

**Decision no. 2016/09-12
pertaining to the State Admission
of Master's degrees from: Vrije Universiteit Brussel -
Faculty of Engineering Sciences of Vrije Universiteit,
Brussel – Belgium (VUB)**

Purpose:

Application G: 1st application for State admission of the following 8 study programmes at Vrije Universiteit Brussel from 1 September 2016:

- *Bachelor en sciences de l'ingénieur - Bachelor of Science in de ingenieurswetenschappen (VL) - Bachelor of Science in Engineering (EN)*
- *Bachelor en sciences de l'ingénieur : architecture - Bachelor of Science in de ingenieurswetenschappen: architectuur (VL) - Bachelor of Science in Architectural Engineering (EN)*
- *Master en sciences de l'ingénieur : architecture - Master of Science in de ingenieurswetenschappen: architectuur (VL) - Master of Science in Architectural Engineering (EN)*
- *Master en sciences de l'ingénieur en génie civil - Master of Science in de ingenieurswetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)*
- *Master en sciences de l'ingénieur en électronique et génie des technologies de l'information - Master of Science in de ingenieurswetenschappen: elektronica en informatietechnologie - Master of Science in Electronics and Information Technology Engineering*
- *Master en sciences de l'ingénieur en génie électromécanique - Master of Science in de ingenieurswetenschappen: werktuigkunde-elektrotechniek (VL) - Master of Science in Electromechanical Engineering (EN)*
- *Master en sciences appliquée et sciences de l'ingénieur : informatique appliquée - Master of Science in de ingenieurswetenschappen: toegepaste computerwetenschappen (VL) - Master of Science in Applied Sciences and Engineering: Applied Computer Science (EN)*
- *Master en sciences de l'ingénieur en chimie et génie des matériaux - Master of Science in de ingenieurswetenschappen: chemie en materialen (VL) - Master of Science in Chemical and Materials Engineering (EN)*

- Having regard to the French Education Code, particularly Articles L.642-7 and R642-9,
- Having regard to the request submitted by the Vice Minister-President of the Flemish Government and the Flemish Minister for Education,
- Having regard to the report prepared by: Gabriel HENRIST, member of CTI and panel chair
Anne-Marie JOLLY, member of CTI and co-chair
Bernard REMAUD, CTI expert and co-chair
Laurent BEDAT, Marie-Jo GOEDERT, Denis LEMAITRE, Jean-Jacques MAILLARD, Roland VIDIL, CTI experts
Danièle CHOUREY, André DE HERDE, Ludo GELDERS, J. WALRAVEN, Stéphane WOJCIK, international experts
Alexandre MILOT, student engineer expert
and presented in CTI plenary sessions held on 13 and 14 September and 11 October 2016,

3 Belgian universities (higher education institutions) asked to be audited by CTI in order to have their degrees recognised in France via the State admission procedure. This was their first application. These “**Master of Science in Engineering**” degrees are issued upon completion of a 5-year programme involving a 3-year general science and technology undergraduate degree followed by a 2-year specialisation resulting in the Master’s degree. The first cycle ends with the issuance of a “transitional” bachelor’s degree. 55 study programmes were examined based on the CTI R&O 2012 international standards, 2009 ESGs and EAFSG (EUR-ACE Master’s degree) standards.

The Commission des Titres d’Ingénieur (French engineering accreditation body) adopted the following decision:

General presentation

VUB is the Dutch-speaking offshoot of the French-speaking ULB, founded in 1834 by Théodore VERHAEGEN. Although some law courses were already being taught in Dutch in 1890, it was not until 1963 that almost all the faculties offered courses in Dutch. Following a political crisis, the francophone sections of KU LEUVEN split from the university in 1968 and the “Université Catholique de Louvain” was established on the new campus in Louvain-la-Neuve, VUB split off from ULB on 1 October 1969 and officially became a separate legal, administrative and scientific entity in May 1970.

During the 2013-2014 academic year, 15,444 students (Appendix 04_02) were enrolled in VUB’s 8 faculties. The Faculty of Engineering Science had 342 bachelor’s students, 609 masters and 354 doctoral students for a total of 1305 students.

This accreditation visit only applies to the Faculty of Engineering Science:

- 2 Bachelor’s programmes (180 ECTS credits): Bachelor of Engineering (238 students) and the Bachelor of Architectural Engineering (104 students). The language of instruction is Dutch.
- 8 master’s programmes (120 ECTS credits) with a total of 609 students (with 13 students in the "Master in Physical Land Resources" programme, 15 students in the "Master in Photonics Engineering" programme and 12 students in the "Master in Biomedical Engineering" programme not included in the audit. According to law in Flanders, these programmes are taught in English provided that equivalent courses are also offered in Dutch.

General characteristics

Like other faculties at VUB, the Faculty of Engineering Science manages its human and financial resources with a great degree of independence. It has eleven departments that are responsible for courses closely related to their scientific research.

A twelfth department, INDI (Industrial Engineering, SER page 7), is responsible for its Bachelor’s and Master’s programmes (240 ECTS). The audit did not cover this department.

Research is one of the pillars of the faculty. Department councils are responsible for the management of the departments. Education is a cross-disciplinary activity managed by the Faculty Education Committee and relies on the human resources and equipment provided by the departments.

The Faculty of Engineering Science receives financial resources mainly from private research funding from companies that use the research results. From 2009 to 2013, it received a total of €72.228 million in research grants, or a growing average of €14.5 million per year.

The general policy of the Faculty of Engineering Science is to “develop, transfer and apply high-quality academic education and scientific research, free from any form of preconception”.

Research-driven education is emphasised with a bottom-up approach to designing programmes.

This approach is based on the expertise of research teams and provides the latest cutting edge scientific knowledge. However this can be problematic for ensuring that engineering students acquire non-scientific and soft skills.

General analysis

Strengths

- *VUB is a research-driven university, which provides a first-rate scientific environment (both staff and equipment) for engineering studies.*
- *With the support of the university, the Faculty has a well-defined training policy centred on student competencies.*
- *Through the bottom-up, research-driven approach to designing programmes, graduates achieve a high level of scientific competency.*
- *Students are provided with a solid foundation of scientific training, enabling them to be versatile and seek a career with broad responsibilities in various fields.*
- *The overall structure of engineering education seems consistent with the Bachelor's degree, providing a strong common basis for all students and a system preparing students for the Master's programmes at the end of the Bachelor's degree.*
- *Inter-faculty collaboration and the number of interdisciplinary projects complement entrepreneurship courses.*
- *The faculty's academic staff have established mutually beneficial long-term relationships with industry.*
- *The Faculty of Engineering Science produces good research output that attracts enough funding to keep a good number of researchers on staff who can to be involved in teaching.*
- *Graduates find jobs easily and quickly as they take advantage of the high demand for engineers in Belgium.*
- *Students appreciate the fact that low numbers give them greater accessibility to teaching staff.*
- *A large-scale infrastructure project is in progress to build student housing, classrooms, and cultural facilities.*

Weaknesses

- *The Faculty relies strongly on the research departments, and therefore lacks a comprehensive view and proper management of non-scientific learning outcomes.*
- *The considerable independence of the programmes' departments leads to inconsistent implementation of Faculty policies.*
- *There seems to be some reluctance to involve all stakeholders (society, alumni, employers) in the formal supervision of programme content and outcomes.*
- *The high demand for engineers in Belgium does not motivate the staff to invest heavily in the employability of graduates (e.g. graduate follow-up, internship policies, exposing students systematically to non-academic work environments, etc.).*
- *The Faculty does not take full advantage of its geographical position, the status of and Brussels and its international reputation for the outbound mobility of its students and to attract the best foreign students.*
- *Soft skills such as Human and Social Science skills are supposed to be acquired through various learning experiences and projects throughout the programme. All or some of these skills could be taught by outside lecturers specialised in the relevant field.*
- *Professional experience should not be limited to non-mandatory internships.*

- *Administrative issues related to BRUFACE programmes and differences in VUB and ULB systems have been worked on and are one of the aspects of VUB's current action plan.*
- *The number of students enrolled in engineering studies is relatively low despite high demand for graduates in Belgium. Female student numbers are low, except for Architectural Engineering.*

Risks and opportunities

- Legal requirements related to teaching languages to be used could hinder the international development of the faculty, even if it has not been a problem to date.
- The staff's involvement in preparing the international accreditation deserves to be mentioned. Efforts need to be made to pursue their involvement in order to achieve long-term benefits.
- The highly successful BRUFACE programmes and other English-speaking Master's programmes offer a unique multicultural and multi-lingual experience that could be further developed.
- The faculty could pursue increased collaboration with other universities (ULB, Ghent University) to achieve same level as the BRUFACE "European Master in Photonics" and "Biomedical Engineering" programmes.
- Strategic partnerships with external stakeholders could increase VUB's financial resources and help it attract more students.

General presentation

VUB is the Dutch-speaking offshoot of the French-speaking ULB, founded in 1834 by Théodore VERHAEGEN. Although some law courses were already being taught in Dutch in 1890, it was not until 1963 that almost all the faculties offered courses in Dutch. Following a political crisis, the francophone sections of KU LEUVEN split from the university in 1968 and the "Université Catholique de Louvain" was established on the new campus in Louvain-la-Neuve, VUB split off from ULB on 1 October 1969 and officially became a separate legal, administrative and scientific entity in May 1970.

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--> 8 Masters of Engineering programmes (120 ECTS credits): with a total of 609 students (with 13 students in the "Master in Physical Land Resources" programme, 15 students in the "Master in Photonics Engineering" programme and 12 students in the "Master in Biomedical Engineering" programme not included in the audit.

Global characteristics

Like other faculties at VUB, the Faculty of Engineering Science manages its human and financial resources with a great degree of independence.

"The Faculty of Engineering has **eleven departments** that are responsible for the 300-ECTS Engineering course programmes closely related to their scientific research. A twelfth department, INDI (Industrial Engineering), is only responsible for the Bachelor and the Master courses in the 240-ECTS Industrial Engineering programme which are/is not covered by this report" (SER page 7)

Research is one of the pillars of the faculty. Department Councils are responsible for the management of the departments. Education is a cross-disciplinary activity managed by the Faculty Education Committee and relies on the human resources and equipment provided by the departments. The Faculty of Engineering Science receives financial resources mainly from private research funding:

"From 2009 to 2013, it received a total of €72.228 million in research grants, or a growing average of €14.5 million per year." (Appendix 7.4)

The general policy of the Faculty of Engineering Science is to "*develop, transfer and apply high quality academic education and scientific research, free from any form of preconception*" (SER page 1). Research-driven education is clearly emphasised, with a bottom-up approach to designing programmes.

This approach is based on the expertise of research teams. However this can be problematic for ensuring that engineering students acquire soft skills.

On top of this strong emphasis on research, the faculty of Engineering Science distinguishes itself through involvement in Education Science, professionalization of academic staff and the Department of Educational Affairs.

"Staff appointed to first-time teaching positions are required to receive teacher training (Appendix 1.13). The Department of Educational Affairs organises yearly workshops and lectures on educational themes and teaching techniques. Most members of the academic staff (ZAP or AAP) have participated in one or more of these workshops during their career". Topics have included: "Evaluating group work: peer and self-assessment", "Use of discussion forums in education", "Voice Techniques", "How do I motivate my students?", "Working with the electronic learning platform Pointcarré".

The faculty has worked on the learning outcomes expected from graduates. The description of competencies is completely in line with the Dublin descriptors for the three cycles of the Bologna Process and largely consistent with the competencies included in CTI and EUR-ACE standards. The competencies for learning units and teaching methods has been mapped out for each programme. However, coordination between this outcome-based strategy and the content-based approach described above can be improved. There is a potential imbalance in the arbitration between the portion dedicated to scientific skills required by research needs and resources, and the portion dedicated to "soft skills".

An important initiative is the monitoring of student pathways by a dedicated team.

The Self-Evaluation Report reflects some Culture of Quality Assurance with a dashboard.

We can find only one SWOC analysis of the whole institution in the last appendix 14.01.

The Panel opinion is that VUB would stand to benefit from conducting a SWOC analysis of each programme.

General analysis

Strengths

- VUB is a research-driven university, which provides a first-rate scientific environment (both staff and equipment) for engineering studies.
- With the support of the university, the Faculty has a well-defined training policy centred on student competencies.
- Through the bottom-up, research-driven approach to designing programmes, graduates achieve a high level of scientific competency.
- The overall structure of engineering education seems coherent with the Bachelor's degree, providing a strong common basis for all students and a system preparing students for the Master's programmes during the end stage of the Bachelor's degree.

- *Students are provided with a solid foundation of scientific training, enabling them to be versatile and seek a career with broad responsibilities in various fields.*
- Inter-faculty collaboration and the number of interdisciplinary projects complement master's courses on Entrepreneurship.
- The Faculty of Engineering academic staff have established mutually beneficial long-term relationships with industry.
- *The Faculty of Engineering Science produces good research output that attracts enough funding to keep a good number of researchers on staff who are involved in teaching.*
- Innovation is very efficient at VUB: 18 start-up companies have been created. They are still in the faculty environment and the technology transfer interface (TTI) provides them with strong support. The TTI department has been managing 51 of VUB's patents (alone or with IMEC) since 2004.
- VUB graduates find a job easily and quickly, thanks to the quality of the programmes and the high demand for engineers in Belgium.
- The strong interaction between teaching staff and students and the approachability of the teaching staff are part of the education vision of VUB. Students appreciate the fact that low student numbers give them greater accessibility to teaching staff.
- A large-scale infrastructure project is in progress to build student housing, classrooms, and cultural facilities.
- The Alumni Association is active in the organisation of internships and a yearly job fair. This generates informal contacts providing feedback from the alumni to the university.

Weaknesses

- *The Faculty relies strongly on the research departments, and therefore lacks a comprehensive view and proper management of non-scientific learning outcomes.*
- The considerable independence of the of faculty's departments for programme management leads to inconsistent implementation of Faculty policy.
- There seems to be some reluctance to involve all stakeholders (society, alumni, employers) in the formal supervision of the programme content and outcomes.
- The high demand for engineers in Belgium reduces the need to invest heavily in the employability of the graduates (e.g. graduate follow-up, internship policies, systematic exposure of students to non-academic work environments)
- The Faculty does not take full advantage of its geographical position, the status of Brussels and its international reputation for the outbound mobility of its students and to attract the best foreign students.
- Soft skills are supposed to be acquired through projects and other learning experiences. These skills could be taught by outside lecturers.
- Professional experience should not be limited to non-mandatory internships.
- Administrative issues related to BRUFACE and students having to deal with ULB and VUB systems have been worked on and are one of the aspects of the VUB action plan.
- The number of students enrolled in engineering studies remains low despite work to promote the programmes and ample job opportunities after graduation. Female student numbers are especially low, except for Architectural Engineering.

Risks and opportunities

- The legal requirements related to teaching languages to be used could hinder the international development of the faculty, even if it has not been a problem to date
- The staff's involvement in preparing the international accreditation deserves to be mentioned. Efforts need to be made in order to achieve long-term benefits.
- The successful BRUFACE initiative and the other English-speaking master's programmes offer a unique multicultural, multi-lingual learning environment and should be internationally developed.

- The Faculty could pursue increased collaboration with strategic partners (ULB, Ghent University, etc.) to achieve the education level of BRUFACE programmes, the European Master in Photonics and biomedical Engineering.
- Strategic partnership with external stakeholders could increase VUB's financial resources and help it attract more students.

Evaluation summary for each programme

Bachelor en sciences de l'ingénieur - Bachelor of Science in de ingenieurwetenschappen (VL) - Bachelor of Science in Engineering (EN)

The general aim of the Bachelor of Science in Engineering is to provide a broad-based scientific and technical educational foundation that prepares students for any master in engineering. For that purpose, more than two thirds of the programme is common and only part of Ba3 is dedicated to specialisation. Along with knowledge, students also acquire skills (communication, research, problem-solving, team work, etc.) and attitudes (being critical, life-long learning, awareness of ethical, social, ecological, and economic issues) that are important in the master's programme and in their future careers.

Graduates of the bachelor in engineering have in-depth knowledge in mathematics, physics, chemistry, mechanics, informatics, electricity and related technological disciplines such as material science, heat and mass transfer and electronics. Students must be able to implement the acquired knowledge to solve theoretical, experimental and technological problems. Important problem-solving skills include analytical reasoning, experimental skills, error calculation, programming, and numerical techniques. They must be able to retrieve specific information and assimilate it, to finally draw a conclusion taking into account ethical, ecological, economic and social aspects. The students need to perform well in a team and have the ability to communicate about their own ideas and to discuss things with others to come to a joint conclusion.

Panel opinion:

- The Bachelor Student Evaluation of the programme is quite positive.
- The real actual impact of learning outcomes on programmes and their assessment, for soft skills in particular, remains questionable.
- Student demand for a BRUFACE Bachelor programme has been noted.

Bachelor and Master in Architectural engineering

These 2 degrees constitute a 5-year integrated programme. The Bachelor's degree has no professional orientation, but is a step in the master's curriculum. The bachelor is therefore not eligible for the EUR-ACE accreditation.

Bachelor en sciences de l'ingénieur: architecture - Bachelor of Science in de ingenieurwetenschappen: architectuur (VL) - Bachelor of Science in Architectural Engineering (EN)

180 ECTS credits, taught in Dutch, 104 students (2013-2014)

The general aim of the Bachelor of Science in Architectural Engineering programme is to provide students with a broad level of competence and skills in architectural and engineering sciences.

Bachelor's students are provided with a broad scientific education based on the gradual acquisition of knowledge and skills, with attention to individual guidance and self-development. This is accomplished through a multidisciplinary approach, with a mutual integration of knowledge between courses at its core, supported by strong involvement of teaching staff and researchers. Many of the academic and teaching staff are involved in an architecture or engineering office, thereby providing the students directly with cutting edge theoretical knowledge and practical skills.

A firm training in fundamental sciences serves as the foundation for the acquisition of knowledge and skills related to engineering sciences and their application in the built environment. Teaching students to understand and critically reflect on the theory and history of architecture and on the criteria that can lead to sustainable solutions, provokes them to develop concepts that answer to current societal challenges. (SER, page 28)¹

Panel opinion:

- The Bachelor programme is intended to provide a broad and high level of teaching in the basic sciences, with a system which prepares students for their future Master programme.
- The Bachelor of Science in Architectural Engineering prepares students perfectly for the Master of Science in Architectural Engineering.

Master en sciences de l'ingénieur: architecture - Master of Science in de ingenieurswetenschappen: architectuur (VL) - Master of Science in Architectural Engineering (EN)

120 ECTS credits, taught English, 52 students (2013-2014)

The aim of the Master in Architectural Engineering programme is to train architectural engineers that understand the dynamics between architecture and engineering.

The programme is part of the BRUFACE programme with ULB and taught in English. The academic programme, intrinsically characterised by the integration of scientific research in education, is aimed at bringing students to an advanced level of knowledge and insight. They are trained in the inventive and creative application of engineering and architectural knowledge in complex assignments. Based on a self-developed vision, they can aptly integrate construction and architectural knowledge, practice and culture into projects of high standard.

A multidisciplinary teaching environment, enriched by academic researchers and experienced industry practitioners, provides the ideal backdrop for the transfer of cutting edge knowledge, hands-on experience and inspiration on how to deal with current and future societal challenges for the built environment, with attention to individual guidance and self-development. (SER page 52)

Analysis (specific to the department):

- The design studios which constitute an important part of the curriculum are run by practitioners who are part-time staff members. They have a limited amount of interaction with the full-time research-oriented academic staff.
- The department has relationships with its stakeholders, but they lack a more

¹ Here and below, the short descriptions of the programme are generally extracted from the Self-evaluation report

formal basis. Networking with alumni is not systematic.

- Outgoing international mobility needs to be promoted as well as the exposure to a non-academic work environment.
- International development policy has to be redefined with a clear strategy to attract more students, and in particular inbound-outbound mobility in general

Analysis (specific to the programme):

- The skills matrix that shows the relationship between courses and skills remains a little unclear and is one of the proposed areas for improvement.
- Teaching methods are designed to help students improve and develop innovative skills.
- Little room is left for non-scientific courses, such as optional courses that students are able to choose themselves. This aspect of the learning outcomes is less managed than the scientific aspect.
- The programme seems too focussed on individual work (little dialogue between students and teachers)
- There is a shared culture of student care.
- Lack of strategic vision and some problems projecting into the future. Planning actions must be undertaken to include architectural engineering in the priorities of the energy transition and the post carbon civilization.
- Medium term strategy needs to be defined.
- A quality assurance plan needs to be established involving all staff.
- Systematic investigations about graduates and networking for alumni should be improved.

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

120 ECTS credits, taught English, 30 students (2013-2014)

The aim of the Master in Civil Engineering (CE) programme is to provide a science-based, broad and multidisciplinary education in the design, building and maintenance of civil engineering projects with due regard for stability, safety, sustainability, cost and the environment. Civil engineering is amongst the broadest engineering disciplines; in a strongly varying economy. The graduates benefit from being CE generalists who have an attitude of life-long learning and are able to easily reorient themselves along the course of their career. This aim translates into quite generic Ba3 and Ma1 programmes, which mainly include in-depth training in building material technology, modelling, design and construction of all kinds of load bearing structures, geotechnics, and water management. In the 2nd Master, students have the possibility to specialise in one of three options: (i) *Structures*, (ii) *Construction- and Geo-materials*, and (iii) *Water Resources*. The three options are strongly based on the scientific research conducted within the involved departments. Through optional courses, students can further deepen their expertise in the chosen field, or broaden their knowledge e.g. in management and other corporate subjects, and perform an internship.

The programme aims to deliver responsible communicative professionals with a critical, analytical problem-solving attitude who can play a leading role in civil

engineering projects. Alternatively, the solid scientific background incorporated in the programme provides the optimal pathway to move on to research-oriented jobs, such as doctoral researchers preparing a PhD at a university. The large presence of lecturers from industry in the CE programme (9 external lecturers involved in the non-elective courses alone) ensures that students are exposed to the viewpoints of both academics and industry professionals, and that our young engineers can form a qualified opinion on socio-technological issues. (SER, page 34)

Analysis (specific to the programme):

- The programme should be more proactive in formalising its relationships with its stakeholders.
- A more varied range of elective courses should be offered to the students.
- Internships should be promoted as along with international mobility.

Master en sciences de l'ingénieur en électronique et génie des technologies de l'information - Master of Science in de ingenieurswetenschappen: elektronica en informatietechnologie - Master of Science in Electronics and Information Technology Engineering

120 ECTS credits, taught English, 25 students (2013-2014)

BRUFACE-EIT, English taught programme at VUB and ULB, has a relatively large number of graduates that continue in a research-oriented direction, i.e. by completing a PhD at a university, or by working for research-oriented institutes.

In order to serve different job-directions, the first year of the master is entirely devoted to letting students develop broad-based skills and knowledge, building further on the bachelor programme but going much deeper into the base material. During the second year of the master, students can choose one out of three options, furthering their interests and abilities in one of these directions. Electives allow them to further specialise, or to acquire complementary knowledge and skills that they see fit. (SER page 45)

Analysis (specific to the programme):

- Communication and visibility of this programme must be improved in Belgium and abroad.
- Outbound mobility needs to be further developed.
- Networking for the alumni should be improved.
- The internship policy needs to be better defined, promoted and organised.
- Context and soft skills are supposed to be the result of all the different types of studies without any specific courses. The Panel and the employers we've met understand your point and convictions but do think that complementary mandatory teaching would be very useful for the students and their future employers.
- This programme draws little appeal.

Master en sciences de l'ingénieur en génie électromécanique - Master of Science in de ingenieurwetenschappen: werktuigkunde-elektrotechniek (VL) - Master of Science in Electromechanical Engineering (EN)

120 ECTS credits, taught English, 51 students (2013-2014)

Whereas many universities offer separate tracks in Electrical Engineering and Mechanical Engineering, VUB offers an Electromechanical Engineering (EME) stream. The idea is to produce engineers with a broad education in the field of both mechanics and electrotechnics with special attention to the interactions between these fields. Such generalist engineers are needed in almost all industrial activities and are therefore highly desired. In addition, our engineers have the background and the skills to quickly acquire competence in more specialised matters. Moreover for such specialised jobs the employer often offers an in-house specialisation. (SER page 41)

Analysis (specific to the programme):

- The master programme provides students with a broad and high level core of scientific and technical knowledge and skills.
- It offers 4 majors in line with the expertise of the supporting VUB and ULB laboratories, which provide graduates with easy access to the job market or to PhD studies.
- In the SER, there is no SWOT analysis of the programme (although there is a VUB general SWOC analysis in the last appendix) and therefore no clear strategic plan about the future of this master.
- Although there is strong potential to increase the student numbers (in particular international students), the Faculty makes limited efforts to promote it, firstly because it considers that its resources are limited, and because it finds it difficult to recruit students with the right level.
- The research contracts with professors, the general orientation of the field lead to many informal relationships with industry (50% of the thesis topics come from industry). However, efforts need to be made to further formalise these relationships, for example to increase the job relevance of the curriculum, to increase students' awareness of the needs and contexts of their future careers.
- In reference to international standards, it will remain difficult for this programme to assess all the graduate outcomes for engineers (in particular "engineering practice")

Master en sciences appliquée et sciences de l'ingénieur: informatique appliquée - Master of Science in de ingenieurwetenschappen: toegepaste computerwetenschappen (VL) - Master of Science in Applied Sciences and Engineering: Applied Computer Science (EN)

120 ECTS credits, taught English, 53 students (2013-2014)

The master of applied computer science programme is concerned with the design and engineering of workable, practical computer-based smart systems using available devices, components, electronic and photonic hardware, software technologies, sensors and actuators to meet the requirements of well-defined applications. This field of ICT engineering sciences is generally known as "*smart systems of systems design*" and associates with the field of big data. Smart systems are typically characterised by

their multi-modal and multi-sensory nature, resulting in large multi-dimensional, distributed datasets that need to be efficiently processed, and of which the output needs to be (visually) represented in a consumer/prosumer friendly fashion.

The master of applied computer science provides a broad education in generic smart systems of systems design complemented with elective minors in important fields such as digital health and smart cities. Nonetheless, the programme will offer students the skills to operate in other application domains such as the factory of the future, smart grids or food production systems. In general the accumulated knowledge should give rise to an ICT engineer who is able to design systems of systems. (SER page 48)

Analysis (specific to the programme):

- There is an imbalance between inbound and outbound student mobility (improve participation in exchange programmes)
- More insight/data about the whereabouts of graduates would be useful (graduate employability analysis)
- A much higher proportion of in-company internships is necessary (also improve information about internships)
- Incorporate basic principles of HRM in the program

Master en sciences de l'ingénieur en chimie et génie des matériaux - Master of Science in de ingenieurswetenschappen: chemie en materialen (VL) - Master of Science in Chemical and Materials Engineering (EN)
120 ECTS credits, taught English, 16 students (2013-2014)

The Master in Chemical and Materials Engineering offers unique, integrated insight into chemical and materials' technology not offered elsewhere in Flanders. Its general aim is to train engineers that meet the modern technological needs of the labour market, especially regarding process, chemical and environmental technology and materials' science. Graduates often continue in process or research-oriented directions, often working in processing, quality control, or R&D units of small and large chemical or materials companies, as well as continuing their studies in PhD programmes at a university. The alumni survey, for which 41% of the alumni responded, shows recent alumni working in materials technology, chemical industry, research, aeronautics, and the nonferrous industry.

Analysis (specific to the programme):

- Communication and visibility of this programme must be improved in Belgium and abroad
- Outbound mobility needs to be further developed
- Networking for Alumni should be improved
- A clear strategy for attracting more students should be established

Therefore,

Firstly, the *Commission des Titres d'Ingénieur* hereby issues a favourable opinion concerning the State admission of the following 5 degrees awarded by the Faculty of Engineering at VUB (Belgium), for a maximum period of 6 years, from 1 September 2016:

- **Master en sciences de l'ingénieur : architecture** - Master of Science in de ingenieurswetenschappen: architectuur (VL) - Master of Science in Architectural Engineering (EN)
- **Master en sciences de l'ingénieur en génie civil** - Master of Science in de ingenieurswetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)
- **Master en sciences de l'ingénieur en électronique et génie des technologies de l'information** - Master of Science in de ingenieurswetenschappen: elektronica en informatietechnologie - Master of Science in Electronics and Information Technology Engineering
- **Master en sciences de l'ingénieur en génie électromécanique** - Master of Science in de ingenieurswetenschappen: werktuigkunde-elektrotechniek (VL) - Master of Science in Electromechanical Engineering (EN)
- **Master en sciences de l'ingénieur en chimie et génie des matériaux** - Master of Science in de ingenieurswetenschappen: chemie en materialen (VL) - Master of Science in Chemical and Materials Engineering (EN)

This opinion is issued with the following recommendations:

General recommendations for the institution:

- The Faculty would benefit from including Engineering Fellows and industry professionals in the teaching teams as much as possible.
- The panel regrets that the relatively basic indicators are not available in a public and synthetic form.
- The FIRW staff and management demonstrate their open-mindedness and ability to adapt with the successful BRUFACE initiative led with ULB. This experience, as well as the alliance with NPU in China, should be used to foster international partnerships with specifically chosen European universities.
- The BRUFACE project provides a solid experience of double degrees taught in English and should be used to attract more foreign students. They are good models for the creation of real joint programmes.
- Outbound student mobility is far from what could be expected from a university wishing to educate "world citizens". The Faculty of Engineering Sciences should take strong actions to reach the VUB objectives of 20% student mobility.
- Inbound student mobility is low as well and the university could capitalise more on its key location in the middle of Europe.
- VUB lacks a strategic vision and has some problems projecting into the future. Planning actions must be undertaken in order to include architectural engineering topics in the priorities of the energy transition and the post-carbon civilization.
- Promotion of the BRUFACE deserves greater attention.
- A lack of surveys on future needs is regretted. This would help anticipate updates to curriculum.
- Continuous improvement cycle (Deming Wheel) is a good way to efficiently complete any Quality Assurance system.

- Well-structured organisation, Quality Assurance training, well-distributed responsibilities, few, well-chosen and relevant KPI and tracking, fully consistent with the Institution Strategy, will give meaning and associated measurable results.
- Participative methods still need to be worked on and Quality Assurance is a good way to develop them and measure the benefits. Results will be published naturally when KPI have been defined, accepted by all actors when the quality system is working and the first results obtained.
- Include more people in the quality process.
- Build a strategy policy for each Master's program
- Build a real international policy, particularly for Students and Staff, both ways.
- Include outside managers from Industry and other stakeholders in the different VUB decision-making committees.
- Organise a real win-win policy between Alumni, Students, Graduates and the Institution.

The recommendations for each programme are as follows:

- **Master en sciences de l'ingénieur : architecture** - Master of Science in de ingenieurwetenschappen: architectuur (VL) - Master of Science in Architectural Engineering (EN)
 - Put internationalisation at the centre of staff concerns, develop relations with Sint Lucas.
- **Master en sciences de l'ingénieur en génie civil** - Master of Science in de ingenieurwetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)
 - Increase the number of internships, select your international partners.
- **Master en sciences de l'ingénieur en électronique et génie des technologies de l'information** - Master of Science in de ingenieurwetenschappen: elektronica en informatietechnologie - Master of Science in Electronics and Information Technology Engineering
 - Increase connections with industry and work on students' oral communication skills.
- **Master en sciences de l'ingénieur en génie électromécanique** - Master of Science in de ingenieurwetenschappen: werktuigkunde-elektrotechniek (VL) - Master of Science in Electromechanical Engineering (EN)
 - Reduce the workload of students, encourage student and staff mobility.
- **Master en sciences de l'ingénieur en chimie et génie des matériaux** - Master of Science in de ingenieurwetenschappen: chemie en materialen (VL) - Master of Science in Chemical and Materials Engineering (EN)
 - Establish a vision for the future, develop outbound mobility, clarify student recruitment strategy, increase teaching in process safety

The institution shall prepare a **report**, due 15 September 2019, detailing how these recommendations have been taken into account.

EUR-ACE Master accreditation may be **attributed to the 5 degrees stated above**, upon the institution's request, for the same period.

Secondly, CTI is in favour of **accreditation** of the following degree, which generally complies with evaluation standards:

- **Master en sciences appliquée et sciences de l'ingénieur : informatique appliquée** - Master of Science in de ingenieurswetenschappen: toegepaste computerwetenschappen (VL)
- Master of Science in Applied Sciences and Engineering: Applied Computer Science (EN)

After evaluation, CTI issues the following recommendations for this programme:

- The requested report is made to be sure that the scientific level of the recruitment and of the graduates allow the future employers to trust the engineering degree.
- Increase connection with industry and work on the lack of information about international exchanges programmes and internships.

The request for State admission may be re-examined in 3 years, based on the changes made as a result of CTI recommendations.

EUR-ACE Master accreditation may be **attributed to this degree**, upon the institution's request, for a period of 6 years, from 1 September 2016.

Thirdly, CTI evaluated the 2 "Transitional Bachelor" programmes and determined that they are compliant with evaluation standards. These degrees do not qualify for State admission or EUR-ACE Master accreditation.

After evaluation, CTI issues the following recommendations for these two programmes:

- **Bachelor en sciences de l'ingénieur : architecture** - Bachelor of Science in de ingenieurswetenschappen: architectuur (VL) - Bachelor of Science in Architectural Engineering (EN)
 - Improve dialogue with other architecture programmes in Flanders; adapt infrastructure to teaching
- **Bachelor en sciences de l'ingénieur** - Bachelor of Science in de ingenieurswetenschappen (VL) - Bachelor of Science in Engineering (EN)
 - Reduce student workload and drop out levels in BA1 and BA2

This opinion will be forwarded to the French Ministry of Higher Education and Research, which will make a decision regarding the applications for State admission.

The list of all accredited French or foreign degrees accepted by the State is published each year in the Official Journal of the French Republic. If applicable, these degrees may be included on the list for the years indicated.

Graduates awarded these degrees during the period covered by the State admission will be authorised to carry the French engineering graduate title.

Discussed during plenary sessions held on 13 and 14 September

Approved during the plenary session held on 8 November 2016

the President
Laurent MAHIEU

A handwritten signature in blue ink, appearing to be 'L. Mahieu', with a horizontal line underneath.