Engineers for the future: Lessons learned from the implementation of a curriculum reform of TU/e Bachelor College

ENGINEERS FOR THE FUTURE: LESSONS LEARNED FROM THE IMPLEMENTATION OF A CURRICULUM REFORM OF TU/e BACHELOR COLLEGE

A.M.C. Lemmens[1]
Eindhoven University of Technology (TU/e)
Eindhoven, the Netherlands

G.A.v.d. Watering
Eindhoven University of Technology (TU/e)
Eindhoven, the Netherlands

A.A. Vinke
Eindhoven University of Technology (TU/e)
Eindhoven, the Netherlands

C.H.A.M. Rijk
Eindhoven University of Technology (TU/e)
Eindhoven, the Netherlands

S.M. Gomez Puente
Eindhoven University of Technology (TU/e)
Eindhoven, the Netherlands

Conference Key Areas*: Engineering Curriculum Development*
Keywords*: Curriculum reform, Engineering Education*

ABSTRACT

With the purpose of educating *Engineers for the Future,* Eindhoven University of Technology launched the 'Bachelor College' (BC), a major university-wide framework to reform the curriculum structure, design and delivery of its bachelor programs. The ambition was to increase the student intake, broaden diversity in graduate engineering profiles, reduce drop-out rates, improve academic success, put students in charge of their own studies and educate '*future proof*' engineering graduates. The BC-framework has been extensively evaluated to assess the design, quality and impact of the reform. Results indicate lecturers' and students' satisfaction with the framework, particularly the *Major (i.e. main disciplinary components in each bachelor study program)* and *electives*. The new elements of the BC, i.e. *Use Society and Entrepreneurship (USE), Professional Skills* and *Coaching,* need further optimization. In this paper we report on the process of implementing the BC reform. Critical successful factors, such as engaging all stakeholders in the process, making a thorough system analysis of the consequences of the reform and stimulating cross-departmental cooperation and exchange of (educational) expertise are addressed.

[1] *Corresponding author: A.M.C. Lemmens*
a.m.c.lemmens-bc@tue.nl

1. INTRODUCTION

In September 2012 Eindhoven University of Technology (TU/e) launched a systemic reform of the curriculum structure, design and delivery of all bachelor programs.Inspired by cutting edge engineering educational reforms in universities worldwide [1], the TU/e initiated a major transformation aiming at upgrading the content and structure of the educational programs to educate the new generation of engineers. This educational reform also embraced educational principles such as active learning and the introduction of formative assessment. The aim of this paper is to describe the process leading towards this reform as well as the outcomes of the implementation. The organizational approach can be found in annex 1. In this paper we will also share the main lessons learned from these two perspectives.

1.1 General overview of educational reforms worldwide

In the past decades the engineering education sector entered a phase of fundamental change [2]. The focus of the rapid transformation to educate engineers for the future centered around a need to create connections with industry, to introduce an interdisciplinary curriculum and technologies in the engineering diciplines, with emphasis on hands-on education, working in multidisciplinary teams and skills development [3-4]. Universities such as Massachussets Institute of Technology (MIT), Olin College, University of Aalborg, Delft University of Technology, and Standford University, were considered the 'current top five leaders' in engineering education [1] as they managed to lead educational reforms to include multidisciplinary components, partnerships with industry and a curriculum that stimulates creativity, innovation and experiential learning.

To mention some experiences at other universities that served to inspire the educational reform at the TU/e, for instance, the Olin College reform embraced several interesting insights in the set-up of the programs. The first semester classes provide hands-on experiences in different disciplines of engineering and throughout the curriculum students work on real-life challenging projects. Also, the first year courses comprise other disciplines such as arts, humanities, social sciences as well as entrepreneurship rather than only engineering domains. Similarly, at MIT, in the New Engineering Education Transformation (NEET) Program, students are engaged in solving challenges of the 21st century valuing multidisciplinary, collaborative, project-based learning. Within the NEET framework, students earn a degree in a major while they also get the opportunity to earn a NEET certificate in one of the five cross-departmental pathways or "threads", i.e. Advanced Materials Machines, Autonomous Machines, Digital Cities, Living Machines and Renewable Energy Machines. Incited by these experiences, the TU/e embarked in a similar reform to educate the T-shape of engineers by integrating systems thinking in core activities and across disciplines, by providing Use, Society and Entrepreneurship (USE) themes in all programs, and by enhancing professional skills, among other elements.

1.2 Drivers for curriculum reform

In 2011 bachelor student intake numbers at TU/e were very low compared to other Dutch universities and had even dropped below a sustainable level for several programs. Furthermore, the programs mostly attracted students who were intrinsically motivated for technology and hardly any students with a societal or career-related type of motivation for technology. Moreover, the average drop-out rate of students for these programs at the time was about 33%, which worsened this situation. Those students who decided to stay needed on average 5 years to finish their three-year bachelor programs, which put the sustainability of the university at risk.

1.3 Educating *'Engineers for the Future'*

Due to changes in the demands for engineers in the labour market [5], TU/e noted, as did other institutes of engineering education, that the nature of engineering is changing rapidly [6]. 'The' (standard) engineer no longer exists. Instead, a wide diversity of engineers is needed to make significant and innovative contributions to society throughout their careers. Society is in need of young professionals with a solid scientific foundation, excellent professional skills, who are able to address interdisciplinary problems and challenges and to cooperate with colleages from various disciplinary backgrounds, to respond flexibly to the fast growing body of knowledge and rapid changes in industry as well as society, to help shape the future in a responsible way, and with a strong awareness of their own strengths and ambitions.

In order to respond to this shifting nature of engineering and to address the student intake and academic success challenges, TU/e embarked on an institution-wide, systemic educational reform of its bachelor programs [7-8].

2. EVALUATING THE IMPLEMENTATION OF TU/e BACHELOR COLLEGE

2.1 Aligning the quality assurance system

The reform of the bachelor programs required a quality assurance system that would be aligned with this reform. At several levels, quality assurance elements were either adjusted, redesigned or added. Student surveys at the level of course and curriculum evaluation were redesigned and standardized, one-on-one review meetings between the Dean of Bachelor College and Program Directors were initiated, and measures were taken to improve annual education reporting by the departments. And finally, short feedback loops were initiated to make improvements on the fly, for example by creating and having regular meetings with the Student Monitor Group, in which every bachelor program is represented by one student. The overall aim was to close the quality assurance cycles at program and course levels.

2.2 Scope of the two-impact evaluation studies into TU/e Bachelor College

At the launch of Bachelor College it was agreed to evaluate the framework after completing the first three-year cycle of the reformed bachelor programs. This evaluation was conducted by an external expert in 2015 [9]. A joint agreement was also made to evaluate the framework as a whole a second time, in 2019, and based

on that evaluation, either redefine the framework as a whole or formulate an adapted framework for a new cycle.

Though the set-up for both impact evaluation studies of TU/e Bachelor College was similar, their goals were partly different, due to the alignment with the timing of the studies. The first evaluation (covering the 2012-2015 period) focused on the early impact and success of the reform with particular emphasis on three of the strategic aims: the increase in the size and broadening of the demographic of student intake at TU/e; improved student drop-out and study success rates; and, improved student flexibility and educational choice. It also centered around the evaluation of the design and delivery of TU/e Bachelor College to identify any operational challenges, risks and opportunities for improvement.

The second evaluation (2015-2019) broadened the scope by also including the other two strategic aims: creating 'future proof' engineering graduates and delivering a larger number as well as broader diversity of engineering graduates. To this end, four working groups were commissioned with investigating the following leading research questions: (1) Has TU/e achieved its five strategic goals with its redesigned bachelor programs?; (2) Do students recognise and appreciate the set-up of the Bachelor College in the education of future- proof engineers?; (3) How do Bachelor College graduates perform in the master?; (4) Do the engineers of the future have added value for their respective fields of work?.

2.3 Method of the two-impact evaluation studies into TU/e Bachelor College

As mentioned above, the two evaluation studies followed a similar method consisting of quantitative and qualitative research methods. In the first evaluation, an external expert conducted the whole evaluation study [9]. In the second evaluation, four TU/e working groups conducted the quantitative part of the research [10-11]. They extracted and analysed data from the TU/e BI platform (generates and shows education-related data) to investigate trends in student intake numbers, drop-out rates, study completion rates and academic performance of master students. Online surveys were used to explore student and teaching staff perceptions of and experience with the reformed bachelor education. An overview of the response rates for the various groups is provided in Table 1.

Table 1. Participants quantitative research first and second evaluation of BC

First evaluation (2012-2015)

Research method	**Target group**	**N=response**	**% of the total group**
Online surveys	Bachelor College students	N=838	46%
Online surveys	Pre-BC Students	N=499	29%
Online surveys	Lecturers	N=342	40%

Second evaluation (2018-2019)

Research method	Target group	N=response	% of the total group
Online surveys	Bachelor College students	N=1581	25%
Online surveys	Master students	N=378	16%
Online surveys	Lecturers	N=295	18%

The qualitative research part of both evaluations consisted of one-on-one interviews that were designed to explore the issues raised in the survey in more depth. In the first evaluation individuals were selected (n=44) with a range of backgrounds (senior university managers, change managers, lecturers, educational directors and students, as well as external observers of the reform). In the second evaluation the external expert conducted the interviews with bachelor students and graduates, and lecturers (n=16).

3. RESULTS

3.1 Outcomes of the first evaluation

The results of the first evaluation indicated a broadly positive impact and successful change. Most impressive were the results for the size and demograhic balance of the student intake already obtained in 2014 (aim 2, see section 2.2 above): a growth of 52% in student intake numbers and an increase in the proportion of female students from an average of 14% to 24%, in which the well-designed marketing and communication strategy played a crucial role. The impact of the reform on student drop-out and study success rates was also quite positive (aim 3, see section 2.2 above). Students' educational choices also showed good progress (aim 4, see section 2.2 above).

A number of challenges emerged from this evaluation as well. They were in line, however, with what might be expected for a change of this scale and ambition. In addition to the very positive feedback, staff and students for example raised their concerns about the contents, quality and delivery of the USE learning lines, the professional skills component and some of the engineering basics. In response to these concerns, several measures were taken. New requirements for the USE learning lines were developed with the aim of improving the rigor, strengthening the integration of engineering and social sciences and enhancing the match with students' interests and ambitions. For the professional skills, the framework was revised and an internal audit system was developed to help program directors redesign the integration of the professional skills within their Major. For the engineering basics a cross-departmental lecturer team was composed to review and redesign the set of courses as a whole.

Two interrelated issues in the Bachelor College's design and implementation were more fundamental: the coherence and integration of the Bachelor College curriculum components and the opportunities available to students to apply and integrate their knowledge. In the absence of an overall framework within which to contextualise what they are learning in courses such as the USE learning lines, many Bachelor

College students appeared to assign a low value to these experiences. As a result, learning and impact from these courses may have been limited. As part of the reform of the bachelor programs, the credit load attached to the Major was reduced from 150 to 95 ec. During this process many departments appeared to have reassigned project-work from the 'core' curriculum to the elective space, thus reducing the amount of knowledge application. In addition, courses outside the Majors attempting to deliver active learning experiences were doing so under very difficult circumstances such as large student numbers (all 1st-year students take the engineering basics courses at the same time). A result of this was that students appeared to have few opportunities to apply their knowledge to authentic engineering problems and engage with deeper modes of learning in their Major.

Despite these challenges, the foundations of Bachelor College's long-term success seemed to be in place: "*It represents an ambitious and groundbreaking approach to engineering education which is likely to offer a template for change to many universities and engineering schools across the world*."[9]. The committed support of the university senior management, the rapid successes already achieved and a well-designed communication and marketing strategy played a crucial role in this.

3.2 Outcomes of the second evaluation

The second evaluation of the Bachelor College [10] aimed to review (1) whether the TU/e had realized its strategic goals with the redesigned bachelor's program; (2) whether the students recognise and appreciate the set-up of the Bachelor College in the education of future- proof engineers; (3) the level of performance of the Bachelor College graduates in the master; and, finally, (4) the added value of the engineers of the future for their respective fields of work.

Results of the evaluation indicated that the reformed bachelor programs attract a larger and a more diverse student intake than was the case prior to the reform, including increases in the proportions of female students, international students and non-local students (See annex 2: Student intake overall 2002-2019; and, annex 3: relative growth and compared to other Dutch Technical Universities). In addition, drop-out rates have decreased while graduation rates have steadily improved. Success rates had already started to improve before the BC reform and, therefore, we cannot contribute this success to the educational reform exclusively. In this regard, students recognize that their education provides ample opportunities (i.e. elective space) to them to shape their own engineering profile, develop a breadth of experience outside of their own engineering disciplines as well as depth of knowledge in their chosen specialiazation field (See annex 4: Success rates: completion rates cohorts 2002-2015 (target: 70% graduates in 4 years).

From the student survey we observed that students are satisfied about how the Major and the electives are embedded in the overall structure of the bachelor curriculum. However, students' perceptions indicate that they recognize objectives of the USE learning lines to a limited extent only, especially with respect to the objectives 'making use of USE aspects in developing technologies' and 'having a clear notion of USE in relation to technology'. Interesting to see is that students recognized the importance of the professional skills, although the embedding of the professional skills in the curriculum still needs attention. Similar results emerged

regarding coaching. Although the importance of coaching is acknowleded, the implementation of coaching still requires attention.

Regarding the research question on the performance of Bachelor College graduates in the master, insufficient data was available to compare Bachelor College students to external influx or to pre-Bachelor College students. The same applies to the final research question. At the moment, we cannot confirm the added value of TU/e Bachelor College graduates for society as they have only recently started to enter the labor market.

4. LESSONS LEARNED FROM THE EDUCATIONAL REFORM PROCESS

Developing, implementing and evaluating the BC framework has led to several insights which may benefit not only TU/e but also other universities in future large-scale educational innovation. Below we will report about the lessons learned from different perspectives, i.e. the reform of the bachelor programs and the process of standardization.

4.1 The curriculum reform process as a whole

First of all, it is essential to determine a strategy for a curriculum reform process in advance. Within this context, TU/e being a small organization has the advantage of offering flexibility and short communication lines. In this process, cooperation with all departments is crucial to take large steps. In order to implement such a large change, sufficient capacity and a clear mandate and responsibility of the bodies in charge of such an operation at the departments are required.

The departments were in the lead to implement the framework in their respective Majors. Experience has taught that strict and uniform regulations do not work with educational processes as flexibilization and adaptation to the various departmental cultures and disciplines remain relevant factors for success. An advantage of the TU/e approach to the curriculum reform was that it made it possible for the departments to shape their program within the framework and at the same time keep their own character and culture.

The degree of implementation differed therefore among departments. Several different factors appear to have played a role in this. First of all, the differences that already existed prior to BC were still visible after implementing the reform in some areas, such as the degree of student-activating education. Secondly, specific ways in which the departments organized the educational reform also contributed to differences in how the framework was implemented. Among these differences are the degree to which Program Directors were enabled to conduct the curriculum reform not only from a content point of view but also from an educational perspective, allowing substantial support to empower lecturers to introduce changes at course level as well. As a consequence, a large organizational change of the support staff and services took place in the years after the start of BC. The purpose was to harmonize and standardize the processes supporting education in order to make sure that the right expertise was available in the right place. Standardization and harmonization of educational reform processes must be, therefore, in balance.

Another rationale behind the implementation of the curriculum reform was to give sufficient freedom to the departments to introduce the BC framework in each bachelor program. This was done under the assumption that it would enable the departments to learn from each other. This peer-learning did take place to a certain degree, but dissemination of best practices among the departments was more limited than anticipated. A good start was made by organizing education meetings, but these gradually disappeared over time. The workshops that were meant to replace them, took shape only to a limited degree. In the later years and in order to give impulse to the TU/e educational strategy and Vision 2030, funds were also made available for educational innovations. The implementation of this strategy was translated in programs such as Challenge-based learning, BOOST! (IT in education), Teacher and Teaching Assistants, within the context of the Ministry of Education Quality Agreements. Also Innovation funding of the Centre for Engineering Education (CEE) was made available to support these initiatives. Through these programs, the teaching staff is able to submit innovation projects under the lead of the Program Directors to carry out innovative initiatives in light of quality of education. These funds have enabled and stimulated teaching staff to redesign their education. In order to disseminate these initiatives, presentations of innovations are organized within the departments and at the TU/e education day. However, cross-departmental learning from these projects can be strengthened.

4.2 Reform of the curriculum components (i.e. basic courses, Major, electives, USE learning lines, professional skills)

With regard to the curriculum reform of the Major (i.e. the disciplinary components of the bachelor curriculum in each study program), strong educational leadership is needed in order to have a clear vision and avoid the inference of other university politically-oriented processes. A key factor is the empowerment of the lecturers to define and elaborate, on the basis of the aims of the study program, the core of the Major and the associated learning objectives (without losing the relationship with research). There must be sufficient support within the teams of lecturers, but also willingness and openness to develop the new courses.

The TU/e BC framework combining the preparation of engineers in a unique discipline (i.e. Major curriculum), the broad preparation that the basic courses provide, together with the electives, professional skills and USE learning lines pave the way to shape the new generation of T or π-shaped engineers who can respond to the challenges of society and the labour market.

4.3 Guidelines to improve study progress

Guidelines were developed in working groups consisting of many different stakeholders from all departments. Subsequently, the agreements made were communicated in various ways: by means of presentations on education days, captured in a Bachelor College framework, education and examination regulations, etc. To guarantee commitment in the implementation of an educational and curriculum reform, communication is essential. Investing in explaining the why and how as part of the preparation as well as implementation process are essential elements of all educational reforms.

5. CONCLUSIONS AND PERSPECTIVES FOR ENGINEERING EDUCATION

The evaluations of the Bachelor College have shown that the framework is a suitable and sustainable structure to shape bachelor programs and curriculum that educate the *Engineers for the Future.* This framework includes characteristics that enable the graduates to meet the challenges of the future worldwide. According to this vision, the TU/e contribution to society are engineers characterized by a T- or π-shaped profile, who have in-depth knowledge and expertise with cross-disciplinary insights, approaches and the skills to address real-world challenges; are able to collaboratively work in multidisciplinary teams; and provide solutions from a systems-thinking and creative thinking perspective.

ACKNOWLEDGEMENTS

We would like to thank the TU/e deans, program directors, lecturers students and policy advisors from all departments who have participated in the two evaluation studies into the Bachelor College framework. Their contribution by sharing experiences and perspectives has been of valuable importance. In particular, we are very grateful to dr. Ruth Graham from Consultancy in Higher Education, for the thorough research and advice she has provided, which will help TU/e shape the future of the bachelor programs.

REFERENCES

[1] Graham, R. H. (2018*).*The global state-of-the-art in engineering education Outcomes of Phase 1 benchmarking study. Copyright © 2018 by Massachusetts Institute of Technology (MIT). ISBN 13: 9780692089200. New Engineering Education Transformation (NEET). Massachusetts Institute of Technology. Cambridge, MA. USA.

[2] Sheppard, S.D. Macatangay, K. Colby, A. & Sullivan, W. (2008). Educating engineeris: Designing for the future of the field. The Carnegie Foundation for the Advancement of Teaching: Preparation for Professions. Jossey-Bass. Standford, CA. USA.

[3] Crawley, E., Malmqvist, J., Ostlund, S., & Brodeur, D. (2007). Rethinking Engineering Education. Springer. ISBN 978-0-387-38287-6.

[4] Educationg the Engineer of 2020: Adapting Engineering to the new century. (2005). National Academy of Engineering of the National Academies. Washington, DC, USA. ISBN 0-309-09649-9.

[5] Taskforce Redesign BA Curriculum (2011). Future-proof and students-centred bachelor education at TU/e: Final report. Eindhoven: Eindhoven University of Technology.

[6] Meijers, A. W. M., & Brok, den, P. J. (2013). *Engineers for the future: an essay on education at TU/e in 2030*. Eindhoven: Eindhoven University of Technology.

[7] Fullan, M. (2009). Large-scale reform comes of age. *Journal of Educational Change*. Vol. 10, pp. 101–113

[8] Kerdijk, W., Cohen-Schotanus, J., Mulder, B.F., Muntinghe, F.L. & Tio, R.A. (2015). Cumulative versus en-of-course assessment: effects on self-study time and

test performance. *Medical Education,* Vol. 49(7), pp. 709-16. doi: 10.1111/medu.12756.
[9] Graham, R. H. (2015*). Bachelor College evaluation and impact study*. Eindhoven Univerity of Technology.
[10] Evaluation of the Bachelor College framework (2020). Eindhoven: Eindhoven University of Technology.
[11] Graham, R. H. (2020). External review of the Bachelor College Evaluation. Eindhoven: Eindhoven University of Technology.

ANNEXES

Annex 1.

1.1 The organizational approach towards implementing the curriculum reform

The journey to the curriculum reform was started late 2010 by establishing a dedicated 'Redesign Bachelor Curriculum' Taskforce [5]. This taskforce analyzed the drivers for the educational changes and created a vision for future bachelor education at TU/e [6]. They also proposed possible future directions to address issues such as the diminishing student intake and relatively low study success rates [5]. Based on the final report and recommendations of the taskforce, TU/e's Executive Board decided to fundamentally reform TU/e's bachelor education and to unite all bachelor programs in a single 'TU/e Bachelor College'.

The main aims of this reform were to:

1. Create 'future-proof' engineering graduates who are able to operate effectively and professionally across borders and disciplines and are equipped to tackle the complex challenges of the 21st century.
2. Increase the student intake numbers and broaden the appeal of TU/e to new groups of prospective students (female, international and other 'beta-mentality types': not only students with an intrinsic motivation for technology but also students with a societal or career-related motivation for technology).
3. Reduce student drop-out rates and improve study success rates.
4. Provide education that is supportive, flexible and responsive to the individual needs and priorities of each TU/e student.
5. Deliver a larger number as well as greater diversity of engineering graduates

In order to prepare the implementation of the curriculum reform, the BC Dean was appointed as Program Manager to lead this process supported by a Program Management Team (PMT). Various projects were defined to accomplished the envisioned aims of the reform, which were conducted by different stakeholders distributed across working groups, i.e. program directors, policy advisors, teacher support staff and students.

The vision and the advice of the working groups together helped shape the Bachelor College framework, and the organizational systems and structures that made it possible to implement the framework. The vision was further developed into and described in *'Engineers for the future. An essay on education at TU/e in 2030'* [7].

Core elements of this vision include active student learning as the main driver for innovation of education, small-scale education, close student-student and student-lecturer interaction, diversity in student population and a focus on multidisciplinarity.

The process of implementing BC can be characterized as relatively quick. About one year and a half after the establishment of the original taskforce, the reformed bachelor programs were launched. Once the framework was established, the Dean of TU/e Bachelor College, supported by the Project Management Team, guided and monitored the implementation. Departments were given the lead in how to implement the framework in their respective bachelor program(s).

1.2 Systemic educational reform

TU/e Bachelor College launched an institution-wide framework that reformed the curriculum structure, design and delivery of all bachelor programs.

The curriculum of all bachelor programs was structured in the same way, consisting of the following elements (also see Figure 1): engineering basics (25 ec), a disciplinary Major (95 ec, including a Bachelor End Project of 10 ec and professional or '21st century' skills), a User-Society-Enterprise (USE) learning line (15 ec, restricted electives), and a substantial free elective space (45 ec).

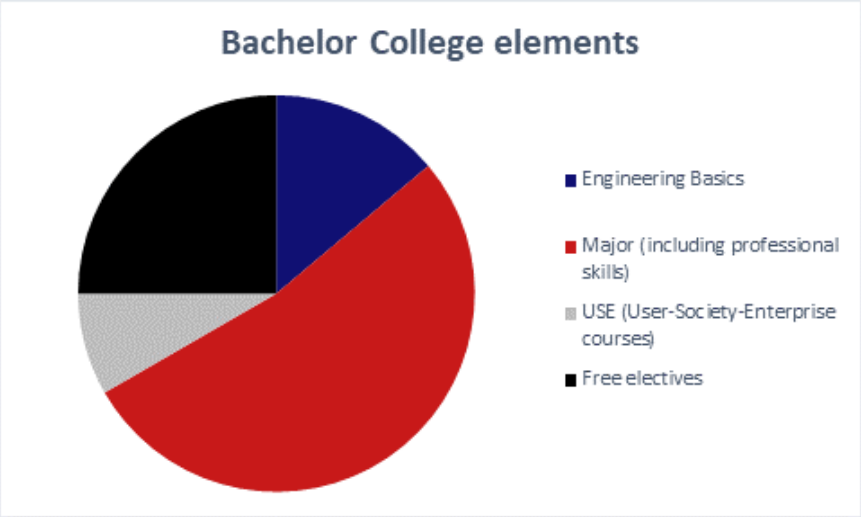

Figure 1 Bachelor College curriculum elements

In addition, all courses got a fixed size of five European credits (ec) and were programmed in a ten-week schedule, with only three courses running in parallel and a reduced number of contact hours to enable independent study. To enable these changes, fixed timeslots during the weeks were used to schedule all courses. Finally, several measures were taken to enhance study success rates such as introducing interim testing and reducing the number of resits [8].

All these standardized structural components were intended to create optimal flexibilization for students in shaping their own program and choosing their electives from the range offered by their own as well as other departments. This set-up of the free elective space served various kinds of students: students who aimed for depth in their chosen discipline as well as students who wanted to pursue their individual

interests and ambitions. Personalized coaching was introduced to support students in investigating their ambitions and interests, and making study-related choices accordingly. All these components addressed to the rationale to conduct the curriculum reform.

The university's marketing and recruitment strategy was fundamentally changed as well. A *'Let engineering make your dream come true'* campaign was launched and two new bachelor programs were designed to broaden the appeal of TU/e to new groups of prospective students. And finally, a new *'Study Choice Check'* to determine how well a study program suits the interest of the student, was developed to reduce drop-out rates.

Annex 2. Student intake overall 2002-2019

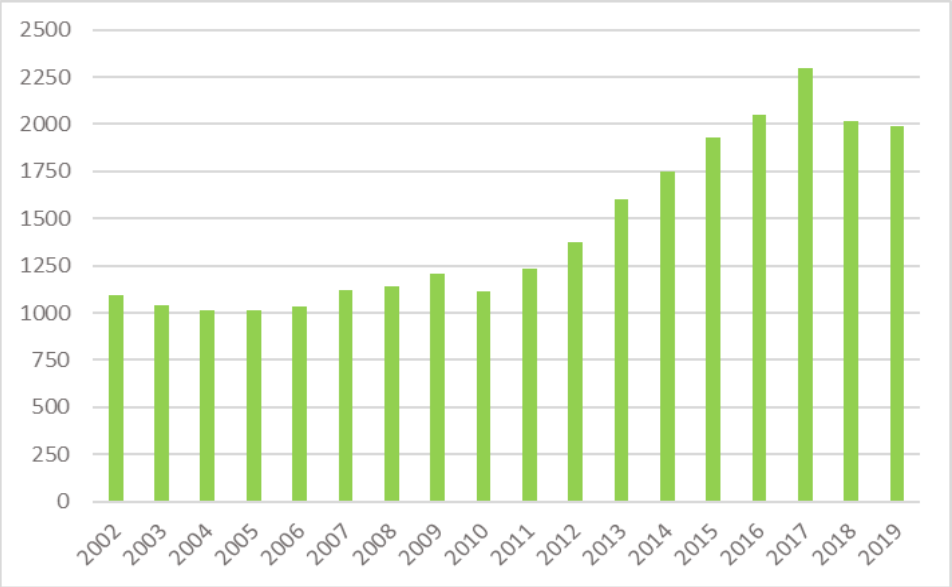

Figure 1. Absolute size of BSc student intake at TU/e since 2002 (source: TU/e BI Portal, BSc intake first-year institution 1 October)

Annex 3. Relative growth and compared to other Dutch Technical Universities

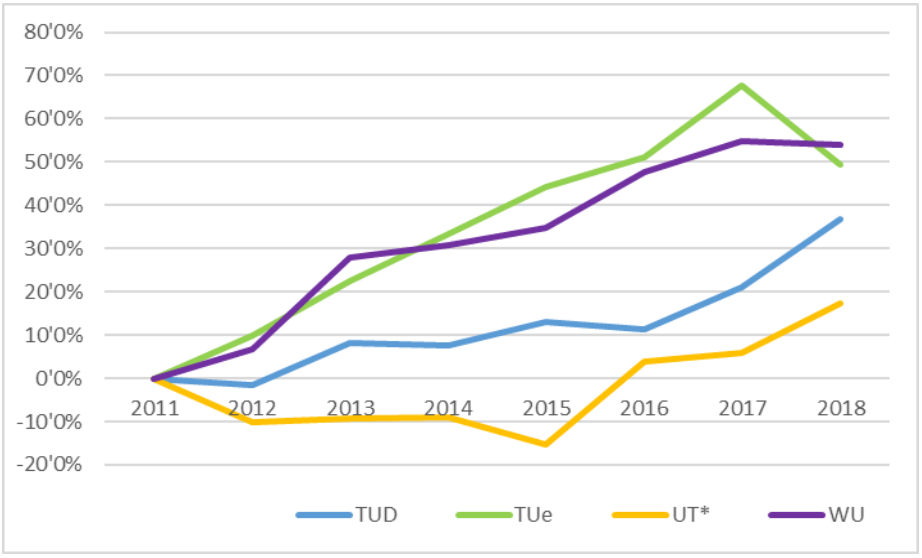

Figure 2. Growth percentages BSc student intake at 4TU since 2011[2] *(*includes intake for non-technology programs; Source: VSNU/DUO Intake first-year university students, main enrolments 1 October). Legend: TUD- Delft University of Techology; TU/e – Eindhoven University of Technology; UT- University of Twente; WU- Wageningen University.*

Annex 4. Success rates: completion rates cohorts 2002-2015 (target: 70% graduates in 4 years)

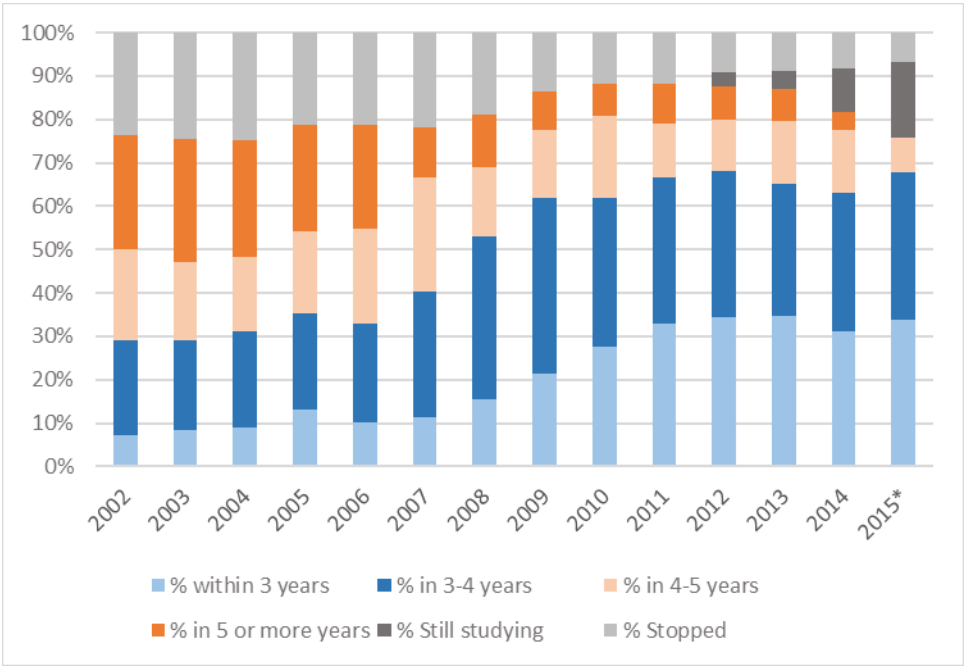

*Figure 3. Completion rates for BSc cohorts 2002 – 2015 (*data for cohort 2015 not yet complete*[3]*; source: TU/e BI Portal, Completion rates BSc students).*

[2] In order to determine growth percentages since 2011, this percentage was set to zero for 2011.
[3] For cohort 2014 data for 'diploma in 5 years or more' is lacking and for cohort 2015 data is lacking for 'diploma in 4-5 years' and 'diploma in 5 years or more'. This means that the grey part indicating the percentage of 'no diploma' will get smaller once data is available.