# Assessment Committee Report on Research in Electrical Engineering 2017-2022

## Eindhoven University of Technology
## University of Twente

October 2024

# Assessment Committee Report on Research in Electrical Engineering 2017-2022 at the Eindhoven University of Technology University of Twente

**"Creating more impact, a stronger international brand, and growth in the field of Electrical Engineering by setting a clear and differentiating vision and increasing the awareness of its own strengths"**

*October, 2024*

Title:
Assessment Committee Report on Research in Electrical Engineering, 2017-2022, Eindhoven University of Technology, University of Twente

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87 pages (including appendices)
Photo's Courtesy of Levi Baruch
Date: October 2024

ISBN 978-94-6491-835-9

# Summary

The Assessment Committee assessed the research at the Electrical Engineering faculty of the Eindhoven University of Technology (EE@TU/e) and the research at the Electrical Engineering discipline of the faculty EEMCS of the University of Twente (EE@UT). This assessment covers research in the period 2017-2022/2023. The Assessment Committee Report is approved by all Committee members.

**Joint Remarks for the Electrical Engineering Domains at TU/e and UT**

The Committee appreciated the open and transparent approach of both TU/e and UT, which allowed a comprehensive insight into their organisations and research domains. The research conducted at both universities is commendable, with significant societal relevance and strong industry collaboration. However, there are areas requiring improvement, including the support for PhD students and junior faculty in work-life balance and career progression. Key external threats identified include insufficient political support for internationalization and fundamental research.

The Committee observed that both universities have understated their mission statements. The core strengths of the EE departments are more significant than presented and the Committee recommends that both EE departments improve their mission statements to better reflect their unique vision and strengths, including fundamental research, to highlight their competitive edge.

Collaboration among the three technical universities (TU/e, UT, and TU Delft) is seen as essential for deploying strategic initiatives effectively. However, the current state of collaboration, particularly through the EE-NL initiative, lacks clarity and momentum, reducing its effectiveness.

While there have been minor improvements in gender balance at both universities, more significant changes are needed. The recruitment approach needs to be re-evaluated to attract more female talent, and efforts should be made to professionalize career planning, mentorship, and work-life balance support.

The changing political climate in the Netherlands, particularly the mandate to use Dutch as the primary language in BSc courses, poses a threat to universities like TU/e and UT that rely on international students and staff. The Committee stressed the importance of maintaining internationalization and securing base funding as vital components for a viable Dutch academic landscape.

Both universities have made progress in open science, with a focus on research data management and open access publications. However, continued efforts are needed to maintain and improve these initiatives. The Committee also noted the importance of supporting PhD students, particularly in career planning and mental health, to ensure timely completion and reduce dropout rates.

**Assessment of the Electrical Engineering Faculty at TU/e**

The Committee noted that the mission statement of TU/e's EE department is too broad and lacks a distinct identity. It recommended personalizing the mission statement to better reflect the department's unique identity and vision, with a stronger focus on cutting-edge innovation and societal impact. The competitive edge of TU/e, particularly its strong industry links and innovative projects like "Future Chips," needs to be better articulated and promoted.

TU/e is successful in attracting external funding, but the Committee observed a lack of quantitative metrics to assess research quality comprehensively. The strategy for fundamental and applied research should be more clearly defined, with a focus on long-term societal trends like AI and climate change.

The connection between research, education, and industry collaborations is strong, but more systematic reporting on innovation

metrics and a strategic approach to international collaborations are needed.

TU/e's leadership is commended for its pragmatic approach, but the Committee recommended adopting more top-down strategies in leadership and career management. The university's ambition to double the number of graduates requires addressing challenges like infrastructure constraints and maintaining a balance between industrial collaboration and fundamental research.

**Assessment of the Electrical Engineering Discipline at UT**

The Committee found that UT's mission statement is too general and lacks a clear focus. The department's strengths, such as its collaborative atmosphere and state-of-the-art laboratories, need to be more effectively communicated to attract talent and partnerships.

UT's research quality is high, but the Committee recommended more international benchmarking to enhance its global standing. The department's shift from quantity to quality in publications is commendable, but this needs to be substantiated with evidence of increased impact. KPIs should be better integrated into the research culture to guide the organisation effectively.

UT's societal relevance is well-established, but its visibility needs improvement. The Committee recommended enhancing the department's narrative to attract a broader audience and improve communication of its societal impact. UT faces significant challenges, including funding cuts, declining student numbers, and bureaucratic burdens. The Committee emphasized the need for strategic leadership to address these issues and capitalize on UT's geographic advantages.

**Conclusion**

The Electrical Engineering departments at TU/e and UT have made significant strides in research and societal impact, but there are critical areas that need attention. By addressing mission clarity, enhancing collaboration, improving gender balance, and securing

internationalisation, both departments can strengthen their global standing and ensure long-term viability.

A list of recommendations is provided at the end of the Domain of the Electrical Engineering section and at the conclusion of the University sections.

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# Preface

The Assessment Committee was entrusted with the task of evaluating the Electrical Engineering research at the University of Twente (UT) and Eindhoven University of Technology (TU/e). Our mandate was to assess the institutions' strategic direction, research quality, societal impact, and the effectiveness of their governance and leadership structures. This comprehensive review also involved examining the alignment of the universities' missions with their operational practices and future goals.

The organisation of the site visits was exemplary, and we extend our sincere thanks for the warm and professional reception we received. The atmosphere throughout our visit was marked by openness and a genuine willingness to engage in constructive dialogue, which greatly facilitated our assessment process.

During our time at both universities, we had the opportunity to engage in in-depth discussions with faculty members, administrative leaders, and external stakeholders. The presentations and exchanges we experienced, particularly the enthusiastic and insightful discussions on key topics, were instrumental in shaping our understanding and evaluation of the current state and future potential of the Electrical Engineering disciplines at UT and TU/e.

While our role required us to take a critical stance, it is important to note that we were deeply impressed by the substantial progress and achievements made by both institutions. The Committee identified several areas for improvement and strategic refinement, but these are offered in the spirit of enhancing what is already a solid foundation for continued success.

I wish to express my gratitude to the Committee members for their diligent and thoughtful contributions throughout this process. Their

expertise and commitment were vital to the thoroughness and fairness of our evaluation. I am also pleased to report that our final conclusions were reached with unanimous agreement among all Committee members. Finally, I would like to extend our collective thanks to our process consultant, Sven Laudy, for his exceptional preparation and support, which ensured our review remained focused and productive.

Sonja Berlijn
Committee Chair

# 1. Assessment Committee and Assessment Procedures

## 1.1 Assessment Scope

The Assessment Committee was asked to assess the research at the Electrical Engineering faculty of the Eindhoven University of Technology (EE@TU/e) and the research at the Electrical Engineering discipline of the faculty EEMCS of the University of Twente (EE@UT). This assessment encompasses research conducted between 2017 and 2022. In line with the Strategy Evaluation Protocol 2021-2027 for Research Assessments in the Netherlands (SEP) and as stipulated in the Terms of Reference (ToR), the Committee was tasked with evaluating the quality, societal relevance, and sustainability of the research programmes based on documentation provided by the Faculty and interviews with Faculty management and research departments. In assessing these criteria, the Committee carefully considered specific aspects highlighted in the SEP, including Open Science, PhD Policy and Training, Academic Culture, and Human Resources Policy.

Following this, the Committee was to make recommendations for the future.

## 1.2 Committee Composition

The members of the Committee were:

**Prof.dr.ir. S.M. (Sonja) Berlijn**, Committee Chair, Professor of Sustainable Integrated Energy Systems, KTH Royal Institute of Technology, Sweden.

**Ir. L.A. (Luc) Enthoven**, PhD Candidate, Quantum Integrated Circuits Group, Delft University of Technology, The Netherlands.
**Prof.em.dr.ir. S.J.A. (Sabine) Van Huffel**, Professor of Biomedical Engineering, Katholieke Universiteit Leuven, Belgium.
**Prof. dr. P. (Peter) O'Brien**, Head of the Photonics Packaging Group, Tyndall National Institute, Ireland.
**Prof. em. dr.ir. J. (Joris) De Schutter**, Professor of Mechanical Engineering, Katholieke Universiteit Leuven, Belgium.
**Dr.ir. A.P. (Arnoud) van der Wel**, Innovation & Roadmap Manager, NXP Semiconductors, The Netherlands.
**Prof.dr.ir. W.M. (Wouter) van der Wijngaart**, Professor in Micro and Nanosystems, KTH Royal Institute of Technology, Sweden.

A short curriculum vitae of each Committee member is included in Appendix A.

Ir. Sven Laudy of Quicken Management Consultants was appointed as an independent and qualified process consultant to the Committee.

## 1.3 IMPARTIALITY

All Committee members signed a statement of impartiality and confidentiality to ensure that they would assess the quality of the research programmes in an impartial and independent way. Committee members reported any existing personal or working relationships between Committee members and members of the programmes under review before the interviews took place. The Committee discussed these relationships at the first Committee meeting. The Committee concluded that there exist no unacceptable relations or dependencies that could lead to bias in the assessment. Impartiality was also confirmed and the Committee accepted by the Executive Boards of the UT and the TU/e.

## 1.4 Data provided to the Committee

The Committee received the following detailed documentation:

- Self-evaluation report of the unit under review, including all the information required by the Strategy Evaluation Protocol 2021-2027 (SEP), with appendices,
- Promotion requirements and guidelines Tenure-track and Tenured staff.

These documents together with the interviews during site visit formed the Committee's key basis for the assessment.

## 1.5 Committee Procedures

The Committee followed the Strategy Evaluation Protocol, 2021-2027 (SEP). On May 17, 2024 the process consultant of the Committee briefed the Committee on the Strategy Evaluation Protocol for research assessments in an online meeting with the Committee. Prior to the site visit, all assessors were asked to evaluate both programmes. These assessors independently formed a preliminary assessment for each programme.

At the start of the site visit, the Committee discussed the preliminary assessments. For each interview, the Committee prepared a number of comments and questions. All Committee members were actively involved in the interviews. After each interview, the Committee discussed comments and recommendations. The Committee interviewed the management teams, as well as the research staff and PhD Candidates responsible for the electrical engineering research at TU/e and UT. Interviews took place on June 19 (at TU/e) and June 20 (at UT). The full interview schedule appears in Appendix B. The Committee

presented preliminary general impressions to the TU/e and UT on the last day of the visit.

After the site visit, the Committee finalised the report through email and video conferences. Final assessments are based on documentation provided by the universities, preliminary assessments and interviews. Following approval by all Committee members, the Faculty EE at TU/e and the EE discipline at UT received a copy of the first version with the invitation to correct factual errors. In response, the Committee discussed these comments, made several modifications to the text and then presented the final report to the Boards of the University. This was printed after formal acceptance.

# 2 Joint remarks for the Electrical Engineering Domains at TU/e and UT

## Introduction

The Committee perceived that the two universities were very open and wanted to give an open and transparent insight in both their organisations and research areas. Indeed, it was appreciated that the Committee looked into 'their kitchen'. The Committee concluded that the site visits added a lot of value. The research that is conveyed at the two universities is impressive and something that both universities should be proud of. The research performed at both universities was perceived as societally relevant and there was a lot of collaboration with the industry.

The primary strengths that were particularly notable include the engaged faculty and their dedication to fostering a positive academic culture, the high quality of research output, the robust infrastructure, and the strong collaboration with industry and society. However, there are areas that could benefit from improvement, such as the need to professionalize support for developing the work-life balance and career progression of PhD students and junior faculty.

The main external risks/threats to be addressed are insufficient political support for internationalisation and fundamental groundbreaking research.

This report comprises some recommendations, as it is the task of the Committee to provide constructive feedback so both universities can improve their international standing even further.

## 2.1 Mission statement

The challenges faced by EE departments at UT and TU/e are common across universities, including issues related to talent acquisition, growth, financial stability, and (cost of) housing.

The Committee's impression is much more positive than what is depicted in the self-evaluation report. For both universities, the mission statement is understated, and the core strengths are more significant than presented and may not have been communicated as effectively as possible. The community may be too humble and modest, even if this is a nice trait, in tough competition between universities this doesn't work to their advantage. In general, it is highly recommended that both EE@TU/e and EE@UT work on improving their mission statements to better reflect their key strengths and activities (not only in applied, but also fundamental research) so as to highlight their unique vision, own identity and competitive edge [1][1]. Further details are provided in the respective chapters.

## 2.2 TU Collaboration

The Committee considers cooperation and alignment between Eindhoven, Twente and Delft absolutely essential for meaningful deployment of strategy. Preventing overlap, identifying synergies, and selecting focus areas are crucial steps. The E-kamer initiative has faded, and its successor, EE-NL, has yet to gain momentum. The ineffectiveness of EE-NL is attributed to the lack of clarity regarding its mandate. Without a clear mandate and funding distribution, EE-NL functions as a

[1] The numbers in brackets correspond to the recommendations outlined at the end of each Chapter

friendly discussion group without actionable outcomes, leading to low enthusiasm to invest time and effort.

The Committee would have preferred to assess the three EE departments in the Netherlands simultaneously. Unfortunately, TUD declined to participate in this assessment, which the Committee views as a missed opportunity and a negative indicator for future collaboration.

The collaboration between three TU's could be an important instrument in voicing to the Dutch Government the perceived threats to academia, including 1) financing of low-TRL research and 2) the international character of universities. Internationalisation and fundamental groundbreaking research are essential for a viable Dutch academy. It is of utmost importance for the University leadership to secure these two components within the Dutch research landscape.

## 2.3 EE-female talent recruitment and Junior Staff support

On average, the self-assessments report minor increases in female staff for both universities across various positions, suggesting that some improvements to gender balance are being made with current policy. Nevertheless, more significant change is still needed to achieve self-set goals and get to a more desirable gender balance.

Staff report difficulty in reaching a large pool of female technical talent, a significant issue shared with other Northern and Western universities. This problem is partly due to the name "Electrical Engineering," which non-specialists often associate with "electronics". Human-machine interactions, energy solutions, information processing, medical technology, aeronautics, and material science are core aspects of electrical engineering that may attract more women but are not widely

recognised as part of the EE discipline. Possibly, how EE is branded can be re-evaluated.

The Committee recommends adopting a recruitment approach that is more attractive to women and to try to identify other underlying factors [2].

Furthermore, offering work-life balance is crucial for being able to attract young faculty in general, and especially women. Aspects of career planning, training, mentorship, and parental leave planning for PhD students and junior staff seem to be managed on a research group level - and therefore depend on the specific group leader, who may or may not be qualified for such tasks. The Committee recommends professionalising these aspects and organising those on a higher organisation level to ensure clarity, transparency, quality control and minimise risk of bias. Formalise, plan, measure, and publicly reporting measures and their results can lead to transparency and reduced bias.

It was also noted that female researchers said they are often requested to join committees to ensure gender balance, and due to the limited number of female researchers available, they are often overloaded by these requests.

## 2.4 INTERNATIONALISATION AND BASE FUNDING

The political climate is changing in the Netherlands. The now compulsory use of Dutch as the main language in BSc courses significantly impacts universities like TU/e and UT, which rely heavily on international students and staff. Additionally, cuts to essential funding, such as the sector plans, threaten the viability of both universities.

Internationalisation and fundamental groundbreaking research are essential for a viable Dutch academy, especially in the area of EE. It is of

utmost importance for the University leadership to secure these two components within the Dutch research landscape.

Furthermore, the two universities need to develop a plan to attract more external funding or, in a worst-case scenario, prepare to cut costs to balance the finances in case the sector plans will be discontinued. This is important as long-term scenarios for potential developments are currently missing, which are crucial for ensuring better preparedness for the future [3].

The Committee strongly recommends that the three technical universities team up to present a united front to the political establishment in The Hague, making this a core focus of the three technical universities with an Electrical Engineering discipline [4].

## 2.5 Extra question to the Committee

The Committee also reflected on a separate request for advice to the Executive Board regarding the financing of expensive equipment used in EE research and lab facilities. This financing is an ongoing concern and is a well-known internationally recognised challenge. The Board seeks a critical assessment of how TU/e and UT handle this situation and welcomes suggestions from the Committee's international members.

The Committee believes that lab services could be more professionalised. This includes centralising labs to avoid ‘duplication' (which results in low use rates), combining laboratories, sharing support staff, keeping track of use rates, and improving the use rate by conducting more tests per square meter. Inviting companies and external researchers to use the labs could also be beneficial.

The Committee observed no planning of expected expenses to maintain facilities, keep them up to date and retain support staff, nor financial forecasts accounting for large expenses. Therefore, the Committee

recommends accounting for the depreciation of the facilities [5]. Also, we recommend that the universities account for the cost of use of laboratory facilities rather than the cost of procurement of the laboratory facilities as is common practice today.

In summary, the EE departments at UT and TU/e need to improve the mission statements to better reflect core strengths and activities. Cooperation and alignment among the three technical universities are crucial for strategic deployment, but the EE-NL initiative lacks mandate, clarity and effectiveness. Female talent recruitment requires a more pro-active approach, and the changing political climate necessitates a united representation towards the Dutch political arena for internationalisation and fundamental research. Lastly, financing expensive equipment and support staff for research and lab facilities needs more professionalisation and planning to ensure sustainability. By addressing these areas, the EE departments can enhance their impact and ensure their long-term viability.

## 2.6 List of recommendations

The Committee recommends EE@TU/e and EE@UT both to[2]:

[1] Improve their mission statements to better reflect their key strengths and activities and make their unique vision and competitive edge visible.
[2] Adopt a recruitment approach that attracts more women.
[3] Make a plan to increase external funding or reduce costs in case the base funding will be cut drastically.
[4] Team-up with the three technical universities with an Electrical Engineering discipline to present a united front regarding important topics such as internationalisation and base funding.

[2] The list of recommendations is limited to the Committee's most crucial observations.

[5] Account for the maintenance and depreciation of the facilities and professionalise the planning and use of laboratory time and support staff.

# 3 Assessment of the Electrical Engineering faculty of the Eindhoven University of Technology

| | |
|---|---|
| Dean | Prof. dr. ir. M.J. (Mark) Bentum |
| Research staff 2023 | 162 Research FTE (excl. PhD and EngD) |

The Faculty of Electrical Engineering is one of the nine faculties of the Eindhoven University of Technology. Long-term mono-disciplinary research is the responsibility of the research groups of the department. EE@TU/e consists of nine research groups: Control Systems (CS), Electro-Optical Communication Systems (ECO), Electrical Energy Systems (EES), Electromagnetics (EM), Electromechanics and Power Electronics (EPE), Electronic Systems (ES), Integrated Circuits (IC; formerly Mixed-Signal Microelectronics), Photonic Integration (PhI) and Signal-Processing Systems (SPS).

The self-evaluation report states: "The mission of the Faculty of Electrical Engineering is to acquire, share and transfer knowledge and understanding in the whole field of "Electrical Engineering" through education, research and valorisation. The Faculty aims to be a research-driven and design-oriented world-class institute by having education, research and valorisation reinforce each other. Activities share an application-oriented character, a high degree of complexity and a large synergy between multiple facets of the field."

The strategic goals of the department for the coming 5 years are:

- Strengthen the cutting-edge research in the focus areas by strategic hiring, investing in research infrastructure, and promoting interdisciplinary collaborations;

- Target long-term funding programs as a means to enlarge research consistency, relieve some of the pressure on funding acquisition and sustain financial viability;
- Strengthen the connections with other departments, by involving them in the Centres and further engagement in interdisciplinary research through the university Institutes;
- Develop a structure for empowering the next generation;
- Develop the EE department as an inclusive, socially-safe workplace with equitable opportunities and career development;
- Make sustainability an equal weighted factor in choices of the faculty, included in workforce development and career opportunity;
- Continue to improve the gender balance;
- Attempt to sustain the autonomous growth rate the department has shown over the last two decades, accompanied by a similar increase in student influx.

The research staff is composed of 100 FTE scientific staff[3], 62 FTE researchers and 261 PhD candidates (2023).

## 3.1 General remarks

**Mission**: It is important that a mission statement is a simple and brief description that encompasses the purpose of the university defining its culture, goals, and values. It helps partners, customers, employees, and investors to develop a clear vision of the university's top priorities. During the visit, the Committee was happy to see that the faculty had a good idea of what set them apart from other universities and what their goal, value and purpose is. However, the current mission statement is overly broad and lacks a distinct identity and vision, diminishing its impact. It could apply to any department or university, failing to

[3] Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

highlight what makes this specific department unique. To enhance its effectiveness, incorporating a bold and specific goal could be considered, such as aspiring to become a "4th generation university" or aiming to "combine the application-oriented with groundbreaking or pioneering research". This specificity would make the mission statement more compelling, memorable and actionable.

Furthermore, the mission statement does not address the societal relevance or impact of the department's activities. Emphasising these aspects would enhance its appeal and demonstrate the department's commitment to making a difference. The current focus on factors beyond the department's control for growth is also problematic. It is crucial to anchor the mission statement in achievable and department-driven goals.

On its own a phrase like “Activities share an application-oriented character” lacks the ambition expected of a leading academic institution. Combining it with a reference to groundbreaking or pioneering research makes the statement sound more suitable for a top-tier university. The current description of the vision, EE@TU/e, reflects the outcome of operations within the existing Dutch funding landscape rather than presenting a forward-looking ideal.

The mission statement should be adapted to emphasise “Cutting-edge Innovation,” as highlighted in section 6.1.1. While the Committee acknowledges the practical choices made by the EE leadership to address local challenges with an application focus, it criticizes how these choices are communicated through the mission statement.

The Committee recommends personalising the mission statement to better reflect the department's unique identity and vision [6]. Strengthening this statement will help convey a clearer and more inspiring direction for the department, aligning with its aspirations and potential.

**Competitive edge:** During the site visit, the Committee was happy to experience that the university has a competitive edge, however the self-evaluation report and mission statement of EE@TU/e lack a clear articulation of the department's competitive edge. This omission may stem from the competitive edge being so ingrained in the department's culture that it is often overlooked, or that the university is so successful in attracting funding and has such a good reputation that a good written formulation, which sets TUE apart from other universities, is not needed. While the Committee observed an outstanding sense of community within EE@TU/e, it remains unclear how aware the department is of its other core strengths.

It is important that EE@TU/e actively seeks feedback to identify and highlight its core strengths, including comparisons with other universities to gain an external perspective. Staff feedback identified several competitive advantages, such as the strong link to the high-tech industry and healthcare, synergistic partnerships between academia, medical centres and industry, emphasis on innovation and challenge-based learning, and expertise in technical areas like integrated photonics, next-generation wireless technology, and the semiconductor environment. Recent initiatives, such as the flagship 'Future Chips' project, also contribute to the department's competitive edge. EE@TU/e is well-equipped and positioned to explore new areas, and it is essential to communicate that valorisation is a central focus of the faculty. Furthermore, the University and/or department should strategically identify and address the long-term influence of major societal trends, such as the multi-crisis (climate change, biodiversity loss, and the unsustainable economic framework focused on growth and consumption) and AI revolution, in its operations, while also positioning itself as a leader in aligning and guiding educational, research, and valorisation activities to proactively respond to these evolving challenges.

In summary, the Committee recommends developing strategies to better foster, promote, and market the department's unique strengths

and competitive advantages, including identifying long term strategic trends [7]. This should include a robust marketing plan and consistent internal and external communication efforts. EE@TU/e can enhance its reputation and attract more talent, partnerships, and opportunities by clearly identifying and actively promoting its competitive edge.

**Strategy and objectives:** During the site visit, the Committee explored the communicated expectations regarding groundbreaking research and the mechanisms in place to incentivise, steer, and guide the faculty. It was noted that the sector plan has provided opportunities for more open and fundamental research. The strategy of maintaining numerous contacts with industrial and clinical partners and other departments is designed to facilitate joint programmes and operations, including creating roadmaps with industry. While there is a perceived risk that a company might collapse, the roadmap remains intact, allowing EE@TU/e to continue developing new propositions and initiatives.

Although the Committee acknowledges that EE@TU/e's strategies are valid, they are not clearly formulated, and the objectives remain vague. While the current report suggests that there is a strategy and goal, definition and measurement of success is lacking. The Committee therefore recommends enhancing the measurability of the strategy and objectives [8]. An explicit international strategy remains a question mark to the Committee and should be included in the objectives.

By addressing these areas, EE@TU/e can strengthen its mission statement, better articulate its competitive edge, and develop clearer and more measurable strategies and objectives. This will not only enhance the department's identity and vision but also improve its appeal and effectiveness in achieving its goals.

## 3.2 Research quality

The university is successful in attracting external funding, suggesting that the collaborations lead to desirable outcomes with the research quality perceived to be of good or high standard by the collaboration partners. The presentation of the EE research area using a multi-layered circular diagram is enlightening, effectively showing the progression from core disciplines to societal challenges. However, the Committee observed a lack of quantitative bibliometric information necessary for a comprehensive external assessment. Additionally, there is limited critical engagement with the selected metrics. As an example, the 'top conferences' and 'top journals' in Appendix I.1, are defined as 'their favourite journals'. The current Key Performance Indicators (KPIs) at EE@TU/e do not adequately reflect research quality, instead focusing on research quantity.

EE@TU/e appears to lack a clear set of KPIs. The listed KPIs seem mostly anecdotal and are not consistently applied in practice. Junior and mid-level staff are often unaware of these KPIs, indicating that they are not embedded in the departmental culture. For example, while patents were mentioned as an important KPI by staff, these, along with spin-offs and other tools (e.g., software, standards, and infrastructure), are only partially registered.

The Committee recommends developing comprehensive and uniform documentation of awards, software, spin-offs, patents, prizes, and other recognitions to fully assess research quality across different groups. It is also suggested that “other products” be included in the scientific KPIs and that these KPIs be effectively communicated to staff.

Furthermore, the department strives to be groundbreaking and field-leading in strategic research fields like robotics, neuromorphic computing, AI, and e-health, ensuring systematic development from lower to higher technology readiness levels. Observations indicate that the research conducted is indeed both fundamental and applied.

However, applied research is more easily pursued due to challenges in securing funding and PhD candidates for fundamental research. Some junior staff reported difficulties in conducting cross-disciplinary research and publications. Additionally, some PhD students are unaware of citation and impact factors, which could affect their future careers.

The university should consider defining success - hence KPIs - on the different TRL levels since they aim to cover a wide range of TRLs (2-7, p.3 of report). For fundamental research, (TRL 1 – 3), the KPIs are likely different compared to applied research (TRL 4 to 5) and prototyping (TRL 6 and 7), hence clarifying what success means for the different TRL's would be beneficial.

## 3.3 Relevance to society

The research at EE@TU/e is structured into nine largely autonomous groups, each conducting long-term, monodisciplinary, fundamental research. Medium-term, cross-disciplinary research, encompassing both fundamental and applied aspects, is organised within research centres. These centres promote collaboration among different research groups, both within and outside the department, often in partnership with external entities. They contribute approximately half of the department's external funding and are dynamic, frequently evolving entities. Currently, there are three centres: CWTe, C3Te, and CPSe, with a fourth centre, CTSTe, being established in the area of terahertz research. The Eindhoven Med-Tech Innovation Center (eMTIC) involves collaboration with five other departments, Philips Research, and clinical hospitals in the Eindhoven region. In photonics, the JePPIX platform initiative plays a significant role.

**Societal Impact and adaptation:** these centres clearly facilitate cross-disciplinary research and are able to bridge the gap to society by developing more applied products in collaboration with the relevant

external partners. Appendix II.1 mentions some impressive realisations of the research centres highlighting the potential and success of these centres. While the culture at EE@TU/e inherently aims to impact society, this is not explicitly mentioned in their reporting. Notably absent are topics such as the impacts of climate change and climate transition. Addressing these issues is crucial and will help prepare the department for the next generation of purpose-driven students and can enhance promotional and marketing efforts, also potentially attracting more women to the field.

There is a surprising lack of reflection on the implications of major societal trends, specifically the multi-crisis and the AI revolution. How these trends will affect operations and necessitate adaptations in education, research, and valorisation portfolios remains unaddressed. A university should not merely respond to societal trends but should actively support society by helping to identify and develop pathways towards the future. Considering these questions may require forming a broad think tank with members from within and outside the EE area, including faculty, young students, industry and healthcare representatives, governance, and non-profits, or aligning with existing think tanks.

Societal impact is also highlighted by outreach activities, which seem to be only partially registered by the Pure system. These activities could be more structurally reported and formally rewarded.

**Number of graduates:** The number of graduates is considered a key measure of societal relevance for research, though it is the most evident output expected from a university and does not reveal the department's identity or vision. The number of master's graduates has remained constant, between 80 and 100 annually, since 2016. The department aims to increase this number to 150 with the introduction of the new master's programme in AI and engineering systems. The Committee sees the aim to increase the number of students positively, since many companies have difficulties recruiting talent.

**Collaboration with industry:** Appendix I.6.1 of the self-evaluation report details the various external research contacts with industrial partners and research institutes. The relationship with industry is world-class, characterised by strong collaborations within a vital and unique ecosystem and frequent staff exchanges. This network includes 70 members (appendix 1.6.2) with part-time professorships or consulting roles, often within medical centres, leading to long-lasting commitments that significantly contribute to societal impact. This network offers a unique advantage compared to other universities leading to synergistic partnerships between academia, local medical centres and industry. This is particularly attractive for (female) students and applicants who can cover the complete process from research idea to clinical care innovation. Despite this, the department lacks a systematic approach to European and international collaboration, which should be addressed. It is recommended that EE@TU/e seeks active collaboration not only regionally but also with international partners, such as those in the US [9].

**Innovation potential and reporting:** The innovation potential at EE@TU/e is substantial, not only in industry but also in societally relevant areas such as medicine and healthcare. However, there is insufficient systematic reporting on patents and spin-off companies, which are crucial KPIs for measuring innovation potential. The department recognises both the benefits and risks of close cooperation with industry. The Committee views it positively that EE strives to maintain relative independence by diversifying and evaluating new projects concerning current research expertise and portfolio within the staff team.

In summary, while EE@TU/e demonstrates strong societal relevance through its structured research groups, dynamic research centres, and robust industry collaborations, there are areas for improvement. The department should explicitly address major societal trends, enhance its systematic reporting on innovation metrics and outreach, and adopt a more strategic approach to international collaborations. By addressing

these issues, EE@TU/e can better showcase its societal impact, attract a diverse range of students, and strengthen its global research presence.

## 3.4 VIABILITY

**Leadership and growth objectives:** The leadership at EE@TU/e is pragmatic, which is commendable. Organic, bottom-up growth is evident, while top-down organisation is seen in flagships and world-class collaborations, such as those with medical centres. It is recommended to adopt more top-down approaches in areas such as leadership education and career management to highlight core strengths.

The university aims to double the number of graduates in the next 5 to 10 years (TU/e scale-jump). For EE to meet this goal, a 30% increase in staff (feasible) and more office and lab space (problematic) are required. This goal may impact overall viability or needs a strategy to be addressed in the right way. For this, the department can rely on strong assets, for example the fact that 80% of the TU/e students get a first job in the Brainport region. Moreover, the stay-rate of the international students is highest of all Dutch universities.

**Industrial collaboration and research focus:** Focusing on strong industrial and clinical collaborations to address funding issues is prudent. However, this also necessitates an emphasis on fundamental research.

**Humanities and societal impact:** Increasing the involvement of the humanities – transitioning from STEM to STEAM (Science, Technology, Engineering, Arts, Mathematics) – is essential. The department is already addressing climate issues but should explicitly and structurally connect research to the Sustainable Development Goals (SDGs) to build a stronger profile.

**Infrastructure and housing:** During the site visit, the Committee noted that the infrastructure is up-to-date, though the housing situation is tight, which hampers collaboration and community building. The Committee appreciates the ample workspace facilities for bachelor, master and PhD students within the Flux building enhancing a cooperative atmosphere among students and with staff. While staff were relaxed about funding and cost management, a more professional approach is needed. The lack of internal accounting for facility costs results in no incentives for efficient facility use. Some labs appeared unorganised, which might potentially cause ARBO-related issues in the future. The Committee recommends to pay improved attention to lab usage and financing which lead to better reinvestments [10].

**Strategic analysis and benchmarking:** Following recommendations from the previous research assessment, the department conducted an internal strategic analysis and initiated a benchmarking project with the EE department at Chalmers University. Three positive online meetings have been held, with further conclusions pending.

In a meeting with the vice-rector, the ambition to become a 4th generation TU – engaging in science with society – was discussed. The vice-rector implicitly requested the Committee to find a comparative institute. The Committee suggests the University of Melbourne or the Norwegian University of Science and Technology (NTNU) in Trondheim but recommends further searching for a suitable comparison partner [11]. Additionally, benchmarking should be performed more structurally and with greater depth, focusing on concurrent challenges.

By addressing these areas, EE@TU/e can strengthen its leadership, enhance its research and societal impact, and ensure sustainable growth and viability.

## 3.5 Open Science

Regarding publications in journals and conferences, 75% of papers from EE@TU/e are open access (OA), with this percentage increasing. An additional document mentions 71%, while 87% of TU/e publications were OA in 2023. The lower number for EE@TU/e is primarily due to the policies of IEEE journals, which do not widely support OA. The department's top journals are published by IEEE or Elsevier, which are not OA, although efforts are being made to pressure these editors to change their policies.

The Taverne amendment to the Dutch copyright act significantly facilitates the right to publish OA. The TU/e repository, Pure, stores and manages 135 datasets and makes formally closed publications available free of charge, although this is still a work in progress. TU/e also provides OA to educational materials, with master's course materials already publicly available, though bachelor course materials are not yet included and it is surprising that open access courses are not considered a KPI or output indicator. This is a strong asset compared to other universities, improving visibility and possibly attracting more students.

In practice, the extent to which Open Science is embraced varies by group, despite university-wide policies. The implementation of OA rules is still in progress. The Committee observed that Open Science is strongly encouraged nowadays, as it can lead to more citations.

The Committee recommends that EE@TU/e should continue to pressure IEEE and Elsevier to adopt more OA-friendly policies and utilise the Taverne amendment to maximise OA publishing within the existing legal framework [12]. Additionally, efforts should be accelerated to make closed publications available in the TU/e repository, Pure, and to increase the number of datasets managed and stored in the repository. To enhance reproducibility of research results, open source should be recommended by making the source codes of the software and measurement data of experiments available on public repositories as

much as possible and by promoting research data management plans. It is crucial to encourage uniform adoption of Open Science principles across all research groups and support the implementation of OA policies to ensure consistency with university-wide objectives.

By addressing these areas, EE@TU/e can further enhance its commitment to Open Science, leading to greater accessibility, visibility, and impact of its research.

## 3.6 PhD Policy and Training

EE@TU/e follows the guidelines of the Graduate School. Since 2018, the Hora Finita Progress monitoring is used. Each student has at least 2 (co)promoters and together with the supervisor they set up the training plan, support and preparation to next career steps. Members of the scientific staff stated that they aim to limit the number of supervisees per permanent staff member to three. While this is not a strict or formal rule, and exceptions are common, it generally helps to allocate more research time for permanent academic staff and promotes a healthy supervisor-PhD ratio as a consideration and priority for supervisors.

As part of their training, PhD students must follow a mandatory course in scientific integrity. Students from the SPS group and the Eindhoven Med-Tech centre also follow a mandatory RDM course. However, courses to develop more general skills such as leadership, inclusivity, sustainability, diversity, scientific writing, etc. are optional only or are not given. Furthermore, there is currently no systematic career development support, neither towards industry nor academia. Support for these aspects varies among units and supervisors, undermining quality assurance across the department. It is recommended to centrally organise general skill development of PhD students in areas of project and academic leadership, inclusivity, sustainability, diversity, ethics and scientific writing [13].

There has been a notable increase in PhD enrolments at EE@TU/e, from approximately 70 in 2016 to about 85 in 2023. The number of PhD dissertations has almost doubled between 2017 and 2023. Despite a dip due to the COVID-19 pandemic, the number of organised scientific events has remained consistent with 2016 levels.

The duration of PhD programmes is a concern, with more than 20% of PhD candidates not finishing within seven years (Appendix IV, Table E4). The completion rates for 2018/2019 were particularly poor. Despite this, the drop-out rate for PhD candidates has decreased from 20% in the previous assessment period to 5-10% currently, indicating a positive trend.

Alumni have reported that the department's competitive edge lies in its strong sense of community. There is a focus on creating an inclusive work environment, which is highly appreciated by industry, and substantial support is provided for students. PhD candidates highlighted that they learnt most from internships, partnerships, and peer-to-peer collaboration. They valued learning to work independently and emphasised the importance of collaboration.

However, the extent to which collaboration is stimulated varies across different groups and fields, indicating a lack of a structural approach to collaboration. PhD completion is associated with typical stressors such as workload, job offers, and the challenges of finishing and writing dissertations. International students also face visa issues, adding to their stress. Formal and informal support structures for PhD students vary between units or supervisors, undermining quality assurance across the department.

The department does not have active alumni networks; however, this is not considered a significant drawback. Alumni tend to feel primarily attached to their specific research groups rather than the broader university.

To address the issue of prolonged PhD durations, the Committee recommends EE@TU/e implement stronger measures to support timely completion [14].

## 3.7 Academic Culture

**Academic culture**: The department exhibits a collaborative attitude and a positive, cooperative working culture that fosters teamwork. The collegial atmosphere prioritises collaboration over hierarchy or competition. The community is welcoming to students and new staff, regardless of their background, and pays close attention to integrating new members into the team. Overall, the academic culture is perceived as open and inclusive, with generally satisfied staff.

Staff turnover is low, and sick leave is minimal, with a 1.2% absence rate. This is possibly due to a lack of (incentives for) reporting of sick leave, which is typical in an academic setting. A sense of community is promoted by organising events that keep EE staff informed and provide opportunities for socialising. The department appears to invest significantly in the careers through the recognition & rewards initiative and well-being of its researchers through various well-thought-out mechanisms.

**Social safety**: In terms of social safety, EE adheres to university policy. PhD students, who are particularly vulnerable, require extra attention. A National PhD survey from 2022-2023 indicated that 24% of EE PhD students encountered undesirable behaviour in the past year, and 36% did not feel supported by TU/e (with the figure rising to 60% across all TU/e departments). These are concerningly high percentages.

During the site visit, the Committee noted measures to address these issues, including the establishment of a confidential contact person for PhD students to lower the barrier to sharing concerns. This contact person is trained to redirect students rather than counsel them directly.

Additionally, the implementation of two supervisors from the same group for each PhD student (the four-eyes principle) is in place. A team is actively working on these issues, though no results or clear plan have been reported.

The Committee recommends prioritising the improvement of social safety and accelerating the process, working in a more structural manner and with a clear path toward resolution [15].

**Inclusivity**: The Committee observed an inclusive and welcoming environment at EE@TU/e. However, the approach to gender and inclusivity appears to be reactive: support is provided only if a problem arises. There are no regularly organised meetings or training courses on sustainability, diversity, (gender) bias, cultural awareness, team building, leadership and inclusivity within the groups, although such discussions and trainings do take place. There is a risk that issues not raised from the bottom up may go unaddressed. Inclusivity is not a prominent topic among PhD candidates, who only mention one mandatory course (on scientific integrity). Additional training in the afore-mentioned skills enhancing inclusivity is recommended [16].

The Committee was informed that some working groups, which should include international or non-Dutch-speaking staff, may not be perceived as fully inclusive, as they tend to operate predominantly in Dutch. To proactively prevent undesirable behaviour, the department should establish a dedicated group to address these topics, including interpersonal interactions and the environmental setting. During the site visit, the Committee learned about workshops on these topics, and a non-violent communication course has been implemented in one group and is now being expanded department-wide with a six-month evaluation planned.

The Committee recommends that EE@TU/e develops structural strategies to address inclusivity at all staff levels [16]

**Research integrity**: Regarding scientific integrity, EE adheres to university policies. TU/e adopted its own code of conduct in 2019, which must be signed by all academic staff and master's students. There is also a complaint procedure, including a confidential advisor, a complaints committee, and a promotion plan. No cases have been reported thus far, likely due to the flat hierarchy and the significant role of close cooperation in research. PhD students are required to complete a mandatory course on scientific integrity as part of their training. The Committee observed no flaws in the practice of research integrity and commends the effectiveness of the research integrity measures within EE@TU/e.

## 3.8 Human Resources Policy

**Talent management:** Junior staff at EE@TU/e identify the department's competitive edge as its people, infrastructure, strong and healthy research groups, and an exceptional culture of mentorship, though mentorship is not structurally offered. They also appreciate academic freedom and strong industry connections. Increasing second-tier funding is expected to enhance independence and allow research directions within the department to become more autonomous from industry contracts, thus making long-term fundamental research more sustainable. However, the numbers for ERC (European Research Council) grants are not impressive. The Committee learned that while ERC applications are actively stimulated and coached, with results improving post-reporting period, there is potential for further enhancement. Aligning internal promotion processes and focusing on securing grants could be better communicated. The Committee recommends systematically encouraging and supporting academic staff to apply for prestigious personal grants, despite increasing competition [17].

The Committee also got the impression that the relative ease to attract external funding, other than ERC grants, creates a high barrier to apply for ERC grants, which could pose a long-term disadvantage for younger staff.

The Committee was somewhat concerned about the cap on the number of PhD students that supervisors can manage, but learned during the site visit that this is an average rather than an official cap. See also sector 3.6.

**Diversity:** Cultural diversity is strong, with more than 50 nationalities represented. However, gender balance remains an issue. The Irene Curie Fellowship (ICF) program, which promotes additional positions for female staff by opening vacancies exclusively for women for the first six months, aimed to attract at least 30% female staff but only achieved 15%, primarily increasing the gender ratio among Assistant Professors (UDs) with limited impact in other categories[4].

To further diversify academic careers, EE has implemented CV-based career development in the promotion procedure in line with the Recognition & Reward initiative ("Room for everyone's talent," applicable to all Dutch universities). New staff receive initial funding to cover their first PhD project, and all professor positions (from Assistant to Full Professor) are now permanent, eliminating the tenure track. The ICF also opened three generic vacancies and matched applicants' interests with relevant groups. While the Committee appreciates these efforts, it believes there is still room for improvement.

The Committee recommends improving the gender balance across all categories of academic staff by continuously monitoring the gender

[4] Sectorplan-I was the starting point of the ICF. Of the original 12.5 Sectorplan-I positions managed by the EE department, most of the senior positions were split into two junior positions, so EE ended up with 17 vacancies. Of these positions, 8 have been filled by women, which was well above the target set for Sectorplan I (35%). Of course, the change in the total picture is less.

statistics at all levels and proactively seeking suggestions from students and alumni on how to enhance this balance [18].

**Workload:** Staff report a high workload but generally find it manageable, as it is often self-imposed. The flexibility to participate in projects and educational activities, along with active discussions about workload in some research groups (in some cases structurally, every six months), helps manage work stress. Staff also appreciate the significant support from the department, and the yearly evaluation of workload is well addressed.

Targets for reducing workload were partially successful due to the recruitment of more Postdoctoral Researchers (PDs) and the reduction of the temporary-to-permanent staff ratio to 2.5 (well below the target of 3). Several concrete initiatives have had mixed outcomes, as shown by an employee experience survey in 2021, which indicated that the experienced workload remains high, as is the case in other TU/e faculties.

The Committee recommends continuing to monitor and manage workload through flexible project participation, active discussions, and comprehensive support systems to ensure that staff can effectively manage stress and maintain mental health [19]. Also, setting up a mentorship programme, including mental health training, should be helpful [20].

By addressing these areas, EE@TU/e can further strengthen its human resources policy and enhance the overall well-being and productivity of its staff.

## 3.9 List of recommendations

The Committee recommends EE@TU/e to[5]:

[6] Personalise the mission statement to better reflect the department's unique identity and vision.
[7] Develop strategies to better foster, promote, and market the department's unique strengths and competitive advantages, focussing not only on technical but also on sustainability and societal aspects. This includes strategically identifying and addressing the long-term influence of major societal trends.
[8] Enhance the measurability of the strategy and objectives.
[9] Develop a systematic approach to seek collaboration with international partners, such as those in the US.
[10] Pay improved attention to facility and lab usage and financing which lead to better usage and reinvestments.
[11] Continue to search for a suitable comparison partner for an in-depth benchmark analysis.
[12] Continue to pressure IEEE and Elsevier to adopt more OA-friendly policies and utilise the Taverne amendment to maximise OA publishing within the existing legal framework.
[13] Centrally organise general skill development of PhD students in areas of project and academic leadership, inclusivity, sustainability, diversity, ethics and scientific writing.
[14] Organise stronger measures to support timely PhD-completion and proactively include career planning towards either industry or academia during the PhD process.
[15] Prioritise the improvement of social safety and accelerating the process with a clear path toward resolution.
[16] Develop structural strategies to address inclusivity at all staff levels, including skills training.

[5] The list of recommendations is limited to the Committee's most crucial observations.

[17] Systematically encourage, incentivize and support academic staff to apply for prestigious personal grants.

[18] Improve the gender balance across all categories of academic staff by continuous monitoring of gender statistics and proactively seeking suggestions from students and alumni on how to enhance this balance.

[19] Continue to monitor and manage workload through flexible project participation, active discussions, and comprehensive support systems.

[20] Improve mental health by setting up adequate training and mentorship programmes.

# 4 Assessment of the Electrical Engineering discipline of the faculty EEMCS of the University of Twente

| | |
|---|---|
| Interim Dean | Prof.dr. ir. Peter Veltink |
| Research staff 2022 | 74.7 Research FTE (excl. PhD and EngD) |

The UT has three research institutes and five faculties. One of the faculties is Electrical Engineering, Mathematics and Computer Science (EEMCS) in which Electrical Engineering discipline resides. EE@UT consists of 12 research groups of which three are both in the Electrical Engineering and Computer Science disciplines. The research groups are: AMBER, Biomedical Signals and Systems, The BIOS lab-on-a-chip group, Integrated Circuit Design, Nano Electronics, Robotics and Mechatronics, Integrated Devices and Systems, Power Electronics & Electromagnetic Compatibility, Radio Systems, Computer Architecture for Embedded Systems, Design and Analysis of Communication Systems.

The self-evaluation report states: “It is our mission to research and develop innovative EE Systems Technologies to serve society by bridging the gap between physics and computer technology using a broad spectrum from deep theory to demonstrable prototyping, and to teach our students to become responsible scientists capable of taking leadership roles in technical and societal matters”.

Strategic research fields that EE@UT will (further) develop are robotics, neuromorphic computing, artificial intelligence, and (e)health, organ-on-a-chip. In the context of an EE systems-approach, from a technological viewpoint EE@UT wants to concentrate on vertical integration of photonics and electronics, with a firm industrial embedding to safeguard long-term application perspectives. Other

aspects that are part of the next six years' strategy include PhD pass rates, the influx of EE students, financial autonomy, and diversity.

The research staff is composed of 74.7 FTE scientific staff[6] and 137 PhD candidates (2022).

## 4.1 General remarks

**Mission:** It is important that a mission statement is a simple and brief description that encompasses the purpose of the university defining its culture, goals, and values. It helps partners, customers, employees, and investors have a clear vision of the university's top priorities. The Committee was, during the site visit, happy to experience that the faculty had a good idea of what set them apart from other universities and what the goals, value and purpose is. However, the current mission statement doesn't comply with the overall intention of a mission. EE@UT's current mission to "bridge the gap between physics and computer sciences" is too general and lacks a clear focus on the research field. Given the need for a more purpose-driven approach to attract young talent, a rebranding of this mission is essential. During the site visit, the Committee observed that the current mission statement does not resonate with the staff and lacks the clarity needed to drive future initiatives. A stronger, more concrete mission statement will not only articulate ambition but also lay the groundwork for actionable steps.

The Committee recommends to rebrand the mission statement to one that is inspiring and aligned with sustainability goals [21]. This new mission should clearly define EE@UT's focus and objectives, motivating staff and stakeholders. For example, a mission such as "To lead innovations in sustainable electrical engineering solutions, driving

[6] Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

technological advancements for a better future" could be more impactful.

**Competitive edge:** EE@UT possesses numerous strengths that should be highlighted and leveraged to form a clear and compelling identity. Although these strengths are apparent in discussions and observations, they are not sufficiently reflected in current reports.

One of the most significant strengths is the collegial and collaborative atmosphere at EE@UT, which makes it easy for staff to join forces across disciplines. Both medior and junior staff emphasise the supportive environment and ease of collaboration, particularly within the TechMed Centre and the local ecosystem. This environment fosters strong relationships and encourages innovative research, making it a unique aspect of EE@UT's identity.

In addition to its supportive culture, EE@UT boasts excellent research capabilities and state-of-the-art laboratories. The presence of both TechMed and Nano+ centres provides valuable resources for researchers, facilitating advanced research and innovation. These facilities are critical to the institution's ability to conduct cutting-edge research and attract top-tier talent.

EE@UT also offers significant opportunities for SMEs and start-ups, supported by a robust ecosystem of knowledge and technology transfer. The entrepreneurial spirit is strong, and the university's network with local industry and larger companies such as Demcon, Xsens, and Thales positions EE@UT as a prime location for innovation and business growth. This network provides ample opportunities for collaboration and development, which should be a key part of EE@UT's identity.

The regional advantages of EE@UT further enhance its appeal. The cost of housing and living in the eastern part of the Netherlands is much lower, making it an attractive option for students and staff. Additionally, EE@UT's strong collaboration with companies, coupled with its open, dynamic culture and societal mindset, should be emphasised to attract

talent to the region. These factors contribute to a unique and appealing environment that distinguishes EE@UT from other institutions.

Another differentiating factor is EE@UT's distinctive approach to research, particularly its work on lower Technology Readiness Levels (TRL). The KPIs related to these levels are quantitative and relevant, providing a solid basis for internal and external evaluation. This focus on early-stage research is a key strength that should be highlighted in communications.

To fully leverage these strengths, EE@UT should work with faculty staff to develop and clearly communicate a distinct identity. This identity should be consistently marketed both internally and externally to build a unified vision and attract interest. Improving self-reflection to better showcase the strengths identified by the Committee is essential. The Faculty Board must be well-informed about these strengths to effectively pitch EE@UT to potential stakeholders.

Aligning the communication strategy with UN sustainability goals is also crucial to attract students, increase public interest, and secure funding opportunities. Emphasising the entrepreneurial ecosystem, including the strong network regionally and beyond, is vital. Highlighting the benefits for starting companies at EE@UT due to the proximity to students, facilities, and collaborative opportunities will further enhance the institution’s appeal.

Finally, tracking and reporting the success of start-ups, including metrics such as funding rounds achieved and longevity, will demonstrate the supportive environment for innovation at EE@UT. By focusing on these areas, EE@UT can develop a strong, distinct identity that leverages its strengths and attracts talent, funding, and partnerships.

In summary, the Committee recommends EE@UT to determine and emphasize the unique strengths and opportunities in their communications [22].

**Strategy and objectives:** EE@UT plans to further invest in several key areas, including robotics, neuromorphic computing, AI, e-health, organ-on-a-chip technology, and the vertical integration of photonics and electronics. These fields are increasingly important and represent the future direction of the department's research efforts. While there is a stated vision and mission, and some general aims are outlined, the focus of the research lines lacks concrete objectives for both the past and upcoming periods. This absence of clear objectives raises concerns about how the department's goals are defined and measured.

The Committee found it unclear what EE@UT aims to become, both at the departmental level and within individual research groups. There is a need for well-defined and measurable research objectives that align with the department's overall vision. Specifically, clearer research goals are needed especially to prepare the top management for the eventuality of a (funding) crisis. The overarching topic of system thinking was mentioned during the interview, but it is uncertain whether this is embraced uniformly among all staff.

The Committee recommends that EE@UT articulates its ambitions and formulates more concrete objectives and targets for the next period [23]. These objectives should be specific and measurable, such as doubling the number of students or developing certain research areas to a defined level of excellence. For example, the department could set a goal to achieve specific milestones in robotics or AI research, or to increase collaboration with industry partners in e-health and organ-on-a-chip technologies.

By setting these concrete objectives, EE@UT will not only clarify its future direction but also provide a clear framework for evaluating progress and success. This approach will help to unify the department around common goals and ensure that all staff is aligned with the overarching vision. It will also make it easier to communicate the department's ambitions to external stakeholders, thereby increasing

public interest and funding opportunities and attracting researchers and PhD students.

In conclusion, EE@UT should establish clear, measurable research objectives that reflect its ambitions and strategic priorities. This will involve defining specific targets for key research areas and ensuring that these targets are understood and embraced by all staff. By doing so, the department can better demonstrate and communicate its commitment to excellence and innovation, and more effectively attract the resources and support needed to achieve its goals.

## 4.2 Research quality

The research environment seems to be open and dynamic, organised in groups and research centres for interdisciplinary collaboration to tackle large societal challenges. Research is organised in 12 autonomous research groups covering the full range from hard core electronics (nano, micro, photovoltaic) to integrated circuits, communication, embedded systems, to information (signal and image) processing, and to robotics, automation and control, smart sensing. The research institutes (MESA+, DSI, TechMed) clearly foster the intergroup research collaboration and hence also research quality. They concentrate research on certain research foci (such as nano, AI, health) thereby attracting larger budgets (e.g. Growth funding). In addition, the EEMCS faculty promotes interdisciplinary research between the disciplines by awarding so-called Theme-team initiatives. These are nice incentives to stimulate interdisciplinary research within the faculty and aligns with the aim of linking technology to societal needs.

The quality of research at EE@UT is commendably high. This is evidenced by a Field-Weighted Citation Index of 1.2, indicating that EE@UT's research output is impactful when compared to global standards. Several of the research units (BIOS, AMBER, Robotics and

other) are internationally well-recognised. However, it would be beneficial to incorporate more international benchmarking, as current comparisons are predominantly Netherlands-based.

Regarding publication output, there has been a notable increase in peer-reviewed articles, from 188 in 2016 to 208 in 2023. The number of PhD theses has remained constant at around 33 per year. Despite this, there has been a sharp decrease in the number of publications per member of staff from 2016 to 2023. The Committee learned that this decrease might be a result of a deliberate shift by some of the research groups from quantity to quality in publications. The interviewed staff indicated that the focus is now on producing higher-quality work, which may have Staff indicated that the focus is now on producing higher-quality work, which may have led to fewer publications but with potentially higher impact factors. It is essential to substantiate this shift by providing evidence of increased impact factors.

The self-reflection on Key Performance Indicators (KPIs) was missing in the report, making it challenging to use KPIs to guide the organisation. Additionally, some fields within the KPIs appear to be short, incomplete, or poorly defined (e.g., 5.a, 6.a, 4.b). The Committee also observed during the site visit that the KPIs are not well integrated into the daily activities of the staff; many are not even aware of them. The Committee recommends structurally embedding KPIs into the research processes, not only for periodic reviews but as a continual part of the research culture [24].

EE@UT heavily relies on “famous researchers” who perform outstanding research and inspire many within the faculty. However, it is crucial to plan for the future, beyond the current staff, and to focus on promising research fields. Strategic areas identified for further development include robotics, neuromorphic computing, artificial intelligence, e-health, and organ-on-a-chip technology. It is important to aim for groundbreaking and field-leading research in these areas and to ensure that typical TRL 2-4 research systematically advances to TRL 5-

9. The ChipTech Twente cluster exemplifies this forward-thinking mindset.

In summary, EE@UT should continue to build on its high-quality research by incorporating more international benchmarking and by focusing on the impact of its publications. The strategic shift towards quality should be supported by data demonstrating higher impact. Embedding KPIs more deeply into the research culture will provide clearer guidance and improve alignment to organisational goals. Planning for the future by investing in strategic research fields will ensure EE@UT remains at the forefront of innovation and research excellence.

## 4.3 Relevance to society

The Committee appreciates the University's motto "High Tech-Human Touch," which effectively encapsulates the dual focus on STEM and Social and Behavioural Sciences. This theme is well represented throughout the report, illustrating how societal needs are addressed by the three research institutes. The connection between technology and human behaviour is illustrated well by figure 1.2, where EE is positioned as a cornerstone of society. The 12 research groups are shown at the intersection of the three research institutes, highlighting their role in linking technology to society.

**Cross-disciplinary research:** To address larger societal challenges, cross-disciplinary research is essential. The groups at EE@UT collaborate with larger research centres such as BRAINS, QUANT, and the EDGE centre, as well as the robotics centre, which combines robotics and AI and is initiated by two faculties: EEMCS and Engineering Technology. The latter centre, with one stop interface to the external world and a strong societally relevant focus on robotics for citizens encompasses a broad vision which connects education to research and

to valorisation. To address these needs, the centre also developed a new MSc programme on Robotics. This centre is the result of a nice strategic vision of the future of AI and robotics.

EE@UT groups often take leading roles in these centres, underscoring their leadership in interdisciplinary research.

**Industry cooperation:** The list of technical products (D.13) and the various forms of long-term collaboration with industry further demonstrate the societal relevance of EE@UT research. The Committee notes UT's strong tradition of industry cooperation and its success in maintaining excellent connections with SMEs. However, the Committee also observes that the technical products listed seem somewhat random and not well-defined, which is understandable given that universities typically produce fewer finished products compared to the number of projects undertaken.

**Spinoff and start-ups:** Another significant aspect of EE@UT's societal impact is the creation of spinoff and start-up companies. Since 1993, more than 30 companies have been launched, with EE@UT consistently creating a new company every year. These companies, generated by a diverse mix of research groups, are continuing to grow, thanks in part to the support provided by the UT. Many companies benefit from the "Tijdelijke Ondernemers Plaatsen" arrangement, which allows start-ups to use UT lab facilities and enjoy the advantages of the academic environment. For instance, Athom, a company started by students from the master's programme in Creative Technology in 2014, now employs 20 people. The Committee considers the number and growth of spinoff companies to be good.

**Visibility:** Despite the high relevance of EE@UT's work, its visibility, especially to the general audience, could be significantly improved. The list of outreach activities (Table D15) shows activities of specific staff members, but not a structured approach. The narrative could be strengthened to highlight EE@UT's role in technological R&D and its

contributions to solving sustainability problems. This enhanced storytelling is crucial for attracting students. Additionally, more focus on positioning EE@UT as innovative, connected with SMEs, and engaged in low-level TRL research is needed.

**Education and research:** The strong connection between education and research at EE@UT is another indicator of societal relevance. Bachelor and master assignments integrate research and education, creating a dynamic and multidisciplinary atmosphere. EE@UT offers a wide range of education, not only within its own programmes but also by significantly contributing to other BSc and MSc programmes, which generate more than 62% of its income. This flexibility in setting up new multidisciplinary bachelor and master programmes that meet societal needs, such as the bachelor in Creative Technology or the MSc in Embedded Systems and Technical Medicine, is a significant asset.

The education of engineers is one of the main products to deliver to society: workforce to fulfil our societal needs after having obtained the MSc or BSc degree. Figure 3.1 of the self-evaluation report shows an increase till 2021 and then a sharp decrease which is of big concern, partially explained by the pandemic. Moreover, study pace is on the low side, certainly after 2021. Less than 50% of BSc students graduate within 4 years, the overall drop out is 30-40% for BSc (however, mainly in the first year). These numbers are slightly better for Graduates (see Tables 3.1, G.3, G.4). Measures should be taken to improve the pass rates without lowering standards in order to improve the outflux.

In summary, while the societal relevance of EE@UT is very high, the Committee recommends that efforts should be made to enhance its visibility and narrative to attract a broader audience and more effectively communicate its impact to society [25]. In addition, measures should be taken to improve the BSc and MSc students' pass rate in order to increase their outflux to society.

## 4.4 VIABILITY

EE@UT is facing multiple threats, as discussed during the site visit and mentioned in the self-evaluation report. These threats include a decrease in funding, e.g. the sector plans, a decline in student numbers, increasing bureaucracy, and the negative political climate regarding internationalisation, which poses a major threat to EE. The latter has already been discussed in the joint section of UT and TU/e about EE in the Netherlands.

**Funding:** Research funding has increased considerably, primarily in contract research (third tier). Direct funding has increased by almost 53%, primarily covering the salaries of permanent staff. A significant portion of research funding comes from contract research (personal grants and EU projects, accounting for 20-25% of total funding), while second-tier funding (NWO, FOM, etc.) has decreased from 19% to 10% of total funding. Although this funding is highly competitive, it is financially less sustainable than third-tier funding since it does not cover the salaries of permanent personnel. Overall, the current funding is strong, with the research portfolio increasing to €15.8 million, and larger projects being funded, such as advanced ERC grants and Horizon 2020 EU projects. However, the Committee shares concerns expressed by 16 EE@UT about long-term financial stability, particularly the impact of the possible discontinuing of the sector plans. The Committee considers the existing ecosystem to be very strong and believes that participating in the entire TRL chain, together with the ecosystem, can help improve financial stability. It is crucial to ensure that the desired increase in staff is balanced with the availability of funding opportunities.

**Influx of students:** The influx of students is seen as the main challenge for the next ten years. EE@UT is partially dependent on the influx of international students, but the current political climate is not very supportive of this. The Committee believes that UT's location can be an advantage due to its proximity to Germany and the ample space for

economic growth, offering great potential in the long term. This, however, requires a mental shift. The Committee recommends capitalising on UT's location, as it is central in Western Europe, providing opportunities for collaboration with institutions like Münster University [26]. Positioning UT as a preferred university for German students could be a strategic move. Additionally, the remoteness of Twente may present opportunities to focus on building niche specialisation areas where EE@UT can be groundbreaking and field-leading, such as an innovation and entrepreneurship community or establishing global relationships rather than a local industry focus.

**Bureaucracy:** Administrative work is seen as a significant burden rather than a support. There is a desire for less paperwork and more trust, particularly concerning the Graduate School's requirement for one or two PhD supervisors. Administrative issues are present at all levels, and staff are not well-connected to services such as LISA and ICT. The Committee considers it essential to revise the administrative design by involving stakeholders (including faculty) in the process, obtaining formal approval from end-users (including faculty) before implementing new administrative methods, and establishing a change management system for systematically improving existing processes. The positive aspect is that the bureaucracy can be directly addressed internally. The Committee recommends reducing bureaucracy by improving software tools for communication, particularly concerning financial issues [27].

**Governance:** EE does not have its own governance structure but must find consensus among all research group chairs, with formal decisions made at the faculty level, where mathematics and computer science also compete. As a result of this organisational structure, research chairs and scientific staff have considerable freedom to develop their research programmes, allowing for collaboration on societally relevant topics and diversified career paths. Strategic decisions are made at the faculty level, leaving staff with limited scope to influence strategy at the discipline level. The Committee felt that the Faculty Board was somewhat distant from the discipline, unaware of specific challenges facing EE, and

therefore not well-equipped to develop effective strategies and lobby for their interest. The Committee concluded that this is more of an operational issue, i.e., related to the way the interactions between the two levels are currently conducted, than a governance structure issue.

**Leadership:** The Executive Board of the University of Twente has appointed Prof. Dr. Ir. Boudewijn Haverkort as the new dean of the Faculty of Electrical Engineering, Mathematics & Computer Science (EEMCS), effective 1 October, for a period of four years. Given the multiple threats facing EE@UT, the Committee believes that strong leadership from the new dean is crucial. This section can therefore be read as an agenda for the new dean. Although EE@UT excels in research, addressing financial stability, safeguarding future student influx, and reducing bureaucracy are critical issues requiring bold leadership. The new dean should guide the organisation towards a clearly communicated strong mission, vision, and strategy with concrete objectives. While there is much freedom among staff, the current challenges are too pressing for a laissez-faire approach. Academic freedom should not be confused with organisational freedom. Therefore, while the governance structure can remain unchanged, a stronger top-down and robust leadership is desirable, particularly in preparation for crises and to address issues such as clear career paths for junior staff, stability for PhD students, and fairness in expectation levels. The Committee strongly recommends that the new dean adopts bold leadership. In doing so, The Committee recommends to work very closely with the research group chairs, who form a strong and very capable group and who -today- carry the *de facto* vision of the Department, and who should be used as a key asset and sounding board [28].

**Infrastructure:** The UT campus infrastructure is excellent. Together with the neighbouring Kennispark, it includes a Nanolab, a Design Lab, a TechMed Centre, and an on-campus bridge between companies and researchers (Gallery and Novel-T offices). The infrastructure supports the required research and offers ample opportunities for industrial

collaboration. The various labs are well-equipped, fostering multi- and transdisciplinary research, providing academic freedom, and facilitating pre-competitive research. EE@UT could benefit from external input on financing their infrastructure. This involves better commercialising labs, addressing potential gaps in EU project involvement, and improving the network to establish a strong footprint in Europe, thereby increasing funding opportunities. The Committee recommends that EE@UT develop a business case around the infrastructure, considering both financing and commercialisation of the facilities [29].

In summary, while EE@UT faces multiple challenges, these can be addressed through strategic top-down leadership, improved funding strategies, leveraging geographical advantages, reducing bureaucracy, and better utilisation of infrastructure.

## 4.5 Open Science

UT has developed a comprehensive policy for research data management (RDM), which was bolstered in 2021 by the establishment of the Digital Competence Centre with funding from the Dutch Government. UT's "Shaping 2030" initiative established FAIR (Findable, Accessible, Interoperable, Reusable) data as the new norm for researchers. This university-wide RDM policy was further refined by the EEMCS faculty, resulting in practical guidelines and workflows for data handling. A data steward was hired to provide practical support for EEMCS researchers, and PhD students are required to take a course on RDM policy provided by the Twente Graduate School. These well-organised procedures are crucial for enabling open and FAIR data management.

From 2016 to 2023, the fraction of open access (OA) publications at UT increased from 75% to 90% in 2021 but dropped to 55% in 2023. This decrease, which includes green access that requires a prescribed delay

before becoming publicly accessible, is also attributed to the focus on IEEE journals and conferences, which have specific OA requirements. Consequently, the number is expected to increase in the coming years. There is good awareness of how to improve OA publications, and significant steps have already been taken. The Committee finds it promising that the Taverne amendment allows authors to place the publisher's version in OA repositories after six months of publication. UT has implemented this through the PURE repository.

The Committee considers it positive to see both OA publications and OA datasets and suggests defining a metric of success to implement and track progress. Encouraging the availability of software and data alongside publications is highly recommended, as it leads to more downloads and citations, faster dissemination of knowledge, and better transfer to society [30]. The divide between Open Science requirements and IEEE requirements may seem significant, but a closer examination could help bridge this gap and it is promising to see EE@UT staff push OA at IEEE journals.

Moreover, UT's data policy is very well developed, positioning the university as a leader in promoting open access publications and nearing the target of 100% open access. The "Shaping 2030" norm for FAIR data, along with the university-wide RDM policy, practical guidelines, and workflows established by the EEMCS faculty, and the support of a data steward, provide a robust framework for managing research data. PhD students' compulsory RDM course further ensures awareness and adherence to these policies.

In summary, UT's RDM and OA policies are well-developed and implemented, leading to significant progress in open science. However, continued support will be required to maintain these efforts. By continuing to refine these policies and address the challenges posed by specific publication requirements, UT can further improve its leadership in open access and research data management.

## 4.6 PhD Policy and Training

It is commendable that the number of incoming PhDs at EE@UT has been stable or has even increased slightly over the past eight years, especially given that many universities struggle to maintain PhD entry numbers. The PhD policy at EE@UT appears well developed. The Twente Graduate School (TGS) has established uniform procedures and rules for all candidates. Students are required to follow a strict Training and Supervision Plan (TSP) and complete a 30 ECTS programme, including mandatory courses in Research Data Management (RDM), academic integrity, and academic writing. The coaching of PhD students is also clearly described, with fixed frequencies for coaching meetings, which is not always the case in other universities. This clarity ensures that students can rely on intensive coaching. Additionally, there is a formal qualifier between six and nine months to assess whether the PhD student is qualified to continue.

However, the Committee noticed that some PhD candidates expressed dissatisfaction with TGS, feeling that its policies restrict their freedom, particularly with compulsory courses that they find uninteresting. Despite this, the Committee believes the current TGS approach is beneficial. It unifies all processes and procedures related to PhD students, setting a baseline for all. Certain topics, such as academic writing, are too universal and important to be left to individual groups and it is beneficial to have these at TGS level. The obligatory TSP is a strength, providing uniform training and supervision for all PhD students. Nevertheless, the sources of dissatisfaction with certain TGS courses should be further evaluated.

There is a high dropout rate of 25%. EE@UT expects improvements in the coming years, attributing past dropout rates partly to COVID-19. More factors explain the large dropout and/or slow progression such as a stop of external funding, early leave to the job market or not qualified enough. However, (mental and physical) health and well-being issues are mentioned as a major factor and are of serious concern. The

Committee noticed that the dropout numbers are not always recognised by staff, who find them surprising. The Committee believes that the PhD duration is often too long due to overly optimistic and ambitious planning, not fully accounting for practical delays. For international students, finishing on time can be particularly important due to visa requirements.

During the site visit, the Committee spoke to various junior staff and PhD alumni and gathered the following impressions: the level of courses is not always perceived as good, and mandatory courses are often disliked. There is a desire for fewer mandatory and more optional courses. Course requirements are sometimes unclear, and PhD students do not always receive sufficient training to supervise MSc & BSc students.

Regarding guidance, career advice is sometimes lacking and depends on the supervisor. If there is a good relationship between mentor and mentee, rules may be unnecessary. However, in the absence of this, rules and regulations are needed to avoid problems. Supervisors do not always prepare PhD candidates for industry. For example, it is important to offer international students opportunities to familiarise themselves with the (Dutch) industrial environment, especially those who wish to find a job in (the Dutch) industry after a PhD at low TRL level. The pressure from set milestones after 3 months, 12 months, etc., is seen as stressful but very helpful.

Promotion criteria are inconsistent and depend on the supervisor. Some PhD students mentioned that two publications are required for scientific success, while others do not see this as a formal requirement. Overall, PhD durations are longer than desired with less than 50% finishing a PhD within 5 years on average (Figure 4.1). In addition, the number of successful promotions has remained stagnant over the last years while the number of active PhD's have been increasing. Worryingly, some PhD students communicated that in some research groups, (un)successful completion of a PhD depends on "external" factors, i.e., factors outside

the student's direct control, such as academic competitors publishing solutions faster or the research results from a project not turning out as good as originally anticipated. The Committee recommends to define – and monitor (!) - the criteria for success clearly and transparently, ensuring that a student's success does not depend on external factors. This approach will provide clear career paths and stability for PhD students [31].

The Committee did not notice any evaluations of the PhD trajectory taking place and recommends conducting these evaluations, especially to identify the causes of the high dropout rate and duration [32].

## 4.7 Academic Culture

**Academic culture:** EE@UT seems to have an open and informal culture, as well as a societal and open mindset, with a strong focus on team spirit and collaboration and taking care of each other's talent in the team. These are strong assets for a healthy academic culture. The social atmosphere and team spirit created by common lunch breaks, regular brainstorm meetings looking for synergies were also confirmed by the Alumni. For example, according to the report (appendix A), the success of the RAM group is partly due to this atmosphere.

**Inclusivity:** Conform the faculty's policy, EE@UT recognizes the unique talents of each employee and is striving for more diverse teams. Therefore, recruitment is well organised by focusing on the talents of applicants and how they fit into the team. This policy applied to promotion facilitates more diverse career paths and should attract more female and international staff, as confirmed further on (see section Diversity). A nice tool to facilitate recognition and appreciation of diverse talents is the 9-grid tool which should be better promoted to junior staff and used as an active monitoring tool for inclusion within a group.

**Ethics and research integrity:** The scientific integrity complaints procedure at EE@UT is a notable strength. The University of Twente (UT) has developed comprehensive procedures to promote scientific integrity across all levels, culminating in the integrated integrity program known as the "House of Integrity." This initiative is well-documented on the UT website, providing detailed information on handling integrity issues and offering links to relevant resources.

PhD students have access to dedicated facilities for ethics assessment of research and innovations, scientific integrity education, and research data management. UT has also introduced additional initiatives such as Mindlab, the Dilemma Game, and Active Bystander Training to educate students on various aspects of integrity and ethics and prevent unacceptable behaviour. Complaints procedures for reporting and addressing violations of scientific integrity are fully developed and consistent with the national LOWI guidelines. Turnitin is used to check all PhD and MSc theses for plagiarism, ensuring academic honesty.

Furthermore, UT has formulated a policy for the use of generative AI in report writing, addressing modern challenges in academic integrity. The university has also adopted a comprehensive research ethics policy, facilitated by four domain-specific ethical committees, ensuring thorough ethics assessment across all research activities.

It is clear to the Committee that UT invests significant effort at the university level to advance scientific integrity. However, additional measures have also been implemented at the EE@UT level, such as the establishment of an integrity committee and mandatory integrity courses for PhD students.

Despite these efforts, the Committee observed during interviews with various staff members that integrity is often experienced passively. While all university-wide mechanisms are in place, there appears to be a lack of active discussion on the topic within the EE discipline. The Committee recommends that EE@UT encourages staff to address the

topic of integrity more actively, for instance, by periodically including it on the agenda of department or group meetings for discussion [33].

By fostering a more active engagement with scientific integrity, EE@UT can strengthen its commitment to maintaining high ethical standards in research and education.

## 4.8 Human Resources Policy

**Talent management**: EE@UT's new promotion policy recognises and appreciates diverse career paths, allowing employees with significant involvement in education and educational innovation to be promoted to full professor with a focus on education. This policy acknowledges the wide range of talents among employees and provides equal opportunities for promotion, which the Committee views as a promising development.

Promotion policies at EE@UT are documented, but not rigid, allowing for individual talents and career aspirations to be considered through the 9-grid tool. This tool, integrated into EEMCS policies and mentioned in the self-assessment report, helps guide junior staff towards appropriate career paths, whether in research, education, or management. However, the Committee found that junior staff are not familiar with the 9-grid tool and are uncertain about career advancement and promotion criteria. Clear communication from leadership is needed to address this uncertainty and actively steer junior staff towards their career goals.

The Committee observed that while junior staff enjoy a comfortable working environment, there is a lack of active encouragement to stand out. Leadership is needed to foster an environment where junior staff is motivated to excel, such as by pursuing ERC grants. The Committee recommends encouraging and supporting young staff to apply for prestigious personal grants despite the growing competition [34]. These

kinds of grants are also important to allow mobility to other universities. It was also noted that a lot of staff had been at the university for a long time, which might be an indicator for low mobility rate, which has its pros and cons. It is recommended to investigate opportunities for staff, especially early-career staff, to do sabbaticals at other leading international institutes to bring back new insights and expertise to the university [35].

Developing leadership skills within the group occurs occasionally, which is positive. However, mentorship and career planning seem today largely depending on the group chairs, which may be well or less well versed for such task. The Committee recommends professionalising these aspects and steer them from a higher organisational level. The Committee sensed clear leadership potential among junior staff and encourages EE@UT to actively nurture this potential. Clear career paths and opportunities for growth should be established to allow junior staff to take on leadership roles and contribute to defining long-term goals.

**Diversity**: The faculty has set gender goals to employ 20% female full professors, 20% associate professors, and 35% assistant professors. Currently, these numbers are 16%, 17%, and 39% (in FTE), respectively. The pool of female EE engineers is small, with only 10% of students being female. However, the percentage of non-Dutch scientific staff has increased during the assessment period, and three group chairs are non-Dutch.

It was noted that female researchers voiced concerns about the number of committees they are requested to join (due to the requirements to have gender balance on these committees). This should be managed to avoid commitment overload for these researchers.

Given that the average age of current full professors is 54 years (Figure 5.2) and the pool of female PhD students and postdocs is growing, there are promising opportunities for young female staff members. The Committee applauds the steps taken to improve gender balance, such as

opening vacancies to females only during the first month, offering Hypatia chairs, implementing more diverse selection committees, gender bias training, a female faculty network, and a coaching programme.

The Committee considers it crucial to emphasise the societal relevance of science and technology from kindergarten to university to increase female interest in STEAM (Science, Technology, Engineering, Arts, Mathematics) careers. However, the issue is complex, with many hidden societal and behavioural mechanisms at play. The Committee appreciates that EE@UT participated in a pilot gender-scan and will implement some of the recommendations to raise appropriate awareness.

**Recruitment**: The Committee observed that recruitment at EE@UT is well-organised, focusing on the talent of applicants and their fit within the team, which is crucial. Notably, EE@UT tries to avoid Tenure Track positions. Instead, new assistant professors are evaluated during their first year and, if successful, receive a permanent contract. This approach, preferred by many junior staff, reduces pressure on individuals and fosters a healthier working environment by prioritising group-related priorities over individual competition.

With a wave of senior staff retirements expected in the next 5-10 years, there are significant opportunities for junior and female staff. The Committee recommends giving these staff members sufficient support, space and time to grow, define their research niches, and build their network of collaborators [36]. Consider, for example, regular "Junior Faculty" breakfast meetings with the Dean for communication and cross-mentorship.

**Wellbeing**: EE@UT places considerable emphasis on well-being. Two teams, the informal Diversity, Equity & Inclusion EEMCS team and a broader sounding board, were created to improve diversity, equity, and inclusion. Data is collected via anonymous surveys and behavioural

audits to raise awareness. A faculty-wide workshop on work-life balance resulted in key takeaways: talk about well-being and work-life balance, block time for yourself, specify and respect your boundaries, and accept that work is never done. These measures are highly positive and contribute to a supportive working environment. In addition, setting up a mentorship programme with additional training might be very helpful to guide staff members at all levels more individually, e.g. to find the best work-life balance in different phases of the career.

## 4.9 Extra question to the Committee

In addition to the criteria specified in the Strategy Evaluation Protocol, the Board has requested that the Committee pay attention to the following additional question and offer its assessment and recommendations: EE@UT is a discipline within a Faculty, situated between faculty management and a range of reasonably autonomous research groups without clear governance mandates. In this context, the discipline seeks to organise itself better and establish its own identity. The Committee is asked to critically evaluate this situation and potentially provide insights or examples of best practices.

This issue is comprehensively addressed in the Viability section of this Chapter.

## 4.10 List of recommendations

The Committee recommends EE@UT to[7]:

[21] Rebrand the mission statement to one that is inspiring, easily communicated, and aligned with sustainability goals.
[22] Determine and emphasise their unique strengths and opportunities in their communications.
[23] Articulate the ambitions and formulate more concrete objectives and targets for the next period.
[24] Structurally embed KPIs into the research processes, not only for periodic reviews but as a continual part of the research culture.
[25] Enhance its visibility and narrative to attract a broader audience and more effectively communicate its impact on society.
[26] Capitalise on UT's location, as it is central in Western Europe, providing opportunities for collaboration with institutions like Münster University.
[27] Reduce and improve bureaucracy by ensuring stakeholder (including faculty) involvement in the design of the administration, improvement of existing processes and improving software tools for communication, particularly concerning financial issues.
[28] Build on the competence of the research group chairs, adopt bold leadership that guides the organisation towards a strong mission, vision, and strategy with concrete objectives.
[29] Develop a business case around the infrastructure, considering both financing and commercialisation of the facilities.
[30] Encourage the availability of software and data alongside publications.
[31] Make the criteria for success clear, fair and transparent, ensuring that a student's success does not depend on external factors.

[7] The list of recommendations is limited to the Committee's most crucial observations.

[32] Conduct evaluations of the PhD trajectory, especially to identify the causes of the high dropout rate and long PhD durations.

[33] Encourage staff to address the topic of integrity more actively, for instance, by periodically including it on the agenda of department or group meetings for discussion.

[34] Encourage and support young staff to apply for prestigious personal grants.

[35] Provide opportunities and encourage staff sabbaticals to bring back expertise and stimulate new insights to the university.

[36] Give staff members sufficient space and time to grow, define their research niches, and build their network of collaborators.

# Conclusion

**"Creating more impact, a stronger international brand, and growth in the field of Electrical Engineering by setting a clear and differentiating vision and increasing the awareness of its own strengths"**

As the Electrical Engineering disciplines at the University of Twente (UT) and Eindhoven University of Technology (TU/e) navigate their current landscape, they stand at a pivotal moment in their development. Building on a foundation of impressive research output, robust industry collaboration, and a strong academic culture, both institutions are well-positioned to enhance their global impact. However, the next phase of growth will require focused professionalisation and strategic refinement across several key areas.

To maintain and extend their leadership, both UT and TU/e must refine their mission statements to better reflect their unique strengths and ambitions. Clear, inspiring, and aligned with sustainability goals, these statements will serve as beacons for the universities' future direction, attracting talent and fostering a stronger sense of identity. Moreover, the implementation of measurable and specific objectives, underpinned by SMART KPIs, will provide a clear framework for assessing progress and ensuring alignment with overarching institutional goals.

The recommendations for a more structured approach to leadership, particularly in the areas of strategy, governance, and funding, highlight the necessity of a top-down approach that complements the existing bottom-up culture. By embracing bold leadership, both universities can more effectively navigate the challenges of financial stability, student influx, and bureaucratic complexity, ensuring that their academic and research endeavours are supported by a solid operational foundation.

Human capital remains a critical asset for UT and TU/e. Strengthening the support for junior faculty and PhD students, through enhanced mentorship, clearer career paths, and a commitment to diversity and inclusion, will be vital for sustaining long-term success. Encouraging the pursuit of prestigious personal grants and fostering international collaboration will further enhance the institutions' research capabilities and global standing.

While the existing research and infrastructure are commendable, there is room for growth in fostering cross-disciplinary collaboration, particularly in emerging fields such as robotics, neuromorphic computing, and e-health. By leveraging their regional advantages and enhancing their visibility, both universities can attract greater interest from industry, students, and funding bodies, positioning themselves as leaders in innovation and societal impact.

The Committee’s recommendations are offered with the utmost respect for the significant progress already made by both institutions. These critiques are intended to sharpen focus, drive strategic alignment, and inspire continued excellence. With these enhancements, UT and TU/e are poised to not only sustain their current momentum but also to broaden their horizons, achieving new levels of success in the global academic and research landscape. The path ahead is filled with promise, innovation, and the potential for groundbreaking achievements that will shape the future of electrical engineering.

# Appendix A Curricula vitae of the Committee members

**Prof.dr.ir. S.M. (Sonja) Berlijn**, Committee Chair, Professor of Sustainable Integrated Energy Systems, was born in Amsterdam, received her M.Sc. degree in Electrical Engineering from the TUE, Eindhoven, the Netherlands in 1994, her PhD degree from TUG, Graz, Austria, in 2000 and her MBA in 2012 from Melbourne University. She has been working at the High Voltage Laboratory of KEMA; the Netherlands (1993-2000), and at STRI in Sweden (2000-2008). She worked at the overhead line department at Statnett (2008-2014) and was responsible for the electromechanical and insulation co-ordination design of the world's largest voltage upgrading project. She was SVP for Statnett's R&D and part-time professor in Power Systems at the NMBU (2014-2021). In January 2021 she became professor in sustainable integrated energy systems at KTH. Since May 2023 she also working as Senior Principal Consultant for DNV. She has been and still is member of board member of several organisations and centra. In 1998 she got a Working Group Recognition Award from PES IEEE and in 1999 she got the prize paper award from ISH 99/Hydro-Quebec. She became senior IEEE member in 2020 and got elected fellow in the Swedish Royal Academy for Engineering Sciences (IVA) in 2021.

**Ir. L.A. (Luc) Enthoven**, PhD Candidate, received his B.Sc. and M.Sc. degrees (both cum laude) in Electrical Engineering from the Delft University of Technology, The Netherlands. Currently, he is pursuing a PhD in the field of cryo-CMOS circuits for scalable Quantum Computing in the group of Fabio Sebastiano, during which he has presented his work at conferences such as ISSCC and VLSI. During his studies, he has been an intern at the Analog Devices BMS group in Munich, Germany, a participant of the Netherlands-Asia Honours Summer School, and a board member at the study association. His research interests are in

analog and mixed-signal circuit design as well as low power cryo-CMOS circuits and systems.

**Prof.em.dr.ir. S.J.A. (Sabine) Van Huffel**, Professor of Biomedical Engineering at the Department of Electrical Engineering (ESAT) of the KU Leuven (period: 2002-2020) and Programme Director of the Master of Science in Biomedical Engineering KU Leuven (period: 2016-2020). Since October 1, 2020, she is Professor Emerita with duties. She received a Master degree in Computer Science Engineering, a postgraduate in Biomedical Engineering and a Ph.D. degree in Electrical Engineering from the KU Leuven, in 1981, 1985 and 1987, respectively. She was a guest professor at Stanford University (USA) in 2000 and at Uppsala University (Sweden) in 2002. From September 2005 to September 2009, she was appointed Rectorial Advisor on Equal Opportunities and Diversity. She is IEEE, SIAM and EAMBES founding fellow and member of the Royal Flemish Academy of Belgium for Sciences and the Arts. In April 2013 she received an honorary doctorate from Eindhoven University of Technology (NL), together with an appointment as a Distinguished professor till January 1, 2021. For 25 years, she led a research group (called BIOMED, more than 30 members) in biomedical data processing and was (co-)supervisor of more than 80 PhDs. She also acquired an ERC Advanced Grant in biomedical data fusion (339804 BIOTENSORS 2014-2019).

**Prof. dr. P. (Peter) O'Brien** is Head of the Photonics Packaging and Systems Integration Group at Tyndall, Director of the European Photonics Pilot Line (www.pixapp.eu) and heads the European Photonics Academy which is part of PhotonHub Europe (www.photonhub.eu). He is also a visiting professor at Keio University in Japan and an adjunct professor at the College of Optical Science, University of Arizona. His research group develops novel optical coupling, laser and electronic integration technologies, focusing on wafer-scale packaging for scale-up to volume manufacturing. He collaborates with multiple academic and industry groups worldwide and is a lead partner in major research programmes, including the

European Quantum Flagship and Europractice. Prof. O'Brien previously founded and was CEO of a start-up company designing and manufacturing speciality biophotonic systems, which he sold in 2009. Before this, he was a post-doctoral scholar at the California Institute of Technology and a research scientist at NASA's Jet Propulsion Laboratory, where he was involved in developing submillimetre wave devices for remote sensing. He also served as semiconductor front-end fab manager for General Semiconductor Corporation, producing power management devices. He received his Degree (Physics) at Trinity College Dublin, Masters (Engineering) and PhD (Physics) at University College Cork.

**Prof.dr.ir. J. (Joris) De Schutter**, Professor of Mechanical Engineering at the Department of Mechanical Engineering at KU Leuven between 1995 and 2023 and currently emeritus professor with duties, received the MSc degree in mechanical engineering from KU Leuven (1980), the MSc degree from MIT (1981), and the PhD degree in mechanical engineering, also from KU Leuven (1986). He pioneered in robot force control and sensor-based robot control using optimization. His research interests included: robot control and programming based on models, sensors and constrained optimization; human-robot interaction; programming by human demonstration; and generalizing human-demonstrated robot skills to new situations. In 2018 he received an ERC Advanced Grant on this last topic. He served as chair of the department (2005-2008 and 2017-2021) chair of the Evaluation Committees for the study programs in Electrical Engineering (2004) and Mechanical Engineering (2006 and 2012) at the Dutch universities.

**Dr.ir. A.P. (Arnoud) van der Wel**, Innovation & Roadmap Manager, was born in the Netherlands in 1974 and grew up in Tanzania. He studied Electrical Engineering at the University of Twente, where he received the master's degree (cum laude) in 1997. In 2000, he graduated from the teacher's training college at the same university, making him a qualified physics teacher. ('Eerstegraads bevoegdheid'). Subsequently, he obtained the Ph.D. degree (cum laude) at the IC-Design

group of the University of Twente for his thesis “MOSFET LF noise under large signal excitation”. Arnoud has been working for NXP in Eindhoven since 2005, and is currently Innovation & Roadmap manager at the Analog & Mixed Signal Competence Center. He holds 15 patents, and has authored or co-authored over 15 peer-reviewed papers. He leads a team of analog circuit designers designing cutting edge analog & mixed signal IP in advanced CMOS and SOI processes, in the fields of power management, dataconverters and references.

**Prof.dr.ir. W.M. (Wouter) van der Wijngaart**, Professor in Micro and Nanosystems, was born in Belgium in 1973. He is married and has three children. Wouter received the M. Sc. degree in Electrotechnical Engineering, the Degree of Philosophic Academy and the Mathematics Education Degree, all from the KU Leuven, Belgium, in 1996. Wouter received the Ph. D. degree in microsystem technology at KTH Royal Institute of Technology in 2002, where in 2010 he promoted to full Professor in micro and nanosystems. Wouter has a current research focus on microfluidics and lab-on-a-chip systems, micro/nanostructured soft matter, biosensors and biomedical microdevices. He has published approximately 200 internationally peer-reviewed journal and conference papers, which have more than 5000 citations. Wouter is very active in his scientific community, for example, as Chair Technical Programme of the IEEE TRANSDUCERS 2027 conference and General Conference Chair of the IEEE MEMS 2015 conference. Wouter has also started seven companies, in various application fields, of which five are active today: Easypark (mobile parking), Mercene Labs (polymer solutions), UTI-lizer (urinary tract infection diagnostics), Lucky Loop Medical (gastroenterological biopsies), and Extendo Medical (endovascular biopsies).

**Ir. S (Sven) Laudy**, process consultant of the committee, received his MSc in Industrial Engineering and Management Science in 2001, specialising in organisational behaviour, and focusing on the design and group dynamics of autonomous workgroups. Since 2001, Sven has operated from his consultancy, Quicken Organisatie Adviseurs B.V.,

where he contributes expertise to strategy and organisational matters in the (manufacturing) industry. Additionally, since 2007, he has served as a process facilitator/secretary for Higher Education institutions, overseeing more than 15 research assessments for technical universities, universities of applied sciences and Nationaal Groeifonds. Beyond the typical support tasks, including reporting and writing the final report, Sven serves as the process facilitator. As the right hand of the chair, he oversees the main goals of review and guides the (preparation) process of the committee. In this role, Sven assumes operational responsibilities from the chair, allowing both them and other committee members to focus on content. His emphasis is on thorough committee preparation, believing it consistently leads to more in-depth final reports. His professional interests span engineering disciplines, economics & business administration, behavioural sciences, and the natural sciences. He also has a keen interest in developing long-term research strategies that work.

# APPENDIX B SITE VISIT PROGRAMME

| DAY 0 – Tuesday June 18, 2024 - EINDHOVEN | | |
|---|---|---|
| *Time / location* | *Activity* | *Participants* |
| 15.00 Hotel | Welcome by RM | On behalf of the Rector: drs. Patrick Groothuis, Vice President of the Executive Board (joins at 17.00)<br>Prof.dr.ir. Mark Bentum, Dean of the Department of Electrical Engineering |
| 15.00 – 19.30 | kick-off and preparation of interviews | Committee (private) |
| 19.30 – 21.30 | Working dinner | Committee (private) |

| DAY 1 – Wednesday June 19, 2024 – EINDHOVEN | | |
|---|---|---|
| *Time* | *Activity* | *Participants* |
| 8.00 – 8.30 | Travel time | Committee |
| 8.30 – 9.00 | Preparation of interviews | Committee (private) |
| 9.00 – 9.30 | PhD alumni | Dr.ir. Joost van der Putten<br>Dr.ir. Lieneke Kusters<br>Dr.ir. Niels Blaauwbroek<br>Dr.ir. Sjoerd van der Heide |
| 9.30 – 9.45 | Reflection | Committee (private) |
| 9.45 – 10.30 | Interview MT / Faculty Board | Prof.dr.ir. Mark Bentum, Dean<br>Prof.dr. Marion Matters, Vice-Dean Education<br>Prof.dr.ing. Guus Pemen, Vice-Dean Research<br>Drs. Jolie van Wevelingen, Managing Director<br>Norine Rijksen, Student Advisor to the Faculty Board |

| | | |
|---|---|---|
| 10.30 – 11.00 | Reflection + Break | Committee (private) |
| 11.00 – 11.30 | Interview medior/ senior staff | Prof.dr. Alex Alvarado, full professor Signal Processing Systems group<br>Ir. Frank Dirne, director of NanoLab@TU/e cleanroom<br>Dr. George Exarchakos, associate professor Electro-Optical Communications group<br>Dr. Ulf Johannsen, associate professor Electromagnetics group & scientific director Center for Wireless Communication<br>Prof.dr. Elena Lomonova, chair Electromechanics & Poer Electronics group<br>Dr.ir. Phuong Nguyen, associate professor Electrical Energy Systems group<br>Dr. ir. Ruud van Sloun, associate professor Signal processing Systems group<br>Prof.dr. Siep Weiland, chair Control Systems group |
| 11.30 – 11.45 | Reflection | Committee (private) |
| 11.45 – 12.15 | Interview junior staff | Dr.ing. Shihab Al-Daffaie, assistant professor Integrated Circuits group<br>Dr.ir. Marco Fattori, assistant professor Integrated Circuits group<br>Dr.ir. Sofie Haesaert, assistant professor Control Systems group<br>Dr. Dook van Mechelen, associate professor Signal Processing Systems group<br>Dr.ing. Christina Papadimitriou, assistant professor Electrical Energy Systems group<br>Dr. Elisabetta Peri, assistant professor Signal Processing Systems group<br>Dr. Weiming Yao, assistant professor Photonic Integration group |
| 12.15 – 12.30 | Reflection | Committee (private) |

| | | |
|---|---|---|
| 12.30 – 13.15 | Lunch | Ir. Thomas Booij, PhD in the Integrated Circuits group<br>Ir. Hamid Hassani, PhD in the Electro-Optical Communications group<br>Ir. Leroy Driessen, PhD in the Electromagnetics group<br>Ir. Djero Peeters, PhD in the Signal Processing Systems group<br>Ir. Beatrice Federici, PhD in the Signal Processing Systems group<br>Ir. Jeroen Markus, PhD in the Electrical Energy Systems group<br>Ir. Hans van Gorp, PhD in the Signal Processing Systems group<br>Ir. Emmanual Stok, PhD in the Electromechanics & Power Electronics group<br>Ir. Matthijs Kleijer, PhD in the Electromechanics & Power Electronics group<br>Ir. Gökhan Yılmaz, PhD in the Signal Processing Systems group<br>Ir. Maira Perez Sosa, PhD in the Photonic Integration group<br>Ir. Chris Verhoek, PhD in the Control Systems group |
| 13.15 – 13.30 | Reflection | Committee (private) |
| 13.30 – 14.30 | Experience EE@TUE: Labtour – different subjects / committee split up | Host: dr.ir. Sander Stuijk<br>Host: prof.dr. Elena Lomonova<br>Host: prof.dr.ir. Peter Baltus |
| 14.30 – 14.45 | Reflection | Committee (private) |
| 14.45 – 15.15 | Prepare Concluding meeting with MT / Faculty Board (+ break) | Committee (private) |

| | | |
|---|---|---|
| 15.15 – 15.45 | Concluding meeting with management team / Faculty Board: 1) fact check, 2) open questions, and 3) sharing first conclusions | Prof.dr.ir. Mark Bentum, Dean<br>Prof.dr. Marion Matters, Vice-Dean Education<br>Prof.dr.ing. Guus Pemen, Vice-Dean Research<br>Drs. Jolie van Wevelingen, Managing Director<br>Norine Rijksen, Student Advisor to the Faculty Board |
| 15.45 – 16.00 | Reflection | Committee (private) |
| 16.00 – 18.00 | Travel to Enschede - prepare first observations based on notes/ bullet-points secretary | Individual committee members |
| 18.00 | Refreshing at hotel | Committee (private) |
| 19.00 | Working dinner: discussing and writing preliminary judgments | Committee (private) |
| 21.30 | Closure | |

| DAY 2 – Thursday June 20, 2024 ENSCHEDE | | |
|---|---|---|
| *Time* | *Activity* | *Participants* |
| 8.00 – 8.30 | Travel time | Committee |
| 8.30 – 9.00 | Preparation of interviews | Committee (private) |
| 9.00 – 9.30 | Welcome by Rector and interview + Faculty MT | Tom Veldkamp (EB), Peter Veltink (FB), Mert Alberts (FB), Lucia Hans (BC), Cora Salm (EE), Gijs Krijnen (DC-EE) |
| 9.30 – 9.45 | Reflection | Committee (private) |
| 9.45 – 10.30 | Interview PI's uit EE disciplines (senior) | Séverine Le Gac (AMBER), Loes Segerink (BIOS), Jan Buitenweg (BSS), Geert Heijenk (DACS), Luuk Spreeuwers (DMB), Jurriaan Schmitz (IDS), Floris Zwanenburg (NE), Stefano Stramigioli (RAM) |
| 10.30 – 11.00 | Reflection + Break | Committee (private) |
| 11.00 – 11.30 | Interview medior staff (associate level) | Jasper Reenalda (BSS), Marco Ottavi (CAES), Suzan Bayhan (DACS), Anne-Johan Annema (ICD), Francoise Siepel (RAM). |
| 11.30 – 11.45 | Reflection | Committee (private) |
| 11.45 – 12.15 | Interview junior staff | Kirsten Pondman (AMBER), Arlene John (BSS), Harijot Singh Bindra (ICD), Dennis Alveringh (IDS), Joost Ridderbos (NE), Tom Hartman (PE), Vincent Groenhuis (RAM), Sujith Raman (RS), Anastasia Lavrenko (RS). |
| 12.15 – 12.30 | Reflection | Committee (private) |

| | | |
|---|---|---|
| 12.30 – 13.15 | Lunch with PhD candidates + Alumni PhD's | Lysanne Mol (AMBER) Frauke Luft (BSS), Kees van Dijk (BSS), Syllas Rangel Carneiro Magalhaes (DACS), Melissa Tijink (DMB), Meiru Mu (DMB), Stef van Zanten (ICD), Maarten Bonnema (IDS), Dennis van der Bovenkamp (NE), Anand Iyer (PE), Hengameh Noshahri (RAM), Frieda van den Noort (RAM), Andrei Mogilnikov (RS), Ibrahim Bilal (RS). |
| 13.15 – 13.30 | Reflection | Committee (private) |
| 13.30 – 14.30 | Experience EE@UT: Labtour – different subjects / committee split up | Jurriaan Schmitz, Arnoud Rop, Alexander Delke<br>Prasanth Venugopal, Roelof Grootjans<br>Floris Zwanenburg, Markus Schremb<br>Loes Segerink, Paul te Braak<br>Stefano Stramigioli, Marcel Schwirtz, Marion Kuipers<br>Jan Buitenweg, Frodo Muijzer<br>Luuk Spreeuwers<br>Marco Ottavi, Dorus Abeln |
| 14.30 – 14.45 | Reflection | Committee (private) |
| 14.45 – 15.15 | Prepare Concluding meeting with MT / Faculty Board (+Break) | Committee (private) |
| 15.15 – 15.45 | Concluding meeting with MT / Faculty Board: 1) fact check, 2) open questions, and 3) sharing first conclusions | Peter Veltink (FB), Mert Alberts (FB), Lucia Hans (BC), Cora Salm (EE), Gijs Krijnen (DC-EE) |
| 15.45 – 16.00 | Reflection | Committee (private) |

| | | |
|---|---|---|
| 16.00 – 16.30 | Prepare first observations based on notes/ bullet-points secretary | Individual committee members |
| 16.30 – 17.00 | Discussing and writing preliminary judgments (+ Break) | Committee (private) |
| 17.00 – 17.30 | Preparing presentation | Committee (private) |
| 17.30 – 17.45 | Oral presentation on first impression by committee | Committee<br>All faculty members participated invited, incl. PhD's |
| 17.45 – 18.00 | Closure / refreshments | Committee<br>All faculty members participated invited, incl. PhD's |

# APPENDIX C SEP-DATA ON RESEARCH STAFF

| | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | | 2023 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | FTE | # | FTE | # | FTE | # | FTE | # | FTE | # | FTE | # | FTE |
| Scientific staff | 88 | 80 | 87 | 81 | 84 | 77 | 94 | 87 | 97 | 88 | 106 | 97 | 109 | 100 |
| *- Assistant professor* | *43* | *41* | *43* | *41* | *43* | *41* | *48* | *46* | *50* | *47* | *49* | *47* | *52* | *50* |
| *- Associate professor* | *20* | *19* | *19* | *18* | *18* | *16* | *20* | *19* | *21* | *19* | *27* | *24* | *28* | *25* |
| *- Full professor* | *25* | *20* | *25* | *22* | *23* | *20* | *26* | *22* | *26* | *22* | *30* | *26* | *29* | *25* |
| Postdoc | 38 | 36 | 37 | 36 | 55 | 52 | 67 | 62 | 74 | 69 | 59 | 54 | 65 | 62 |
| PhD Candidate | 206 | 204 | 211 | 210 | 212 | 209 | 223 | 222 | 219 | 216 | 253 | 251 | 261 | 259 |
| EngD | 14 | 14 | 18 | 18 | 15 | 15 | 9 | 9 | 9 | 9 | 11 | 11 | 14 | 14 |
| **Total research staff** | **346** | **333** | **353** | **343** | **365** | **353** | **393** | **379** | **399** | **382** | **429** | **412** | **449** | **435** |
| Support staff | 46 | 40 | 46 | 40 | 44 | 38 | 55 | 46 | 63 | 53 | 62 | 52 | 64 | 55 |
| **Total staff** | **392** | **373** | **399** | **384** | **409** | **391** | **448** | **426** | **462** | **435** | **491** | **465** | **513** | **490** |

*Table 1: Staff embedded in the Faculty of Electrical Engineering @ TU/e*

| | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | FTE | # | FTE | # | FTE | # | FTE | # | FTE | # | FTE |
| Scientific staff | 52 | 42.9 | 63 | 53.2 | 68 | 56.3 | 81 | 67.7 | 85 | 71.1 | 86 | 74.7 |
| *- Assistant professor* | *13* | *10.9* | *19* | *16.6* | *20* | *17.2* | *33* | *29.7* | *39* | *34.7* | *39* | *35.8* |
| *- Associate professor* | *21* | *19.3* | *25* | *22.9* | *28* | *25.4* | *28* | *24.3* | *28* | *25.0* | *26* | *24.0* |
| *- Full professor* | *18* | *12.7* | *19* | *13.7* | *20* | *13.7* | *20* | *13.7* | *18* | *11.4* | *21* | *14.9* |
| Postdoc | *40* | *35.3* | *40* | *35.8* | *54* | *50.4* | *56* | *50.7* | *52* | *44.3* | *45* | *40.2* |
| PhD candidates | 98 | 96.4 | 116 | 114.6 | 118 | 116.2 | 130 | 127.8 | 137 | 133.7 | 137 | 134.8 |
| EngD | 2 | 2.0 | 2 | 2.0 | | | | | 1 | 1.0 | 3 | 3.0 |
| **Total research staff** | **192** | **176.6** | **221** | **169.8** | **240** | **396.4** | **267** | **246.2** | **275** | **250.1** | **271** | **252.7** |
| Support staff | 25 | 21.3 | 20 | 18.5 | 22 | 20.8 | 22 | 20.4 | 20 | 16.7 | 25 | 21.0 |
| **Total staff** | **217** | **197.9** | **241** | **224.1** | **262** | **417.2** | **289** | **266.6** | **295** | **266.8** | **269** | **273.7** |

*Table 2: Staff embedded in the EE discipline @ UT*

# APPENDIX D SEP-DATA ON RESEARCH FUNDING

| TOTAL | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | | 2023 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | k€ | % | k€ | % | k€ | % | k€ | % | k€ | % | k€ | % | k€ | % |
| Direct funding[1] | 14808 | 38% | 17369 | 45% | 17812 | 47% | 19710 | 45% | 21626 | 45% | 24482 | 49% | 20340 | 47% |
| Research funding[2] | 4924 | 16% | 4955 | 15% | 4675 | 13% | 4920 | 13% | 4965 | 11% | 4704 | 11% | 4072 | 8% |
| Contract research[3] | 12819 | 41% | 12906 | 39% | 14719 | 40% | 16434 | 42% | 19427 | 44% | 17939 | 40% | 22728 | 44% |
| Other[4] | 1637 | 5% | 295 | 1% | 260 | 1% | 50 | 0% | 179 | 0% | 58 | 0% | 620 | 1% |
| **Total funding** | **31154** | | **32964** | | **37023** | | **39216** | | **44281** | | **44327** | | **51902** | |
| Personnel costs | 28758 | | 27208 | 82% | 29495 | 83% | 32749 | 84% | 35583 | 80% | 37622 | 85% | 42811 | 82% |
| Other costs | 5698 | 82% | 5939 | 18% | 5967 | 17% | 6343 | 16% | 8837 | 20% | 6815 | 15% | 9141 | 18% |
| **Total expenditure** | **31456** | | **33147** | | **35462** | | **39092** | | **44420** | | **44437** | | **51952** | |

*Table 3: Total funding of the Faculty of Electrical Engineering @ TU/e. All amounts in* k€.

| TOTAL | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | k€ | % | k€ | % | k€ | % | k€ | % | k€ | % | k€ | % |
| Direct funding[1] | 14687 | 64% | 17513 | 66% | 17880 | 60% | 20741 | 65% | 23322 | 64% | 26052 | 67% |
| Research funding[2] | 4480 | 19% | 4691 | 18% | 4824 | 16% | 4123 | 13% | 4403 | 12% | 4414 | 11% |
| Contract research[3] | 3888 | 17% | 4409 | 17% | 6894 | 23% | 7122 | 22% | 8628 | 24% | 8399 | 22% |
| **Total funding** | **23055** | | **26613** | | **29598** | | **31986** | | **36353** | | **38865** | |
| Personnel costs | 14223 | 63% | 16442 | 66% | 19307 | 68% | 21369 | 74% | 23176 | 73% | 24559 | 72% |
| Other costs | 8309 | 37% | 8393 | 34% | 8897 | 32% | 7611 | 26% | 8726 | 27% | 9764 | 28% |
| **Total expenditure** | **22531** | | **24835** | | **28204** | | **28980** | | **31902** | | **34322** | |

*Table 4: Total funding for the EE discipline @ UT. All amounts in* k€.

*1 Direct funding by the University, obtained directly from the University, and the financial compensation for educational efforts.*

*2 Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, ESF).*

*3 Research contracts for specific research projects obtained from external organisations, such as industry, governmental ministries, European Commission, charity organisations, and ERC.*

*4 Funds that do not fit into the other categories.*

# APPENDIX E SEP-DATA ON PHD CANDIDATES

| Enrolment (#) | | | | Success rates (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Starting year** | **Male** | **Female** | **Total (male + female)** | **<= 4 years** | **<= 5 years** | **<= 6 years** | **<= 7 years** | **Not yet finished** | **Dis-continued** |
| 2016 | 54 | 10 | 64 | 11% | 38% | 64% | 73% | 13% | 14% |
| 2017 | 39 | 12 | 51 | 20% | 63% | 69% | 73% | 24% | 4% |
| 2018 | 54 | 17 | 71 | 13% | 46% | 54% | | 38% | 7% |
| 2019 | 51 | 12 | 63 | 5% | 37% | 38% | | 62% | 0% |
| 2020 | 40 | 14 | 54 | 6% | | | | 89% | 6% |
| 2021 | 61 | 26 | 87 | 3% | | | | 87% | 9% |
| 2022 | 44 | 15 | 59 | 2% | | | | 97% | 2% |
| 2023 | 56 | 22 | 87 | | | | | 98% | 2% |

*Table 5: Success rates of the PhD candidates at the Faculty of Electrical Engineering @ TU/e*

| Enrolment (FTE) | | | | Success rates (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Starting year** | **Male** | **Female** | **Total (male + female)** | **<= 4 years+ 3mo.** | **<= 5 years** | **<= 6 years** | **> 6 years** | **Not yet finished** | **Dis-continued** |
| 2016 | 32,4 | 12,0 | 44,4 | 17% | 38% | 51% | 57% | 18% | 25% |
| 2017 | 24,0 | 11,7 | 35,7 | 20% | 42% | 55% | 61% | 17% | 22% |
| 2018 | 34,4 | 24,5 | 58,9 | 32% | 53% | 58% | 58% | 22% | 20% |
| 2019 | 31,8 | 19,3 | 51,1 | 12% | 21% | 21% | 21% | 64% | 15% |
| 2020 | 41,0 | 15,8 | 56,8 | 4% | 4% | 4% | 4% | 82% | 14% |
| 2021 | 38,0 | 14,8 | 52,8 | 2% | 2% | 2% | 2% | 92% | 6% |
| 2022 | 36,7 | 14,0 | 50,7 | 0% | 0% | 0% | 0% | 94% | 6% |
| 2023 | 42,5 | 16,9 | 59,4 | 0% | 0% | 0% | 0% | 97% | 3% |

*Table 6: Success rates of the EE discipline @ UT*

# Quicken ORGANISATIE ADVISEURS

bureau voor organisatieontwikkeling