in a highly mathematical manner. Nevertheless, part of the course was already brought via guest lectures by representatives from the industry. In the meantime, this course has been taken over by a young faculty member who delivers the course from a much more application oriented point of view.

Additionally, a totally new (elective) course has been implemented in collaboration with Essenscia, the Belgian Federation for Chemistry and Life Sciences industries: “Process Safety: Reactor Technology, Intrinsic Hazards and Process Safety Hazard Analysis (E073770)”. This course is taught by a variety of both professors from Ghent University and industrial representatives. The audience comprises both master students in chemical engineering (who can attend this course for free) and representatives from industry (who are paying participants). It creates a unique opportunity for the students, not only to get exposed to the burning topics with respect to safety in the industry, but also to see how persons from the industrial practice take up the message conveyed by the course and how they react on what is being said. It results in a truly unique and broad view of process safety and examples to reach a fundamental basis for safe operation and analysis in chemical plants.

Include a hands-on execution phase to company project

The company project is a course where the students need to combine knowledge they obtained from various courses into an industrially relevant project. A lot of projects are focused on the conceptual stage of design improvements or totally new concepts. During the projects, the students need to define some hypotheses to check the economical and practical feasibility of different options.

The experimental (hands-on) work that is performed as part of the programme is situated in courses such as Unit Operations, Polymers, Organic Chemistry, Chemical Reactors… and should be adequately addressed in these courses.

A similar ‘execution phase’ at the company site as part of the company project is not realistic because of the nature, scale and timing of the projects. The hands on or execution phase in the case of the company project has been ensured by a more intensive feedback from the companies that have proposed the subjects that are elaborated by the students. It allows the students to achieve a better feeling about the industrial partners and their expectations.

Actions for the near future:

Right now, the actions of the programme committee for chemical engineering are mainly focused on a change of the bachelor programme in chemical engineering and material sciences. Because of changes in the faculty staff involved in the programme and, of course, in order to prepare the programme for the future, an update of the present programme was required. Four reference groups have been defined in order to focus on aspects such as analytical techniques, kinetics and balances, thermodynamics and innovative techniques. A proposal is currently being prepared that should start in the academic year 2020-2021. Subsequently, correspondingly adapted master programmes will be established.

ANNEX A.22 DOE: guest lectures and project week

In the first year of the Bachelor of Science in Engineering programmes, the students encounter two project courses. During the first semester, they work in groups of about four students on a technical project within the course 'Modelling, Making and Measuring' (MMM). In the second semester the group investigates the result of their MMM project from a sustainable, entrepreneurial and ethical point of view. In Dutch the name of the second-semester course is 'Duurzaamheid, Ondernemerschap en Ethiek', hence the abbreviation 'DOE'.

Structure of the course

The DOE course consists of two parts. The (guest) lectures in the first week of the semester serve as a run up to the DOE project week.

Guest lectures

After a first lecture on the general structure of the course, the students follow three times two interactive lectures on the three societal topics which form the backbone of the course.
On each of the Sustainability, Entrepreneurship and Ethics topics an introductory lecture is given by a corresponding stronghold co-lecturer. This way students get a clearer view on the complex and nuanced reality behind each of the topics. After each of these lectures, the students have to answer some low-level questions on the online learning platform in order to verify whether they paid attention. In a second lecture some aspect of the broader topic is deepened or an industry professional shows how companies put it into practice and what difficulties they encounter.
The various lectures serve as input for the students to investigate how each of the societal themes applies to the result of their MMM project. After the thematical lectures the groups consider which DOE aspects of their MMM project they want to elaborate on during the project week. In a final lecture the students are taught how to give an elevator pitch and they put it into practice by pitching their intentions for the DOE week the week after. During these pitches, all students get peer feedback from their fellow students using a generic questionnaire assessing the building blocks of a qualitative pitch.

Project week

The focus of the DOE course is the project week which culminates in an 'engineering festival' where the project groups present the results of their investigations during the DOE week. During this week all other bachelor courses are suspended so the students can fully concentrate on the DOE project.
The DOE week starts with a multitude of interactive workshops connected to the themes Sustainability, Entrepreneurship, Ethics and Communication. Beforehand all project groups received a list with the workshops that are offered through the project week and were asked to select those of their interest (i.e. those workshops that apply most to the intentions they had with their MMM project). The list consisted of three to four deepening workshops on aspects of the societal topics and several communication workshops connected to the possible formats the students could present their results in during the engineering festival at the end of the DOE week.
All of these workshops were explicitly hands-on, which had its repercussions on the number of students each workshop could handle and the number of times it was offered. The topics ranged from performing a life cycle analysis over making a business plan and applying GDPR legislation all the way to the basics on making a podcast. During the first days of the project week, each of the students participated in at least three workshops.
As the DOE week progressed, the workshops made room for genuine group work. The members of the project groups put together what they learned during the lectures and the workshops and applied this distributed knowledge to their MMM project. When they encountered specific questions or doubted on the steps they were taking, the groups could consult the stronghold co-lecturers and their collaborators during their office hours.

In order to keep track of the progress of the groups and detect possible problems in their collaboration, the groups had to fulfil a small assignment at the end of each day. Some of the assignments had to be performed in group, such as 'give feedback on three of the workshops you participated in' and 'send in a picture of all group members during a relax moment'. Others were intended to be answered by each of the students individually, e.g. 'do you agree on every member of your group receiving the same score for the project week'.

Engineering festival

The DOE week culminated in an 'engineering festival' where all groups showed the results of their investigations during the project week.
Each group had to hand in two products: one focusing on the investigation they performed w.r.t. their MMM-project, the other one revealing the path they followed to get there (this part could be a little less serious). Beforehand they had chosen in what formats they would present their work (presentation / podcast / video clip / poster / website /…), though a video clip was expected from each group. The group could choose itself whether the clip showed the product or the process.
During the engineering festival, all groups had a designated time slot to show their work. The festival took place in the foyer and several auditoria of the campus (as well as online, due to COVID-19). Groups that made a poster or a website were asked to make sure that there always was one of the group members next to their product to explain their work, while the others could freely visit the products of the other groups. Groups that chose a presentation or podcast were asked additional questions by fellow students and faculty staff.
The DOE course makes a start with the different learning pathways that form a backbone through the whole bachelor programme: 'sustainability', 'entrepreneurship', 'ethics' and 'communication'.

Impact of the coronavirus pandemic

Because of COVID-19, the first edition of the DOE course differed slightly from what was initially intended. Some of the biggest modifications were the following:

- the guest lectures were performed online. Nevertheless interaction was still possible through voting tools. Also it turned out that the students didn't hesitate to use the chat for asking some profound questions.
- some of the workshops during the DOE week had to be offered online. To that end a virtual venue was created in 'Gather.town', a proximity based chat tool. The space also offered a private collaboration room to each of the project groups.
- visits and excursions to companies in the neighborhood of the campus were not possible. Being able to see how they put the societal themes into practice, seems an interesting add on for further editions.
- during the engineering festival, all groups received specific time slots to be present at the on campus and the online festival. By alternating their presence, the reduced capacities of the auditoria could be respected.
- the engineering festival was intended to be a happening for a broader public, including faculty staff and high school students from schools close-by.
- the evening programme was kept low profile with an online quiz and an online needlework introduction organized by student association VTK.

Overall conclusion

The final competences of the DOE course were formulated as follows:

> *Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.*

Despite the pandemic, these competences have still been achieved successfully thanks to the flexibility of everyone involved (both students and lecturers).

AP/ATP-BELEIDSCOMMISSIE

OPERATIONELE DOELSTELLINGEN BINNEN DE UNIVERSITEITSBREDE BELEIDSKEUZES

ACADEMIEJAREN 2019 - 2020; 2020 - 2021; 2021- 2022

DATUM
28 maart 2019

AANWEZIG
El-Houssaine Aghezzaf, Francis Begyn, Herwig Bruneel, Patrick De Baets (voorzitter), Hendrik De Bie, Koen De Bosschere, Gert De Cooman, Marijke De Keyser, Dirk De Meester, Hennie De Schepper, Filip De Turck (secretaris), Marybeth Defrance, Bart Dhoedt, Dagmar D'hooge, Luc Dupré, Peter Guns, Christophe Leys, Sven Rogge, Kurt Stockman, Peter Troch, Kevin Van Geem, Casper Van Gheluwe, Roger Van Hecke, Hendrika Van Nieuwenhove, Veronique Van Speybroeck, Jo Verhaevert, Joris Walraevens

VERONTSCHULDIGD
Pieter-Jan Boeykens, Nele De Belie, Geert De Schutter, Paul Kiekens, Jeroen Lauwaert, Johanna Louwagie

1 GEVOLGDE PROCEDURE

Een eerste informele vergadering met opdrachthouder Geert De Soete, academisch beheerder Mike Nachtegael en het faculteitsbestuur Ingenieurswetenschappen en Architectuur vond plaats op 28 november 2018[1]. Tijdens deze vergadering werden het algemene concept en de bedoelingen van de universiteitsbrede beleidskeuzes besproken. Ook werd reeds een eerste gedachtewisseling gewijd aan mogelijke concrete beleidskeuzes die voor de faculteit Ingenieurswetenschappen en Architectuur van toepassing zouden kunnen zijn.

Op 11 januari 2019 keurde de Raad van Bestuur het bestuursdocument over de universiteitsbrede beleidskeuzes goed. Aan de faculteiten werd gevraagd om tegen uiterlijk 5 april 2019 vijf operationele doelstellingen te formuleren die aansluiten bij minstens drie universiteitsbrede beleidskeuzes.

Op 15 januari 2019 werd door de decaan aan de vakgroepvoorzitters gevraagd tegen 1 maart 2019 een regulier beleidsplan op te maken voor de periode 2019 tot 2024, en ter gelegenheid daarvan ook suggesties te formuleren met betrekking tot de universiteitsbrede beleidskeuzes.

Tijdens de vergadering van het facultair bestuur van 15 februari 2019[2] werd een eerste set van mogelijke doelstellingen gekoppeld aan de universiteitsbrede beleidskeuzes opgesteld voor de faculteit Ingenieurswetenschappen en Architectuur.

Tijdens de vergadering van de Academische Strategische Adviesraad van 25 februari 2019[3] werden uit deze set enkele universiteitsbrede beleidskeuzes en doelstellingen prioritair gesteld voor de faculteit Ingenieurswetenschappen en Architectuur.

Een tweede informele vergadering met opdrachthouder Geert De Soete, vergezeld van logistiek beheerder Jeroen Vanden Berghe, werd georganiseerd op 1 maart 2019[4]. Ter voorbereiding van deze bespreking werd door het facultair bestuur een document met exhaustieve opsomming van concrete doelstellingen (inclusief indicatoren) opgemaakt. Datzelfde document werd vervolgens ook besproken in de vergadering van de facultaire AP/ATP-beleidscommissie op 11 maart 2019[5]. De door de AP/ATP-beleidscommissie prioritair gestelde doelstellingen werden voor een eerste maal informeel besproken tijdens de faculteitsraad van 21 maart 2019. De facultaire AP/ATP-beleidscommissie wijdde tijdens de vergadering van 28 maart 2019 een tweede bespreking aan dit onderwerp wat uiteindelijk heeft geleid tot dit verslag.

[1] Aanwezig: Patrick De Baets, Geert De Soete, Filip De Turck, Mike Nachtegael, Hendrika Van Nieuwenhove

[2] Aanwezig: Patrick De Baets, Gert De Cooman, Hennie De Schepper, Filip De Turck, Charlotte Louwagie, Hendrika Van Nieuwenhove

[3] Aanwezig: Herwig Bruneel, Patrick De Baets, Koen De Bosschere, Gert De Cooman, Hennie De Schepper, Geert De Schutter, Herbert De Smet, Bjorn De Sutter, Filip De Turck, Wim De Waele, Luc Dupré, Leo Kestens, Patrick Segers, Heidi Steendam, Dirk Stroobandt, Veronique Van Speybroeck, Kim Verbeken, Sabine Wittevrongel

[4] Aanwezig: Patrick De Baets, Gert De Cooman, Hennie De Schepper, Geert De Soete, Filip De Turck, Jeroen Vanden Berghe

[5] Aanwezig: El-Houssaine Aghezzaf, Pieter-Jan Boeykens, Herwig Bruneel, Patrick De Baets (voorzitter), Hendrik De Bie, Koen De Bosschere, Gert De Cooman, Hennie De Schepper, Geert De Schutter, Filip De Turck (secretaris), Marybeth Defrance, Bart Dhoedt, Luc Dupré, Paul Kiekens, Jeroen Lauwaert, Christophe Leys, Sven Rogge, Kurt Stockman, Peter Troch, Hendrika Van Nieuwenhove, Veronique Van Speybroeck, Jo Verhaevert, Joris Walraevens

2 UNIVERSITEITSBREDE BELEIDSKEUZES

De faculteit Ingenieurswetenschappen en Architectuur voert sinds vele jaren een strategisch beleid gericht op het verstrekken van kwaliteitsvol onderwijs en het uitvoeren van toonaangevend onderzoek.

Binnen deze visie en strategie werkte de faculteit ook al (impliciet) aan het realiseren van de thans door het bestuur geformuleerde universiteitsbrede beleidskeuzes. Om die reden kan de faculteit alle universiteitsbrede beleidskeuzes onderschrijven en concrete acties aangeven die ze nu al plant of zelfs uitvoert. Op expliciete vraag van het universiteitsbestuur selecteert de faculteit Ingenieurswetenschappen en Architectuur nu in prioriteit drie universiteitsbrede beleidskeuzes waarop ze de komende drie academiejaren wil inzetten, evenwel zonder afbreuk te doen aan de overige beleidskeuzes, noch aan haar algemene beleidslijn aangaande kwaliteitsvol onderwijs en onderzoek. Het betreft de beleidskeuzes **activerend leren, talentontwikkeling** en **duurzaamheid**. Binnen het geheel van deze beleidskeuzes formuleert de faculteit de volgende vijf concrete operationele doelstellingen met bijbehorende descriptoren.

3 OPERATIONELE DOELSTELLINGEN

3.1 Activerend leren

3.1.1 De DOE!-week als bekroning van het eerste bachelorjaar ingenieurswetenschappen

ACHTERGROND

De opleiding ingenieurswetenschappen (burgerlijk ingenieur) is een brede opleiding die een combinatie biedt van een grondige wetenschappelijke/wiskundige vorming en een hoogstaande technologische vorming, en die beoogt de burgerlijk ingenieur te vormen tot een conceptueel-analytisch ingenieur. De opleiding is gericht op het bestuderen van het hoe en het waarom van systemen, machines en installaties. Naast een diepgaande studie van basisvakken (wiskunde, natuurkunde, scheikunde) is er ook een belangrijk pakket aan algemene ingenieursvakken over de specialiteiten heen (bv. informatica, thermodynamica, mechanica van materialen, enz.) en gespecialiseerde ingenieursvakken volgens de gekozen afstudeerrichting. Minstens even belangrijk is de projectlijn die doorheen de volledige opleiding wordt geweven. Daarbij brengen de studenten door het uitvoeren van gespecialiseerde of vakoverschrijdende projecten de aangeleerde kennis in de praktijk. Deze projectlijn start met een eerste (inleidend) projectvak in het eerste bachelorjaar. Hier leren de studenten een eenvoudig ingenieursvraagstuk aan te pakken, niet alleen op papier maar ook door middel van een fysiek ontwerp waarop ze experimenten en metingen kunnen uitvoeren. Ook moeten ze over hun ontwerp zowel schriftelijk als mondeling rapporteren.

DOELSTELLING

Binnen het kader van het activerend leren willen we de projectcomponent in het eerste bachelorjaar meer gewicht en ook meer zichtbaarheid geven. Het projectvak dat nu in één semester wordt afgewerkt, zal daarom worden uitgebreid tot een jaarvak. De eerste fase van het project (grosso modo samenvallend met het eerste semester) zal nog steeds focussen op de ontleding van een eenvoudig ingenieursvraagstuk, het fysiek ontwerp van een oplossing en een inhoudelijk correcte

doch toegankelijke rapportering. In de tweede fase (begin tweede semester) zal aandacht besteed worden aan de wiskundige modellering van het probleem, waarbij dieper wordt ingegaan op de verschillen tussen theorie (het wiskundig model) en praktijk (het ontwerp). De derde fase van het project moet dan uitmonden in de zogenaamde DOE!-week (Duurzaamheid – Ondernemen – Ethiek) die rond de paasvakantie zal worden ingepland. Tijdens deze derde fase wordt aan de studenten gevraagd hun project te onderwerpen aan een grondige analyse binnen twee van de drie vermelde thema's: duurzaamheid, ondernemen en ethiek. Deze analyse moet dienen als uitgangspunt voor een concrete activiteit: opnemen van een filmpje, maken van een website, poster of blog, opstellen van een businessplan, … Om dit soort van activiteiten mogelijk te maken en de studenten in staat te stellen de nodige vaardigheden hiertoe te verwerven, worden tijdens de DOE!-week de reguliere lessen vervangen door lezingen, workshops en trainingen. Ook is het de bedoeling op dat moment verbanden te leggen tussen de projecten onderling, de link te leggen met andere vakken in het eerste bachelorjaar, in te spelen op de actualiteit, of simpelweg ruimte te maken voor onderwerpen waarvoor binnen het reguliere programma geen plaats is.

Op die manier worden de ingrediënten van het project dus: analyse en opsplitsen in deelproblemen, mathematisch modelleren, ontwerp en constructie van fysische modellen, uitvoeren van metingen, vergelijking van experimentele resultaten en theoretische berekeningen, schriftelijke en mondelinge rapportage.

Op het einde van de DOE!-week wordt een evenement georganiseerd (bijvoorbeeld een tentoonstelling, een symposium, een beurs, enz.) waarop de studenten het resultaat van hun werk aan een breder publiek kunnen presenteren.

DESCRIPTOREN / INDICATOREN

- programmawijzigingen en aangepaste studiefiches van de vakken in het eerste bachelorjaar ingenieurswetenschappen met het oog op het invoeren van het jaarvak 'ingenieursproject I' en de DOE!-week
- organisatie van de eerste editie van de DOE!-week: april/mei 2021

3.1.2 Herwaardering van het praktisch profiel en versterking van de werkveldcomponent in de opleiding industriële wetenschappen

ACHTERGROND

Tijdens de besprekingen over studieduurverlenging van de opleidingen industriële wetenschappen (industrieel ingenieur) is meermaals aan bod gekomen dat er moet worden gewaakt over het onderscheid tussen de profielen van de industrieel ingenieur en de burgerlijk ingenieur. Daar waar de burgerlijk ingenieur een concept-ingenieur is, gericht op kenniscreatie en met veelvuldig contact met de onderzoekswereld, is de industrieel ingenieur veeleer een applicatie-ingenieur, gericht op kennistoepassing en met veelvuldig contact met het werkveld. Ten gevolge van de academisering en integratie van de vroegere hogeschoolopleiding van industrieel ingenieur is de focus van de opleiding in zekere mate afgedreven van het applicatieve karakter naar een meer fundamenteel en conceptueel karakter. Daardoor is het profiel van de industrieel ingenieur geëvolueerd naar iets minder praktisch georiënteerd dan vroeger en sluit het minder aan bij de behoeften en verwachtingen van de bedrijfswereld.

DOELSTELLING

We wensen de praktijkgerichte component van de opleiding industrieel ingenieur opnieuw te verstevigen en het contact met het werkveld te intensifiëren, en dit binnen de huidige studieduur van

4 jaar. Dat zal gerealiseerd worden door een aanpassing aan hoofdzakelijk het bachelorprogramma waarbij de vormende component in de basisvakken tot zijn essentie zal worden gereduceerd ten voordele van de utilitaire component. Hetzelfde geldt voor de verschillende ingenieursvakken, waar eveneens de praktijkgerichte component zal worden versterkt. Deze inhoudelijke beweging zal mede ondersteund worden door een aanpassing van de werkvormen naar meer praktische oefeningen en laboratoriumoefeningen. Daarnaast wensen we een industriële stage structureel in het studieprogramma in te voeren; dit vergt uiteraard het uitbouwen van een ruim netwerk aan bedrijven die kwaliteitsvolle stages voor onze studenten kunnen aanbieden. Een correcte administratieve opvolging en een adequate kwaliteitsbewaking van het werk van de student-stagiair zullen ook moeten worden verzekerd, met het oog op een optimale didactische meerwaarde. Tot slot willen we ook zoveel mogelijk bachelor- en/of masterproeven aanbieden die in samenwerking met bedrijfspartners worden uitgevoerd. Hier geldt uiteraard dezelfde opmerking met betrekking tot de administratieve en inhoudelijke procesvoering.

DESCRIPTOREN / INDICATOREN

- programmawijzigingen en aangepaste studiefiches van de opleidingsonderdelen in het (bachelor)programma industriële wetenschappen vanaf het academiejaar 2021-2022
- aangepaste werkvormen in de opleiding industriële wetenschappen vanaf academiejaar 2021-2022
- studiefiche van het nieuwe structureel ingevoerde vak stages vanaf het academiejaar 2022-2023, met adequate administratieve ondersteuning en kwaliteitsbewaking
- aangepaste studiefiche voor de bachelor- en/of masterproef voor de opleidingen industriële wetenschappen met expliciete samenwerking met de bedrijfswereld vanaf het academiejaar 2023-2024

3.2 Talentontwikkeling

3.2.1 Excellentieprogramma

ACHTERGROND

Aan de UGent wordt een universiteitsbreed honoursprogramma (de Quetelet-colleges) aangeboden aan talentvolle en gemotiveerde studenten die naast hun normale curriculum intellectuele uitdagingen wensen aan te gaan buiten het eigen studiegebied. In sommige faculteiten bestaan ook soortgelijke programma's, al dan niet faculteitsoverschrijdend, die verdiepend of verbredend van karakter zijn. Aan de faculteit Ingenieurswetenschappen en Architectuur bestaan zulke programma's vooralsnog niet. Nochtans is er bij de studenten een groot potentieel aan talent aanwezig, dat door de industrie en de maatschappij in de ruime zin sterk begeerd is. De faculteit wenst deze getalenteerde studenten de mogelijkheid te geven hun intellectuele en technisch-wetenschappelijke vaardigheden te ontwikkelen met het oog op economische en/of maatschappelijke valorisatie door hen de kans te bieden brede maatschappelijke problemen te bestuderen en innovatieve, semi-technische oplossingen ervoor te bedenken. Erg belangrijk is ook om tegelijkertijd het samenwerken in groep, sociale vaardigheden en leiderschap te bevorderen in een multidisciplinaire context. Met het verwerven van deze extra competenties worden deze topstudenten voorbereid en aangemoedigd om belangrijke en impactvolle maatschappelijke posities in te nemen.

DOELSTELLING

De faculteit wenst een tweejarig, vakgebiedoverschrijdend, excellentieprogramma met technisch-maatschappelijke inslag voor topstudenten op te richten. Het programma "Innovation for Society" zal worden opgebouwd in twee fases die over het tweede en derde bachelorjaar van de reguliere

opleiding lopen. In de eerste fase krijgen de studenten de opdracht om in kleine teams innoverende en veelzijdige oplossingen voor een belangrijk hedendaags maatschappelijk probleem te bedenken.
Na de voorstudie onderwerpt de volledige groep honoursstudenten de voorgestelde oplossingen aan een grondige vergelijkende studie (waarbij de haalbaarheid, de economische kostprijs, e.d. worden gekarakteriseerd). Op basis hiervan wordt een selectie gemaakt van de beste oplossingen naar functionaliteit, effectiviteit, rendement, economische, technische en/of politieke haalbaarheid, enz.
In de tweede fase van het programma worden de geselecteerde oplossingen vervolgens opnieuw in team verder concreet uitgewerkt. Bij voorkeur zouden de teams multidisciplinair samengesteld zijn, en indien mogelijk met studenten van verschillende faculteiten. Het draagt dus onze voorkeur weg het programma interfacultair uit te werken; mogelijke partners hierbij zijn de Faculteit Bio-Ingenieurswetenschappen, de Faculteit Economie en Bedrijfskunde en de Faculteit Wetenschappen maar ook andere faculteiten kunnen betrokken worden.

Ter ondersteuning van deze uitdagende opdracht biedt de faculteit deze studenten een waaier van lezingen aan met aansluitende discussie over innovatie, disruptie, strategie, denktanks, leiderschap en ondernemerschap. Daarnaast scherpen we hun creatieve vaardigheden verder aan met onder andere schrijf- en presentatie-opdrachten. Mogelijke programmathema's zijn duurzaamheid op de ingenieurscampus, mobiliteit in Gent/België, veilig drinkwater voor ontwikkelingslanden, klimaatvriendelijk transport van goederen, e.d.

DESCRIPTOREN / INDICATOREN

- het programma wordt uitgewerkt tijdens het academiejaar 2020-2021
- het programma vangt aan in het academiejaar 2021-2022

3.3 Duurzaamheid

3.3.1 Duurzaamheid als backbone in het onderwijs

ACHTERGROND

De studieprogramma's van de faculteit Ingenieurswetenschappen en Architectuur zijn opgesteld volgens een traditioneel concept met een centrale technisch-wetenschappelijke ruggengraat. De techniek en de technologie staan, zoals het ook hoort, voorop. Een nadeel van deze benadering is dat het concept van duurzaamheid, dat om evidente redenen aan maatschappelijk belang wint, minder sterk uit de verf komt. Hoewel duurzaamheid vanzelfsprekend aan bod komt in een waaier van vakken, gebeurt dit vaak op een impliciete en onvoldoende visibele manier. Omwille van het onmiskenbare belang van duurzaamheid in de breedste zin van het woord (energierendement, hernieuwbare energie, levensduur, recycleerbaarheid, grondstoffenbeheer, enz.) verdient dit thema op een meer zichtbare en prominente wijze te worden geïntegreerd in de studieprogramma's. Met respect voor en zelfs ter versterking van het technische karakter van de studieprogramma's van industrieel ingenieur, burgerlijk ingenieur en burgerlijk ingenieur-architect, moet het mogelijk zijn om een rode draad van duurzaamheid zichtbaar door de studieprogramma's te weven, door duurzaamheidsaspecten op een overlegde manier aan bod te laten komen in verschillende opleidingsonderdelen, door enkele vakken in het leven te roepen die rond duurzaamheidsthema's zijn gecentreerd en door het duurzaamheidsdenken in de projectlijn een duidelijke plaats te geven.

DOELSTELLING

Op de eerste plaats zal worden nagegaan in welke opleidingsonderdelen duurzaamheidsprincipes kunnen worden geïntegreerd, en wel zodanig dat deze aspecten over de totaliteit van de vakken beschouwd een consistent geheel vormen. Daarnaast zal voor zowel de bachelor- als de

masteropleidingen bestudeerd worden of het nuttig en wenselijk is nieuwe plicht- en/of keuzevakken aan te bieden waarin duurzaamheidsthema's centraal staan. Daarenboven zal worden nagegaan hoe via de projectleerlijn de basisconcepten van duurzaamheid ingevoerd kunnen worden, onder meer door de projecten op te hangen aan duurzaamheidsthema's. De bedoeling van het geheel van deze aanpassingen is dat de toekomstige ingenieur een automatische reflex ontwikkelt voor duurzaamheid, voor het onderkennen van duurzaamheidsproblemen en voor het bedenken van duurzame oplossingen.

DESCRIPTOREN / INDICATOREN

- in elke opleiding wordt doorheen de vakken een rode draad van op elkaar afgestemde duurzaamheidsthema's geweven (in de syllabi, de hoorcolleges, de oefeningen en praktische cases) vanaf het academiejaar 2020-2021
- een set van duurzaamheidsvakken (plicht- en/of keuzevakken) wordt in alle opleidingen aangeboden vanaf het academiejaar 2022-2023
- het duurzaamheidsdenken wordt ingebouwd in de projectlijn (cfr. de huidige initiatieven in de opleidingscommissies OCingwWE, OCindwBa) vanaf het academiejaar 2020-2021

3.3.2 Naar een duurzame Faculteit Ingenieurswetenschappen en Architectuur

ACHTERGROND

De UGent zet sterk in op duurzaamheid in verschillende domeinen: energiebeheer, mobiliteit, voeding, aankoop- en materiaalbeheer, groenbeheer, enz. In de eerste plaats wenst de universiteit dit te realiseren door het duurzaamheidsdenken ingang te laten vinden in haar bedrijfsvoering. Het verzamelen en verspreiden van wetenschappelijke kennis legt hiervoor de basis, en sensibiliseringscampagnes verbreden vervolgens deze basis.
Uiteindelijk is het wel zo dat veel duurzaamheidsvraagstukken slechts afdoende beantwoord kunnen worden met technische oplossingen en hier spelen ingenieurs een cruciale rol. De faculteit Ingenieurswetenschappen en Architectuur meent dat ze in de vooropgestelde universitaire strategie een cruciale rol kan spelen, omwille van de veelheid aan technische competenties die ze in huis heeft. Om dit aan te tonen kiest de faculteit ervoor om alle nodige studies uit te voeren om van de Campus Ardoyen, die op termijn de volledige faculteit dient te huisvesten, een écht duurzame campus te maken.

DOELSTELLING

De faculteit Ingenieurswetenschappen en Architectuur wil van haar Campus Ardoyen een proeftuin maken voor het ontwerpen en uittesten van duurzaamheidsoplossingen. Conform de reeds goedgekeurde facultaire visie wil de faculteit volledig (met uitzondering van de opleidingen architectuur in het Gentse stadscentrum, biomedische ingenieurstechnieken op de campus UZ Gent, industrieel ontwerpen en machine- en productieautomatisering op de Campus Kortrijk) gehuisvest worden op de Campus Ardoyen, met inbegrip van alle onderwijs- en onderzoeksfaciliteiten en administratieve diensten. Dit betekent dat een populatie van om en bij de 5000 studenten naar deze campus zal overgebracht worden. Minstens één extra onderwijsgebouw zal nodig zijn met grote, maar vooral ook flexibele onderwijsruimtes. Om langdurig nuttig gebruik te kunnen maken van dit gebouw zal gedacht worden aan flexibel indeelbare leszalen, opdeelbaar en geschikt voor hoorcolleges, groepswerk en zelfstudie maar ook voor workshops en mini-symposia.

Nieuwe gebouwen zullen energieneutraal dienen te zijn en geoptimaliseerd met betrekking tot energieopwekking, isolatie, warmte- en koudeopslag, enz. Het iGent-gebouw kan als voorbeeld en studieobject ter zake dienen. Dit gebouw is immers uitgerust met veel sensoren die continu allerhande parameters meten (temperatuur, luchtvochtigheid, lichtintensiteit, stand van ramen en zonneweringen, ventilatiedebiet, aantal personen aanwezig in de ruimtes, enz.), maar een grondige analyse en bijsturing van de energievoorziening en ventilatie op basis van deze metingen gebeurt vooralsnog niet. De bedoeling is dat op basis van de vermelde metingen een optimaal gebouwbeheersysteem wordt uitgewerkt dat verlicht, ventileert, koelt of verwarmt in functie van de omgevingscondities en de behoeftes. Voor het ontwerp van zo'n gebouwbeheersysteem is een nauwe samenwerking met Directie Gebouwen en Facilitair Beheer (DGFB) noodzakelijk. De opgedane kennis kan door DGFB nuttig ingezet worden bij de realisatie van 'slimme gebouwen', zoals opgenomen in de planning.

Voor de verduurzaming van de campus dient verder ook een nieuw energiebeleid te worden gevoerd: energiebesparende maatregelen en eigen energieopwekking (zonnepanelen, warmtenet, windturbines) kunnen de CO_2-afdruk van de campus gevoelig naar beneden halen. Dit energiebeleid vergt natuurlijk heel wat voorbereidend werk waarvoor de wetenschappelijke staf van de faculteit kan instaan: de professoren en hun medewerkers verrichten (in nauwe samenwerking met de DGFB) voorbereidend studie- en ontwerpwerk en geven advies bij de praktische uitvoering. Daarenboven kunnen deelopdrachten ook als projectwerk of masterproeven voor de studenten worden uitgeschreven, wat ook de aantrekkelijkheid van de ingenieursstudies ten goede zal komen en het enthousiasme voor de studies zal aanwakkeren. Verder dient er de nodige aandacht besteed worden aan een duurzame mobiliteit naar en van de campus voor studenten en docenten, waarbij de fietsinfrastructuur, het openbaar vervoer en verkeersveiligheid mee in rekening gebracht worden.

DESCRIPTOREN / INDICATOREN

- een voorbereidende (technische) studie voor de verduurzaming van de Campus Ardoyen in samenwerking met de DGFB wordt opgesteld tegen eind 2021
- verschillende duurzaamheidsprojecten worden vanaf 2022 samen met de DGFB uitgewerkt