

ASSESSMENT COMMITTEE REPORT ON RESEARCH
IN
CIVIL ENGINEERING
2017-2022
DELFT UNIVERSITY OF TECHNOLOGY



MARCH 2024

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“Facilitate continued growth towards a prosperous and aligned Faculty”

MARCH, 2024

Colophon

Title:

Assessment Committee Report on Research in Civil Engineering, 2017-2022 at the Delft University of Technology

Editors:

Prof. Dr. G Dewulf (Chair), Ir. I.A. van der Esch, Prof. Dr. H. S. Mahmassani, Prof. Dr. techn. G. Meschke, Dr. Ir. D. Molenaar, Prof. Dr. L. Raskin, Dr. K. Splinter, ir. S. Laudy (Process consultant)

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SUMMARY

The Assessment Committee assessed the research of the Departments of Engineering Structures (ES), Hydraulic Engineering (HE), Transport & Planning (T&P), Water Management (WM) and Materials, Mechanics, Management & Design (3MD) of the Faculty of Civil Engineering and Geosciences (CEG). This assessment covers research in the period 2017-2022. The Assessment Committee Report is approved by all Committee members.

The Civil Engineering departments (CE) are globally acknowledged for their outstanding quality and quantity, positioning them at the forefront of excellence. The presence of exemplary staff and cutting-edge facilities infuses vibrant energy into these departments, featuring a blend of distinguished experts and promising young talents.

The Committee was tasked with serving as a critical friend to foster ongoing improvement. Consequently, the following sections emphasise recommendations for further enhancement rather than emphasising the highly positive impression the Committee gained from the Civil Engineering departments.

The Committee noted that the presentation and substantiation of research quality in the report are diverse, raising concerns about the absence of an overarching or faculty-wide approach. Establishing such an approach is deemed crucial to foster collaboration and enhance coherence within the Faculty, while recognising critical differences amongst the different departments and areas of specialisation. This initiative would also facilitate cross-departmental learning, fostering a shared understanding of 'quality' and 'impact.'

The Faculty shows a strong commitment to the Sustainable Development Goals (SDGs), but the Committee noted the absence of a

detailed, faculty-wide strategy to enhance their impact on these goals. While individual departments align with and positively contribute to the SDGs, the Faculty Board has an opportunity to increase this impact through a unified strategy.

The Faculty is undergoing a transformative phase to accommodate growth, diversity, and changing expectations by its stakeholders. This transition aims to move from a primarily national, hierarchical structure to one offering greater autonomy, individual recognition, and clearer career pathways. The Committee recognises the value of a unified Faculty, especially in collaboration with the geosciences department, applauding joint positions that foster connectivity, particularly in emerging cross-disciplinary areas like climate adaptation. Also, CE has established cross-faculty cooperation in the context of central university facilities, e.g. Delft Blue Computing Cluster and cross-faculty structures, such as the TU-Delft AI Lab and the Delft Institute for Computational Science and Engineering, which is applaudable.

Concerns arise over the duration of PhD programs and low graduation rates across departments, with some experiencing particularly alarming rates below 50%. The Committee acknowledges the role of TRAIL as a vital network for PhD candidates and emphasises the importance of maintaining connections within this community, possibly seeking to emulate it for other areas of specialisation.

The Committee acknowledges the praiseworthy effort by CE departments in adopting the "Room for Everyone's Talent" approach. Overall, the Committee perceived that there should be more structural support available for junior faculty compared to tenured staff within the departments. Young academics at CE express eagerness to collaborate, finding interfaculty research exciting and beneficial for their careers. There is room for more involvement of young staff in boards across the full breadth of the Faculty.

TU Delft's proactive implementation of a university-wide Open Access policy, fully integrated within the research cycle, is acknowledged. Within the CE departments, a strong commitment to open models, open data, and open publishing is demonstrated.

The Faculty of CEG is commended for addressing research integrity and developing clear policies and guidelines in that regard.

The Committee is impressed by the lab facilities but some concerns are raised about safety regulations in labs, where instances, i.e. loose hair and absence of safety instructions, suggest safety measures may not be consistently taken seriously.

The Committee offers the following recommendations to the departments of Civil Engineering:

Aligning with SDGs and collective vision: Develop a comprehensive understanding at the Faculty level of how aligning with Sustainable Development Goals (SDGs) could amplify impact, engaging the broader CE community in shaping this vision [14]¹.

Improve the alignment of criteria for research quality, HR procedures, staff promotion criteria, and the guidance of PhD candidates and undertake a collaborative research assessment with Geosciences: Conduct the next research assessment jointly with geosciences to foster further development for the Faculty. In light of the Committee's observation regarding the varied presentation and substantiation of research quality, it is recommended that the Faculty takes decisive steps to establish a cohesive, faculty-wide approach. This initiative is deemed essential to foster collaboration and coherence across diverse research endeavours while at the same time provide enough space for departmental or domain differences. By implementing a faculty-broad approach, also when it comes to HR policies, talent

¹ The numbers in brackets correspond to the recommendations outlined in the various sections.

development, staff promotion criteria and the guidance of PhD candidates, the Faculty can strategically enhance its overall research impact and create a more synergistic academic environment. Additionally, this approach facilitates continuous learning among departments [16] [23] [28].

PhD duration and graduation rates: Address concerns regarding PhD duration and graduation rates, establishing regular reviews by the faculty to intervene and assist when needed to help PhD candidates and advisors who may be facing challenging situations, aiming for an optimal supervisory process [18] [20].

Involvement of PhD candidates and Young staff: Prioritise a people-centric approach to enhance success, fostering an environment where individuals can unleash their talents. Leverage the high quality of existing PhD candidates by actively listening and providing constructive feedback. Involve young staff by the implementation of the Young MT model in all departments or possibly at the Faculty level [21] [29].

Further strengthen cross-faculty cooperation: It is recommended to further strengthen collaboration within the already established structures such as Delft Blue Computing Cluster, the TU-Delft AI Labs and the Delft Institute for Computational Science and Engineering. and consider expanding towards novel cross-cutting research themes [15] [17].

Transparent processes: Continue developing transparent processes for both PhD candidates and staff promotions. Evaluate and take necessary steps to address any discrepancies between the 4-eyes principle on paper and its practical implementation. Pay special attention to external PhD candidates and those supervised by part-time professors [24].

A detailed list of recommendations is provided at the end of the Faculty section and at the conclusion of the Department sections.

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PREFACE

The Assessment Committee was tasked with evaluating the research conducted by the Faculty of Civil Engineering and Geosciences at Delft University of Technology from 2017 to 2022. The Committee, comprising a diverse range of expertise aligned with the review topics, visited Delft from December 5-8, 2023. The organisation of the site visit was exemplary, and we extend our appreciation for the professional, friendly, and welcoming reception we received.

Throughout the visit, in-depth discussions were held with management, staff, and PhD candidates in Civil Engineering, fostering an open and positive atmosphere. The lab tours, featuring passionate presentations on various topics, provided valuable insights. The site visit allowed us to validate and enhance our initial impressions from the self-assessment report. The Assessment Committee was asked to take a critical stand.

It is crucial to emphasise that the current challenges society faces necessitates collaboration. The energy transition for instance requires significant system transformation, demanding clear leadership. The Faculty of Civil Engineering and Geosciences is well-suited to take a leading role. Additionally, the Sustainable Development Goals (SDGs) will play a pivotal role in attracting talent. We hope our recommendations will assist the Faculty in advancing its leadership role.

I extend my gratitude to the Committee members for their diligent work and the constructive atmosphere they cultivated. I am pleased that the final conclusions in this report enjoy unanimous support from all Committee members. Finally, I express the Committee's collective appreciation to our secretary, Sven Laudy, for his excellent preparations and unwavering support.

Prof.dr. Geert Dewulf
Committee Chair

1. ASSESSMENT COMMITTEE AND ASSESSMENT PROCEDURES

1.1 ASSESSMENT SCOPE

The Assessment Committee was asked to assess the research of the Department of Engineering Structures (ES), the Department of Hydraulic Engineering (HE), the Department of Transport & Planning (TP), the Department of Water Management (WM) and the Department of Materials, Mechanics, Management & Design (3MD) of the Faculty of Civil Engineering and Geosciences (CEG). 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. Additionally, in a deviation from the SEP and as noted in the ToR, it was decided to report on these four aspects in distinct chapters of the self-evaluation report. The Committee adhered to this approach, conducting its evaluation at the CE level and noting variations within Department sections.

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

1.2 COMMITTEE COMPOSITION

The members of the Committee were:

Prof. Dr. G (Geert) Dewulf, Committee Chair, Professor of Civil Engineering and Management, University of Twente, The Netherlands.

I.A. (Anton) van der Esch MSc, PhD Candidate, Eindhoven University of Technology, The Netherlands.

Prof. Dr. H. S. (Hani) Mahmassani, William A. Patterson Distinguished Professor in Transportation, Northwestern University, USA.

Prof. Dr. techn. G. (Günther) Meschke, Professor of Structural Mechanics, Vice Rector for Research and Transfer, Ruhr University Bochum, Germany.

Dr. Ir. D-P. (David) Molenaar, Managing Director of Siemens Gamesa Renewable Energy B.V., The Netherlands.

Prof. Dr. L. (Lutgarde) Raskin, Vernon L. Snoeyink Distinguished University Professor of Environmental Engineering and Altarum/ERIM Russell O'Neal Professor of Engineering, University of Michigan, USA.

Dr. K. (Kristen) Splinter, Associate Professor of Civil and Environmental Engineering, University of New South Wales, Australia.

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.

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,
- Previous assessment report 2011-2016,
- Promotion requirements and guidelines Academic Career Track and Tenured staff,
- Guidelines regarding the Go-No Go decision PhD candidates.

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 November 20, 2023 the secretary 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, two assessors were asked to evaluate each programme. 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 spoke with the Rector Magnificus of the TU Delft and interviewed the management team of the Faculty of CEG, as well as the five departmental management teams, and research staff of the five departments and PhD candidates. Interviews took place on December 6 to 8, 2023 at the Faculty of CEG in Delft. The full interview schedule appears in Appendix B. The Committee presented preliminary general impressions to the Faculty 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 Faculty, preliminary assessments and interviews. Following approval by all Committee members, the Executive Board 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 Board of the University. This was printed after formal acceptance.

2 ASSESSMENT OF THE DEPARTMENT OF ENGINEERING STRUCTURES (ES)

Head of Department
Research staff 2022

Prof. dr. A. (Andrei) Metrikine
34.0 Research FTE (excluding PhD)

The Department of Engineering Structures (ES) was formed in 2018 to develop resilient, smart and sustainable (infra)structures that meet societal demands in transportation, energy transition and sustainable reuse. The research agenda of ES is mainly composed of two parts: (i) the modelling and (ii) the experimental characterisation of mechanical behaviour of materials and structural components. The experimental part of the research is performed in the Macromechanical Laboratory (MacroLab). The ES department is responsible for the MacroLab, which carries out small and full-scale testing, allowing the development and validation of physics-based and data-driven structural models.

Besides the formal division in sections, the research unit relates its scientific and social identity to four themes: 1) Structures for energy transition, 2) Recycling and circular structural systems, 3) Transport infrastructures for future-proof built environment and 4) Structural integrity through innovative monitoring, damage assessment, prediction and maintenance.

The future strategies for the next six years have six overarching aims: 1) Strengthen the leading position within the four themes, 2) translate research results into effective technologies, 3) include research activities across different TRLs, 4) align the different sections to the four identified themes, 5) growth of an inclusive academic culture, and 6) reach a healthy financial status.

The research staff is composed of 10.0 FTE scientific staff², 24.0 FTE researchers and 60 PhD candidates (2022)³.

2.1 RESEARCH QUALITY

The ES department exhibits a very good performance, reflecting its commitment to academic excellence. The Department has strategically embraced new topics characterised by high scientific potential. These include the exploration of digital twin technologies, advancements in interface mechanics, and approaches to circularity-based design.

Other topics from which the research quality benefits are the excellent lab facilities, the cooperation with industry and the well-established interdisciplinarity among different departments, e.g. monopile design/offshore wind turbines. The MacroLab has been continuously extended and constitutes a strong, and internationally visible core facility serving as the basis for both fundamental as well as application oriented research activities. Research themes convincingly reflect the dedication of the ES department to contribute to engineered solutions for urgent societal needs, e.g. the transition to renewable energy systems.

The close connection and improvements in structuring cooperation with 3MD is considered very positive. However, there is still potential for further exploiting synergies regarding competences and facilities between the two departments, for which the established cooperation structures should be revisited.

² Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

³ FTE has been multiplied by the research factor: 0.4 for scientific staff and 0.8 for post-docs.

2.2 RELEVANCE TO SOCIETY

The research Department ES has demonstrated a persuasive commitment to aligning research themes with sustainability goals. The orientation towards sustainability is evident in their compelling transfer activities, including engagements with GPD, large scale industrial collaborations, entrepreneurial activities and the establishment of spin-offs. ES has explicitly addressed transfer-orientation as a prominent overarching aim, which is appreciated by the Committee.

To further solidify this commitment to sustainability, the Committee recommends the incorporation of quantifiable metrics. For instance, introducing a “carbon footprint” measure, such as reducing the carbon footprint by developing and quantifying a CO₂ per unit measure (similarly to the approach used in circularity). This would enable the identification of areas for improvement and promote the development of innovative solutions, such as determining which components should be designed for longevity (50+ years) versus those intended for a shorter lifespan (20 years). The implementation of such metrics will not only validate the department's commitment to sustainability but also enhance the team's resilience and prepare them for future challenges.

The impact of the ES' efforts is underscored by the number of awards, spin-offs, and various patents that have emanated from the group's initiatives. Notably, ES has fostered close collaboration with industry to understand their needs. However, the Committee acknowledges that balancing these collaborations with maintaining a robust scientific output from PhD candidates poses a significant challenge.

In their outreach to the broader society, ES employs a diverse range of strategies, including master classes, Massive Open Online Courses (MOOCs), media engagement, and contributions to informing standards. These efforts reflect a comprehensive approach to engaging with and highly contributing to the larger societal context.

2.3 VIABILITY

The ES department is highly praiseworthy, boasting excellent lab facilities, achieving a high impact, and demonstrating remarkable success in transfer activities. The research themes exhibit a convincing orientation towards sustainability, showcasing a strong commitment to addressing contemporary challenges. The Committee recommends checking if the researcher facility (support) needs matches with the facility utilisation overview as part of the hiring process to avoid delays/disappointment [2].

Impressively, the group exudes engagement, pride, and enthusiasm. The Management Team (MT) fosters a positive vibe, and the group appears non-hierarchical, maintaining a flat structure that encourages open communication. Younger staff members are notably empowered, controlling their research agendas independently and taking part in ES Young MT.

The Department achieves a good balance between various funding sources, contributing to financial stability, and excels in Joint Industry Projects (JIP's).

The Department has undergone a significant transformation process following its separation from 3MD. While tangible measures have been implemented, challenges persist in improving cohesion among a large number of – sometimes small – heterogeneous sections. Nevertheless, the Department has implemented convincing strategies to foster cohesion among these diverse sections. An exemplary approach involves the strategic hiring of new faculty members who can act intersectionally, bridging gaps and promoting collaborative initiatives that contribute to the overall unity and effectiveness of the Department. Providing internal seed funding to early-career researchers could also serve as an incentive to foster collaboration, notably between the ES and 3MD departments, and across sections within the ES department.

The Committee was impressed by the facilities available in the MacroLab and the ability of the ES to maintain and extend the scientific level of the equipment. An area of concern highlighted pertains to the challenge of aging and ensuring the continuity by presence of skilled technicians, an issue that the Department is fully aware of.

The Committee recommends organising regular strategy meetings between the Management Teams (MTs) of ES and 3MD and make the minutes of meeting available to all [3]. Such meetings could prove instrumental in leveraging synergies between the departments, extending collaboration beyond individual projects and enhancing overall departmental effectiveness.

When considering the Faculty website, there's room for improvement in articulating the Department's specific research focus. Providing more research examples, including practical applications, would enhance readers' understanding of ongoing research endeavours.

An important aspect is the Department's effective handling of the teaching load issue, ensuring a solid equilibrium.

2.4 LIST OF RECOMMENDATIONS

The Committee recommends ES to⁴:

- [1] Expand metrics and evidence, e.g. by substantiating and quantifying the carbon footprint reduction;
- [2] Check if the researcher facility (support) needs matches with the facility utilisation overview as part of the hiring process to avoid delays / disappointment;

⁴ The list of recommendations is limited to the Committee's most crucial observations.

[3] Organise regular strategy meetings between the Management Teams (MTs) of ES and 3MD and share minutes.

3 ASSESSMENT OF THE DEPARTMENT HYDRAULIC ENGINEERING (HE)

Head of Department
Research staff 2022

Prof. dr. ir. S.G.J. (Stefan) Aarninkhof
27.3 Research FTE (excluding PhD)

The self-evaluation report states: ‘the mission of the HE department is to educate world-leading civil engineers, train academic scientists and create scientific breakthroughs by carrying out world-class research’. This comprises combining fundamental science with engineering and design, understanding of natural systems and consequences of interventions, developing numerical and experimental tools to validate and substantiate the knowledge, translating and integrating research findings into impactful solutions.

HE aims to develop state-of-the-art engineering solutions for high-water safety, nature-based development, water-born transport and renewable energy, based on a thorough understanding of natural system dynamics, its response to interventions and infrastructure design.

HE's joint research themes are found across the sections and link advances in fundamental science to real-world applications with key focus on the development of generically applicable modelling tools and design guidance. These four overarching research themes are: 1) Dynamics of marine and fluvial systems, 2) Sustainable infrastructure and nature-based solutions, 3) Climate adaptation and flood risk management, and 4) Renewable energy in the marine environment. The research agenda for the upcoming years is inspired by grand societal themes related to climate change, replacement of end-of-life hydraulic infrastructure, energy transition and loss of biodiversity.

The research staff is composed of 12 FTE scientific staff⁵, 15.4 FTE researchers and 108 PhD candidates (2022)⁶.

3.1 RESEARCH QUALITY

The models developed by TU Delft (and Deltares) are world class, including, as examples: XBeach, SWASH, Delft-3D, Aeolis. Progress is being made in field experience particularly in the domain of fluid dynamics, which is increasingly gaining prominence in the Netherlands. The lab facilities and field equipment available for studies are substantial and form a key part of the fundamental work that is done at TU Delft. Lab space is quite compact but HE makes excellent use of the facilities and space. TU Delft is also conducting large scale experiments on nature-based solutions for a variety of topics, including coastal protection, e.g. ZandMotor, which has gained an international reputation for innovative design and long-term planning and adaptation. Innovative methods to capture storm response through their lab on the beach (container ship) was impressive. Furthermore, research focus is expanding to encompass vital areas such as climate adaptation and resilience. As noted in Table 19 of the self-evaluation report, Scientific Impact and Societal Relevance are key components of the research quality of this discipline.

The group also has an excellent track record in terms of personal grants, Public Private Research projects and societal impact which indicates that high scientific impact can match a high societal impact.

⁵ Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

⁶ FTE has been multiplied by the research factor: 0.4 for scientific staff and 0.8 for post-docs.

Education redesign has been helpful in improving the collaboration between the different sub-groups within HE. There is substantial (assumed) collaboration between TU Delft staff and leading water boards and groups (e.g. Deltares) within the Netherlands but this could be further elaborated with clear examples. The interaction/embedment of staff in these external groups is also a strength and could be emphasised more (for example, A figure from SciVal showing the interconnectivity would be really great here to show the breadth of output, international collaboration, etc.) [4]. If industry experience is considered to be a strength of the faculty members, then there is also room for this to be more clearly articulated within the SEP.

It's worth noting that the Committee observed the absence of explicit mention of climate justice in the discourse. However, given the legal nature of this aspect as opposed to an engineering context, this is understandable.

3.2 RELEVANCE TO SOCIETY

As a significant portion of the Netherlands lies below Mean Sea Level (MSL), the HE department remains inherently relevant to Dutch life, closely integrated with major water entities such as Deltares and Rijkswaterstaat. This point could be further emphasised if seen as a strength of the Department, including the position of the faculty on embedding students during their PhD process in these water entities to further collaboration as well as prepare students for jobs in these fields. While the Department faces the ongoing challenge of translating research into tangible societal impact, it acknowledges this area as a priority for improvement.

In addition, the Department is poised to play a pivotal role in the transition to renewable energy. Although a comprehensive strategy is under discussion, the Committee notes that there is room for greater

clarity in articulating specific objectives and outlining the detailed steps planned to achieve them, including necessary resources and development programmes [5].

Regarding enhancing visibility there is room to gain. It is important to reach out to other faculties, in order to address the complex challenges that society is facing. The Committee learned that HE wants to design new research lines, e.g. to offer new opportunities for students, but decreasing student numbers make this challenging.

Concerning peer institutions, the Committee encountered a lack of a definitive response or a unified perspective on how to approach this matter, given the diversity of HE sub-disciplines and consequently the diversity of HE peers. Nonetheless, there exists an opportunity to enhance direct comparisons of impact with other leading HE programmes worldwide. The Committee recommends delving deeper into this aspect [6] to gain a more comprehensive understanding.

3.3 VIABILITY

A diverse set of facilities are available among lab, field, and numerics. Strategic targeted hires have taken place since the last review to fill in gaps and to build capacity, which is praiseworthy.

In terms of the Academic culture, the Committee observes a positive atmosphere within the team and acknowledges an admirable shift towards inclusivity, marked by the implementation of a robust diversity programme at HE. It is noteworthy that the Department is explicitly incorporating FAIR diversity principles, guided by an external consultancy firm – a laudable effort. While the culture of diversity is gaining traction, there is a recognition that the pace should be accelerated to align more swiftly with global standards.

The Committee appreciates the establishment of a bi-monthly platform where staff can voice their concerns, such as addressing delays in PhD progress. Subsequently, the Department initiated a working group to specifically address and mitigate these delays. In this respect, the Committee suggests incorporating contingency plans into the PhD fieldwork planning to guarantee timely completion.

The Committee has not identified a clear strategy for cultivating entrepreneurship and fostering a startup culture within the Department. Additionally, while the Department excels in contract strategy, it appears that there is no explicitly outlined approach in this regard.

The Committee has noted instances of transdisciplinary collaboration occurring outside the HE department. At the site visit, it was discovered that the interaction between Water Management and HE is expanding, evidenced by evident overlaps and existing collaborations –such as those concerning resilience, student exchanges, and shared courses – details that were not entirely clear in the initial report. While the Committee recognises the divergence in focus between the two departments (management versus design), it believes there is untapped potential for further collaboration. Additionally, there may be opportunities to leverage existing skills from other groups, potentially rendering the expansion of certain skill sets unnecessary.

Throughout the interviews, the Committee gathered insights into HE's efforts to enhance its presence in public discourse, particularly in areas such as climate change. Notably, HE actively participates in various strategic boards within the evolving domain of climate adaptation. While acknowledging these appropriate initiatives, there's a shared sentiment that more could be done to effectively integrate and articulate the narrative. This includes taking steps like developing research projects to further contribute to the discourse and make meaningful advancements.

The Lab Tour was well organised and provided the Committee with a comprehensive view of the available facilities and equipment. The Committee was particularly impressed by the prompt response to recent events in the research, notably the handling of the flooding in 2021.

The self-evaluation report indicates a positive trend in improving safety regulations. Nevertheless, the Committee notes the absence of safety instructions before the lab tour, raising concerns. Furthermore, practical implementation of EHS regulations, which the Committee acknowledges may vary from country to country, were exemplified by observed instances of loose hair in the lab, is an area that requires attention. The Committee suggests an examination of these aspects to ensure consistent adherence to safety protocols.

3.4 LIST OF RECOMMENDATIONS

The Committee recommends HE to⁷:

- [4] Expand metrics and evidence to put each discipline within better context of their international peers with direct comparisons where possible. This includes the use of Field-based metrics (such as Field weighted citation index), number of staff in the Elsevier highly cited researchers list, and/or comparison of TU Delft staff against the top unis in the world in HE using SciVal;
- [5] Improve clarity in articulating specific objectives and outlining the detailed steps planned to achieve the renewable energy transition;

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

[6] Enhance direct comparisons of impact with other leading HE programmes worldwide to gain a more comprehensive understanding.

4 ASSESSMENT OF THE DEPARTMENT OF TRANSPORT AND PLANNING (T&P)

Head of Department
Research staff 2022

Prof. dr S. (Serge) Hoogendoorn
24.0 Research FTE (excluding PhD)

The self-evaluation report states: ‘T&P is a global leader in transport science and engineering, providing top-level education and world-class scientific research to develop knowledge and tools for sustainable and resilient multimodal transport systems for people and goods’.

T&P’s goal is to develop sustainable solutions that address the complex challenges facing transport and mobility in modern societies in the best possible way by researching beyond-state-of-the-art methods and technologies. T&P addresses four main themes: 1) Urbanisation and Smart Sustainable Transport, 2) Climate-friendly Transport and Resilience, 3) Well-being, Health, Equity, and Digitisation in Transport, and 4) Computational Modelling and Analysis for Transport Engineering.

The Department aims to leverage its expertise in advanced traffic and transport models and methods to turn data into actionable insights and evidence, creating tools that enable stakeholders to make more sustainable strategic and operational decisions.

T&P’s strategy for the coming years is to maintain and strengthen its position as a world-leading group in transport research. Two prime research areas for the coming years are sustainable multi-modal traffic management and climate-change adaptation in transport, including initiating scientific projects that address policy ambitions for introducing low-car or car-free areas as well as attaining an overall reduction in mobility.

The research staff is composed of 9.1 FTE scientific staff⁸, 14.9 FTE researchers and 60 PhD candidates (2022)⁹.

4.1 RESEARCH QUALITY

The scientific quality is excellent. The group has overall consistently produced high quality, consequential research that is recognised globally. This is one of the strongest transport groups in the world, and is well recognised as such. This is reflected in publication in high impact journals, organisation of major conferences, strong presence in major events and symposia, etc.

The overall domain is without doubt a very important one, and the research areas advanced by this Department are of critical significance scientifically, methodologically, and for engineering and planning practice.

The Department has put forward a new organisational structure with the dual aims of (1) addressing the diversity of research themes and problems that fall within its scope, and (2) leveraging the breadth and depth of the pool of talent within its ranks to empower junior faculty to innovate and develop professionally. While there may be concerns about fragmentation, the Department actively fosters cross-theme collaboration. During the site visit the Committee was impressed by the way the labs collaborated. Organisational structures need to evolve with perceived opportunities and priorities; the current one is a good attempt to address current priorities and constraints, though it may be difficult to fully appreciate as described in table 21, in combination with

⁸ Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

⁹ FTE has been multiplied by the research factor: 0.4 for scientific staff and 0.8 for post-docs.

figure 21 and 22 of the self-evaluation report.. The justification for the seeming complexity of the current structure needs to be more clearly articulated.

The group provides excellent opportunities for young academics to develop their own brand and achieve personal awards while stimulating across PI collaboration as well. The Committee agrees entirely with the statement on page 117 that the working environment provides unique opportunities for collaboration with peers. This is very impressive. This department has achieved considerable success in the transition underway at the overall school level towards diversifying and empowering its junior faculty and giving them clear advancement pathways.

4.2 RELEVANCE TO SOCIETY

The research conducted by this group is of significant relevance to society – in terms of mobility, sustainability, technology, equity and other social, economic and quality of life dimensions. The impact on the SDGs is also evident, and has been genuinely integrated in the Department’s activities and priorities. Staff members work directly with agencies on actual problem solutions and have developed strong relations with these agencies, as well as with the various companies that support them, especially as most of the transport consultants in the Netherlands are former students.

The societal relevance and impact are further substantiated by graduates that are embedded within industry, as well as various positions of leadership. Members have taken on strategic roles within governing bodies/agenda setting steering committees. Furthermore, the group has a large footprint in the transport field, through research and practical implementation. This impact is increasingly global in scope,

with collaborative activities in other European countries, the USA, China and the Middle East.

Examples of unique relevance is the Department's role in advancing understanding and planning for active sustainable mobility modes such as bicycling, which is receiving considerable attention throughout the world. The Department was first in advancing the science of bicycle traffic flow in cities, through measurement and experimentation (including a virtual reality assisted lab), and commands a leading reputation in this area.

Similarly, the group is at the forefront of research on autonomous vehicles and on-demand urban mobility business models with autonomous vehicles, areas that are transformative for transportation, and of particular concern to planning agencies. The group's work is also critical to societal problems in the areas of emergency evacuation, disaster preparation and response, and hazard mitigation, e.g. to natural events exacerbated by climate change.

4.3 VIABILITY

The Department comprises an outstanding, highly qualified and diverse team of staff. The transport domain is broad and highly interdisciplinary, drawing on developments in multiple fields such as physics, economics, sociology, statistics computer science and artificial intelligence. Tackling these challenges calls for a broad set of skills and a flexible structure that can respond to changing demands and societal needs and priorities. Accordingly, the Department has made positive efforts to transition away from the traditional hierarchical model historically followed across the School of Civil Engineering towards a flatter organisational structure that better leverages the talents and energy of its junior faculty. The resources, laboratories, and facilities are

notably exceptional, providing ample support for measurement and experimentation.

The Committee recognises an admirable and genuine commitment to diversity and staff development within the Department. A key challenge highlighted by the Department is the well-being of staff, a matter being addressed through surveys and the establishment of Taskforces on well-being and knowledge security – a praiseworthy initiative whose impact will likely materialise over time.

The ongoing efforts to organise and to make T&P an attractive place to work while effectively addressing the range of societal challenges transport planners and engineers face, point to a work still in progress. The Committee believes that T&P is very well positioned to navigate these challenges successfully. The centrality of these efforts to the Department is well reflected in the self-assessment document, and its relative focus on internal development issues.

The Committee learned that the rationale for the lab-based organisational structure is primarily to give a sense of belonging and sense of identity to the growing ranks of junior faculty. It promotes leadership development, inclusivity, and contributes to making the Department an appealing workplace. The lab structure serves as a pivotal point of contact, facilitating practical, hands-on collaboration. Additionally, it enhances visibility to the external world. The Committee concurs with the presented rationale.

While the lab structure offers advantages, there may be potential drawbacks, including possible diffusion of effort, insufficient critical mass in certain areas, and unnecessary complexity that may hinder effective management. It is also difficult to explain and convey to internal and external stakeholders. The Committee suggests that T&P revisit this complexity [7] for possible streamlining and clarity.

While not the primary focus of the self-assessment report, the T&P group's research is built around a strong core of science,

observation/measurement and methodology. In response to concerns expressed during the interview about the relatively limited discussion of this aspect in the report, the Committee learned that the core is indeed still based in observation/experimentation, data analytics, modelling theory and ways of optimising processes. What T&P does is overlay it on the different themes and topic areas (addressed through the labs). In doing so, T&P hopes to maintain their signature and quality, and be more able and agile to adapt to various societal challenges. The Committee thinks the strategy is somewhat too diffuse and broad-reaching, possibly beyond demonstrated strengths, potentially resulting in slanting too much towards broader impacts without sufficient focus on core science. As a recommendation, the Committee suggests initiating discussion on this matter within the Department [8].

While the SWOT analysis is thoughtful and comprehensive, the report lacks specificity on how it translates into the future strategy of the Department. For example, the Department identifies weaknesses as 'perceived workload' and 'limited research collaborations with other departments,' yet the future strategy does not elaborate on how these issues will be addressed.

Interdisciplinary collaboration is actively underway within T&P. Notable examples include the Masters' programme TIL (with the Faculties of 3ME and TPM), delta resilience research, and the Transport and Mobility Institute. The latter involves the participation of six faculties, fostering collaboration through shared infrastructure, providing a platform for young staff to convene, and developing a joint vision on mobility and logistics.

The Committee was impressed by the enthusiasm of the two junior faculty members and their evident satisfaction with their roles. Factors such as academic freedom, independence, hands-on learning, and a strong sense of support contribute to the positive experience of young staff. The size of the Department, with numerous researchers exploring diverse topics, facilitates the establishment of connections, further

enhancing the appeal for junior faculty members. The Committee also received reports from PhD candidates highlighting the effective functioning of the daily supervisor model and the buddy system.

One question some Committee members have for the Department is: considering the Dutch structure and culture, will the junior faculty hold leadership positions in 10 years, and what steps might be necessary to facilitate this? Additionally, the Committee appreciated the support in the network, especially for international students. The Committee would encourage extending this level of support to all PhD candidates both within and beyond T&P.

The Lab Tour was impressive, particularly the VR-lab, which stands out as an innovation in T&P science. The utilisation of data from various sources is especially valuable.

Summarising, the Department has an outstanding base on which to build and move forward, and adapt to future challenges. As one reaches for those broader societal goals, it would be important to continue advancing the underlying science. It is also important to not diffuse resources too thinly, and remain focused on a more limited subset of areas where the group possesses unique strengths and skills that can give it an edge in an otherwise increasingly competitive global environment for transport research. The Committee recommends to further discuss this matter [8].

4.4 LIST OF RECOMMENDATIONS

The Committee recommends T&P to¹⁰:

- [7] Revisit the complexity of the lab structure and how it is conveyed, and monitor its effectiveness over time;
- [8] Initiate continuing discussions on the breadth of the Department's strategy, and the relative focus on different key areas within the Department.

¹⁰ The list of recommendations is limited to the Committee's most crucial observations.

5 ASSESSMENT OF THE DEPARTMENT OF WATER MANAGEMENT (WM)

Head of Department
Research staff 2022

Prof. Dr. Ir. M. (Merle) de Kreuk
21.5 Research FTE (excluding PhD)

The self-evaluation report states: ‘Our mission is to advance fundamental scientific knowledge and to develop innovative engineering technologies and water management solutions to address key societal challenges related to water systems and their interactions with humans’.

The Department of WM consists of the sections of Water Resources (the terrestrial water cycle including major aspects of hydrology and water resources) and Sanitary Engineering (wastewater treatment, industry water, drinking water, and urban water infrastructure). These two sections within WM collaborate on research that is organised in three societally driven research themes: 1) Water and Energy in Urbanising Deltas, 2) Water, Health and Disaster Preparedness, and 3) Water, Food and Climate.

The function of these themes is to stimulate cross-disciplinary collaboration in the Department, as well as guide towards a shared longer-term vision. As such, the themes can aid in strategic choices in the Department (e.g. new hires, joint project proposals).

To implement its thematically structured mission, WM pursues four strategic aims: 1) maintain a diverse team of top academic staff that collectively cover the broad range of domain-specific expertise required to tackle today’s complex water management problems, 2) collaborate with external partners and stakeholders including water authorities and companies, research institutes, and other universities in the

Netherlands and globally , 3) create impact through scientific publications and communication of research outputs to wider societal stakeholders, and 4) generate societal impact by translating research results into effective technologies, practical tools such as software and data, and actionable policies, together with societal partners.

In the coming years, research at WM will focus on societal challenges centred around water, including climate change, population growth, urbanisation, the energy transition, the circular economy, (emerging) water contaminants, resource recovery, and digitisation in the water sector.

The research staff is composed of 11.2 FTE scientific staff¹¹, 10.3 FTE researchers and 137 PhD candidates (2022)¹².

5.1 RESEARCH QUALITY

The Department exhibits robust research quality aligned with Sustainable Development Goals (SDGs), resulting in praiseworthy research and translational outputs. The report provides a clear depiction of how the Department's strategy and goals are closely connected to SDGs. Notably, the metrics are well-described, underscoring the Department's global standing, ranking in the top 10 globally based on various metrics. Impressively, the Department has published over 200 peer-reviewed articles in 2022, amassing over 20,000 citations in the 2017-2022 period.

¹¹ Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

¹² FTE has been multiplied by the research factor: 0.4 for scientific staff and 0.8 for post-docs.

The increase of scientific output in the last five years goes hand in hand with a growth of the social impact as indicated in the various societal metrics.

The Committee was also impressed by the number of (global) co-authorships which is a valuable indicator for the excellent collaborations and global impact of their work. It also provides good opportunities for their young staff members to develop their own network and global brand.

The Department boasts an excellent team, including enthusiastic PhD candidates. The Water Management chapter of the report stands out for its well-written narrative, serving as an exemplary model for other departments.

5.2 RELEVANCE TO SOCIETY

The Department is highly engaged with a large range of stakeholders in the Netherlands, as well as in Africa and other countries in the global south. The team has a multitude of projects to showcase, illustrating their extensive work. Additionally, they have undertaken the initiation of Massive Open Online Courses (MOOCs). Their focus spans energy transition and the water cycle, including initiatives such as geothermal heat. To enhance the dissemination of their work, a dedicated communication team is in place to provide comprehensive support.

5.3 VIABILITY

A well-defined strategy and clear governance structure are in place, showcasing excellence. The Department demonstrates a distinct and

well-presented connection to its strategy. The organisation of research and laboratory spaces is designed to foster cross-overs and collaborations, aligning with Sustainable Development Goals (SDGs). Notably, the Department's considerable size enables the comprehensive exploration of the entire global and earth water cycle, setting it apart from other departments globally and highlighting its standout position in water management.

Water Management has adopted a team-based plan, moving away from a traditional hierarchical structure led by a single professor. This shift has resulted in enhanced collaboration and a sense of ownership among the groups operating within the three primary themes of the Department. While the organisational structure remains a work in progress, the Committee has observed the positive outcomes, particularly in terms of fostering increased diversity within the team, contributing to a more vibrant and inclusive work environment.

The Committee acknowledged robust international collaborations that have recently been strengthened, including cross-collaboration with TU Delft institutes and the Faculty of Applied Physics. There is a notable exchange of staff members, and the introduction of new educational programmes is enhancing interlinking, which is appreciated.

The Committee observed that the Department has recently recruited a substantial group of 11 new individuals. Commencing their integration poses a notable challenge. The various strategies described to stimulate collaboration as the planned reorganisation of office space and the match making sessions are important steps to integrate the new staff members. A buddy system could also help. We recommend to provide time and space for new staff members to find their way in the Dutch and European system [9].

WM boasts excellent lab facilities, including a spacious indoor lab known as the WaterLab (500m²), with an additional 150m² under construction. Moreover, the Department follows a policy of sharing data

and models. However, there is room for improvement in the technical support for analytical work in some cases.

The duration of PhD programmes is too long, and a considerable number of candidates do not complete their PhD (average 39% over 7 years). This is attributed to various factors, such as insufficient supervision and guidance compounded by large research groups. WM is acutely aware of the PhD completion issue, including the challenge of overseeing too many PhD candidates. The Committee suggests that WM adopt a more realistic approach to determining the number of PhD candidates each staff member can effectively supervise. Efforts are underway towards this goal, such as discussions in meetings, training opportunities for ACT staff, meetings with the Director of Graduate Studies, and changes to the annual process meeting being monitored by external individuals, a comprehensive and well-thought-out plan to address these issues is still lacking. It is strongly recommended that WM develop such a holistic plan [10].

The lab tour provided additional insights into the Department's activities, revealing variations from the information presented in the report. Adequate technical support was observed with the presence of knowledgeable technicians. Safety requirements and regulations, including the use of safety glasses and meshed shoes, did not receive sufficient emphasis, indicating a need for improvement in executing safety protocols. The facilities were truly impressive, elevating them to the top tier. The researchers demonstrated a high level of commitment, and the Department appears well-resourced, boasting world-class lab facilities. One amusing observation noted by the Committee was the gender distribution in the labs, with the clean-water lab exclusively staffed by females and the dirty-water lab exclusively by males.

5.4 LIST OF RECOMMENDATIONS

The Committee recommends WM to¹³:

- [9] Provide time and space for new staff members to find their way in the Dutch and European system;
- [10] Develop a holistic plan with a more realistic approach to determining the number of PhD candidates each staff member can effectively supervise.

¹³ The list of recommendations is limited to the Committee's most crucial observations.

6 ASSESSMENT OF THE DEPARTMENT OF MATERIALS, MECHANICS, MANAGEMENT AND DESIGN (3MD)

Head of Department
Research staff 2022

Prof.dr.ir. L.J. (Bert) Sluys
19.3 Research FTE (excluding PhD)

The Department Materials, Mechanics, Management & Design (3MD) focuses on design, management, mechanics and materials principles of civil infrastructures and buildings. These structures are analysed by means of a multi-scale approach that governs the entire lifecycle from development, design, testing, building, maintenance and operation to reuse or recycling.

The 3MD department aims to: 1) Conduct world-class fundamental, application-oriented and societally relevant research supported by excellent and unique experimental and computational facilities, 2) Create an open, inclusive, professional and stimulating environment for students, researchers, and lecturers to develop to their full potential;

The 3MD department strategically aims to: 1) Optimise the resilience of buildings and infrastructures to increased loading, natural hazards, and anthropogenic threats, 2) Improve the sustainability of buildings and infrastructures by producing comprehensive solutions to reduce negative environmental impact, 3) Advance the transition to renewable energy systems from a materials, mechanics, management and design perspective, and 4) Foster a technological transition by developing innovative, smart materials, novel construction technologies, advanced computational techniques, and design principles to create safer buildings and infrastructures with increased performance and functionality.

Considering the relatively broad thematic research scope of the 3MD Department, which ranges from the material via the structural to the systems scale, its structure is characterised by three sections: The Materials and Environment (M&E) (which includes the micro-mechanical laboratory (Microlab)), the Applied Mechanics (AM) and the Integral Design and Management (IDM) Section, the core disciplines of which focus on three scales, namely the material scale, structural scale, and system scale, respectively.

In the coming six years, the 3MD research programme will continue to focus on societal and scientific relevance and challenges, enabling the essential transitions as formulated in these department goals.

The research staff is composed of 8.7 FTE scientific staff¹⁴, 10.6 FTE researchers and 80 PhD candidates (2022)¹⁵.

6.1 RESEARCH QUALITY

3MD is distinguished by its high-level research and holds an excellent reputation and a high visibility within the international scientific community. It has secured a leading position in material research and computational methods, as attested by its outstanding international ranking. The Department exhibits praiseworthy productivity, with a diverse output of high quality papers published in highly ranked scientific journals and conference contributions, along with a notable number of personal grants. However, for a more thorough evaluation, additional details from 3MD would be beneficial. The available information, particularly the quantitative measures provided in Table

¹⁴ Comparable with WOPI categories HGL, UHD and UD; tenured and non-tenured staff.

¹⁵ FTE has been multiplied by the research factor: 0.4 for scientific staff and 0.8 for post-docs.

28 of the self-evaluation report, makes it challenging to assess the Department comprehensively.

The Department is currently undergoing a transition, aiming to integrate the robust competences of TU Delft in traditional simulation with data-based methods (ML/AI) and digital design and construction. The laboratory facilities, most notably the MicroLab and the masonry testing lab, are successfully kept on a very high, internationally visible standard in regards to materials characterisation and vulnerability assessment of masonry structures. A challenge is seen in the heterogeneous organisation of the lab structure between the 3MD and the Engineering Structures department. The active participation in setting up the High-performance computing cluster DelftBlue and the integration of the 3MD department in the cross-faculty Institute for Computational Science and Engineering are important for securing the potential of multi-scale oriented High-fidelity computations of materials and structures. Equally important, the planned installation of a new digital construction lab is seen as a valuable step towards integrating and extending the well-established competences in computational methods towards digital design and construction methods.

6.2 RELEVANCE TO SOCIETY

3MD is actively participating in the new national platform "Raad Civiele Techniek," which is strategically crucial. The Department demonstrates a clear and credible research orientation focused on addressing sustainability and societal issues. Examples include the masonry houses, research on the development of novel CO₂-reduced concrete, and research in modelling and smart construction technologies – all conducted at a high scientific level and convincingly aligned with societal needs. To enhance understanding of the broader impact of

3MD's work, explicit links to the Sustainable Development Goals (SDGs) would be valuable [11].

The Department engages in fruitful collaboration efforts and actively participates in standards and committees beyond academia. Notably, 3MD is transitioning toward a greener economy, aligning its key research areas with societal needs. The Department is successful in the transfer of innovative research targeted towards a reduction of the environmental footprint of engineering construction, in particular in regard to new, CO₂ reduced and self-healing materials for the construction industry. This is corroborated, among others, by four patents and the founding of start-ups emanating from the Department. The group focussing on integral design and project management has achieved significant visibility with ministries, especially in the realm of sustainability. Leveraging this visibility presents an opportunity for them to assist other groups within the Department.

6.3 VIABILITY

The Committee observed that 3MD is a young department undergoing its first assessment. Notably, 3MD has successfully recruited a significant number of talented new staff, with a strong focus on computation and the improvement of lab facilities, including the Digital Construction Lab, Delft AI Lab, and High-Performance Computing – an accomplishment worthy of praise. The Department establishes a close link between research and education.

Similar to other departments, 3MD is grappling with organisational changes, also detailed in the CE-level section. While 3MD seems to maintain a structure historically built around key leading professors, the staff appears content with this arrangement. However, the Committee emphasises the need to remain vigilant, ensuring that this leadership

style not impede the transition toward a less hierarchical structure. Recent appointments of young faculty members in new research themes show a strong ability of the Department to attract and to integrate excellent international talents.

Formally, the Committee finds the composition of 3MD somewhat unusual, encompassing a broad spectrum of disciplines. During the site visit, it became evident that the Department seems to aim at “creating its own scale-bridging universe”. The Committee learned that 3MD perceives opportunities in the diversity of topics and successfully integrates them. A notable example was the joint research proposal recently submitted, involving multiple researchers from different sections. This initiative required combined and in-depth knowledge spanning the three levels of scale, showcasing the strength of the Department. The Committee was notably impressed by this multilevel scale approach. Nevertheless, overlaps of the research agenda and also lab infrastructure of the 3MD and the ES Department exist (e.g. Material/Structural Health monitoring, masonry lab, composite materials for wind turbines, BIM, digital fabrication etc.), which require smooth mechanisms to facilitate and foster cooperation and to fully exploit the huge potential of the lab infrastructure and competences in these two departments. It is recommended to consider forming a cross-departmental MT-governance structure between the 3MD and ES departments to enable regular exchange and synergies in regards to future research targets and common methodological foundations, e.g. digital design and construction, ML and AI methods etc. [12].

The Committee inquired about the integration of groups and their commonalities. Given the diverse backgrounds and cultures, it sees potential challenges. However, during the site visit, it became apparent that 3MD views this diversity as an opportunity. Multi-disciplinarity is predominantly visible in the IDM group, showcasing the added value of diverse backgrounds and expertise's, much needed in joint EU calls – a clear advantage of collaboration within the Department. We would

suggest to further develop this joint proposition and showcase the added-value to external stakeholders.

The Department exhibits good integration and participation in cross-faculty facilities, such as a Delft AI lab and HPC computing. The Committee noted successful interlinkages, particularly with chemistry, exemplified by joint PhD projects on self-healing concrete, which were not apparent from the report. This cross-disciplinary collaboration underscores the Department's commitment to broadening its impact and leveraging expertise from diverse fields.

The Committee also observed diverse approaches to involving junior staff, linking them to senior staff, e.g. from the Geosciences departments, and even beyond the Faculty. Additionally, efforts towards transparency in the MT and communication of decisions were noted. However, the Committee suggests further consideration on how to genuinely engage young staff [13], viewing them as a valuable asset. Embracing and involving them more actively could contribute significantly to lifting the Department, possibly adopting an approach similar to the "ES young management" model.

Throughout the Lab Tour, the Committee encountered superb lab equipment meticulously maintained to uphold high technological standards. Furthermore, admirable integration with central facilities, exemplified by the AI lab, was observed.

6.4 LIST OF RECOMMENDATIONS

The Committee recommends 3MD to¹⁶:

- [11] Enhance understanding of the broader impact of 3MD's work, explicitly linked to the Sustainable Development Goals (SDGs);
- [12] Consider forming a cross-departmental MT-governance structure between 3MD and ES;
- [13] Consider how to genuinely engage young staff.

¹⁶ The list of recommendations is limited to the Committee's most crucial observations.

7 JOINT REMARKS FOR THE CIVIL ENGINEERING DEPARTMENTS

7.1 COLLECTION OF GENERAL REMARKS

The CE departments are well-recognised, both in quality and quantity, CE is world-class. The presence of excellent staff and state-of-the-art facilities contributes to the vibrant energy within the CE departments, comprising both renowned experts and promising young talent. The future seems very bright although we all know that there are uncertain times.

The Committee observed that the presentation and substantiation of research quality in the report were so diverse that it appeared there is no overarching or faculty-wide approach. The Committee deems it essential to establish a more consistent approach to enhance collaboration.

The interviews were very informative. In several instances, the Committee had formed a different impression from the report than from the interviews regarding how a particular Department is structured and operates. Moreover, the Committee was impressed by the achievements presented during the interviews. All staff members the Committee met were extremely enthusiastic and energetic, aspects that are difficult to convey through the narratives included in the report.

STRATEGY

The Faculty exhibits a strong commitment to the Sustainable Development Goals (SDGs), yet the Committee observed a lack of a comprehensive, overarching strategy from the Faculty Board on

enhancing the impact on these goals. Although individual departments are evidently aligned with the SDGs and are contributing positively, there is a significant opportunity for the Faculty Board to amplify this impact. This can be achieved by developing and implementing a unified faculty-wide strategy focused on the SDGs. In doing so, the Committee recognises potential benefits in fostering and intensifying cross-departmental collaborations. Such collaborative efforts could lead to innovative approaches and synergies, furthering the faculty's collective impact on achieving the SDGs. In addition, there is a lack of clarity regarding the Faculty Board's objectives, the intensity of its push toward specific strategic directions, and the autonomy left to individual departments to pursue their own goals. This ambiguity extends to what is expected from the departments and individual staff at all levels.

The Committee learned about several developments, including those in AI-labs, and climate actions at the central TU Delft level. These developments offer opportunities for Civil Engineering, and the Committee suggests that the Faculty take a proactive position to leverage these opportunities.

STRUCTURE – A WORK OF PROGRESS

The Faculty is undergoing a period of transition – to accommodate the growth, diversity and changing demands on and expectations by its professoriate, as well as to better position itself in an increasingly competitive European and international context. From the strongly hierarchical, primarily national, structure of the previous era, with limited prerogative to associate and assistant professors, the transformation is seeking to provide greater autonomy and responsibility, individual recognition while contributing to group reputation, as well as clearer career pathways to all faculty.

The Civil Engineering Management Team appeared to be committed to the change with good intentions and a high level of awareness.

The Committee's assessment reveals that different departments are dealing with the challenges of this necessary transformation in different ways. Some appear to have retained the hierarchical legacy but within smaller divisions in the same department, while others appear to have flattened the structure through an expansive set of sub-entities, e.g. laboratories, to provide greater leadership opportunity and empowerment to junior faculty.

While different structures may be more appropriate to each Department's themes, culture, and external stakeholders, the Committee's conclusion is that this transformation remains work in progress, and that different departments could learn from the other departments' experience to adopt best practices and adapt own structure and processes. Along these lines, it would be useful to establish a process by which these transformations are assessed internally, and open conversation take place to share experiences and frustrations as well.

The Committee perceived that formal structures were based on history and did not always match with the informal way of working or intended way of working.

COLLABORATION

CE encourages cross-departmental collaboration, but the notable differences in the structure and implementation of HR policies (as well as working practices) among departments pose challenges. During assessments, departments displayed variations in aspects such as academic culture, (PhD) supervision, talent management, and HR involvement with younger staff. An example of this is the role of junior faculty and the diverse expectations placed on them by different departments. The Committee questioned the rationale behind assessing these aspects at the Faculty level in this Research Assessment, pondering whether conducting five separate reviews would yield different outcomes. It raises broader questions about the collective

vision for the Faculty of CE – what kind of Faculty it aspires to be and its added value within the university and to society. The Committee suggests that engaging the wider CE community in answering these questions could contribute to greater cohesion and growth as a Faculty. It recommends undertaking such an investigation, with the CEG Board taking the lead in the debate [15].

Despite these challenges, the Committee recognises the significant value of working within a unified Faculty, including collaboration with the geosciences department. Notably, there is strong connectivity, particularly in areas such as climate adaptation. The Committee applauds the practice of new positions working jointly across departments. In light of this, the Committee recommends conducting the next research assessment jointly with geosciences [16], fostering further development for the Faculty.

Young academics at CE express eagerness to collaborate, finding interfaculty research exciting and beneficial for their careers. The emerging generation values working in interdisciplinary teams and close collaboration with societal and industrial partners. To enhance collaboration, social impact, and cohesion both within and beyond departments, the Committee recommends establishing funds for interfaculty and interdepartmental research [17].

FOLLOW-UP ON PREVIOUS ASSESSMENTS

Despite the self-evaluation report's assertion that the accessibility of the CE website has improved, the Committee remains unconvinced. It observed that certain departmental websites are still not easily navigable, and locating individuals, particularly those below the full professor level, can be challenging.

COMMENTS SELF-EVALUATION REPORT

The self-evaluation report was appreciated, but the Committee encountered numerous questions, many of which could have been easily avoided. Firstly, different departments presented their work in varied formats, making comparisons challenging. For instance, the evidence provided varied significantly between departments, making it difficult to assess research quality without consistent quantitative measures. While the Committee acknowledges that quantitative measures don't capture the entire picture, a more substantial backing of the narrative with metrics is appreciated. The Water Management chapter could serve as an example here.

Secondly, the report lacked concise information, such as details on ACT, which consumed valuable interview time for clarification instead of delving into critical questions. Some policies, particularly those related to HR and the Graduate School, need to be documented and made explicit. Several important policies and procedures were often unclear to Committee members, even after interviews with (especially young) staff members. The Committee assumes that if clarity is lacking for them, it will likely be unclear for the staff as well.

It is advised that the department chapters be better aligned to enable the Committee to conduct more thorough analyses and interviews. This improvement is not solely beneficial for the Committee's purposes. Enhanced alignment also fosters self-reflection, which is crucial in preparing for upcoming (intermediate) research assessments.

LIST OF RECOMMENDATIONS

The Committee recommends CE to¹⁷:

- [14] Provide a clear understanding of how aligning with Sustainable Development Goals (SDGs) could further enhance the impact the Faculty can make;
- [15] Undertake an investigation about the collective vision for the Faculty of CE and how collaboration can be enhanced by aligning (HR-) processes) and ways of working. Discuss what is needed at Faculty level and what at Departmental level;
- [16] Conduct the next research assessment jointly with geosciences fostering further development of an integrated approach for the Faculty;
- [17] Establish funds for interfaculty and interdepartmental research to enhance collaboration, social impact, and cohesion both within and beyond departments.

7.2 PHD POLICY AND TRAINING¹⁸

The TU Delft University Graduate School (UGS) and its local branch, the CEG Graduate School, provides a structured Doctoral Programme with a PhD Development Cycle, which includes a clear assessment timeline and a course-based Doctoral Education (DE) Programme. It is the ambition of the UGS to facilitate doctoral candidates to become highly qualified, autonomous, and leading researchers and skilled professionals. At TU

¹⁷ The list of recommendations is limited to the Committee's most crucial observations.

¹⁸ In accordance with the Terms of Reference (ToR), this aspect is evaluated at the CE level; hence, the comments in this section are applicable to all departments unless stated otherwise. Remarks specific to departments are detailed in their respective sections.

Delft, a Doctoral Programme consists of Research and Doctoral Education. The research is embedded in research Departments. The DE Programme is an integral part of the preparation for the doctorate and the graduate's further career. It ensures and enhances the development of scientific quality along with the needed proficiency for interpersonal skills.

The success rates of the PhD candidates at the five Departments are found in Appendix E.

REMARKS

The duration of PhD programmes and the graduation rates are serious areas of concern. Across all departments, graduation rates are generally low, with some experiencing particularly alarming rates of less than 50%. Only 3% of candidates meet the targeted graduation rate of 4 years. While there is a collective awareness of this issue, the Committee is uncertain whether individuals fully grasp the extent of the problem and its potential consequences. Despite the presence of measures and guidelines aimed at reducing prolonged PhD durations, they either seem ineffective in practice or are not consistently followed.

The Committee recognises the challenges of timely completion of PhD candidates and the complexities of adequate supervision, degree requirements, and external factors that are sometimes beyond the control of all parties. There is no single reason for the delay, but some concerns were mentioned by individual PhD candidates as 'limited time of the supervisor' (some have only a part-time appointment), delay due to difficulties to get access to data, etc. The Committee recommends the Faculty undertakes a thoughtful study of all aspects of PhD supervision in the various departments and formulates a regular review process that ensures continued progress of PhD candidates towards their degree goals, including ensuring that supervision needs are adequate, and establishing interventions when needed [18].

Suggestions to address this problem include:

- *Evaluate data at different levels.* Analyse graduation rates by staff member and within sections. Gather comprehensive data, including completion statistics categorised by gender, nationality, funding source, and enrolment status (full-time/part-time) for each Department to identify trends. Also, data are needed for each supervisor/promoter in terms of PhD completion (they may need to be kept confidential, but this could be informative). Furthermore, not all PhD candidates might have a four year contract. There are also five year contracts for PhD candidates, and then the statistics of the four year completeness rate are less relevant. So, these statistics need to be added in the next self-evaluation report (and analysis). Consider sharing relevant information about duration and graduation rates with all staff.
- *Proactive role of the Graduate School.* The Graduate School could play a more proactive role in evaluating the PhD programmes in the different departments. For example, do they know if the milestones are enforced or if the mentoring practices are implemented in practice? Director of Graduate Studies has a lot of information and ideas. It is not clear if he has enough influence with all faculty. Recognise the critical importance of the Director of Graduate School and consider increasing his influence by potentially including him in the Management Team (MT).
- *Structured exit interviews.* Conduct structured exit interviews with PhD candidates to understand what worked well and what did not in the PhD programme.
- *Career trackers and alumni network.* Implement career trackers for PhD graduates and establish a robust PhD alumni network to track the post-graduation trajectory of PhD holders. This can be integrated with the idea of “stories, whereabouts, etc.” of

graduated MSc/PhD candidates, as described in the HR policies section of the report.

The PhD candidates interviewed generally expressed satisfaction with their research and regular activities with peers. However, several concerns and suggestions were raised regarding the advising/mentoring processes and requirements:

- *Supervisor influence.* PhD candidates voiced concerns about the power dynamics with supervisors, citing requests for non-research-related tasks that contribute to work pressure and the number of papers.
- *Equity Issues with Scholarships.* Scholarships and bursaries that international students receive from their home countries are sometimes too low to live on, which causes inequality, which is problematic. Scholarship from home countries sometimes only pay the minimum required by Dutch law – less than half the stipend of the other PhD candidates – which is insufficient to live on. This creates inequalities and does not seem sustainable.
- *4-Eyes Principle implementation.* Discrepancy between the theoretical 4-eyes principle and its practical implementation is noted, with some international PhD candidates facing time constraints. Emphasis should be on TU Delft remaining the main responsible entity, especially in cases of external supervisors.
- *Student wellbeing and resources.* Lack of clarity for PhD candidates on where to seek support for concerns. If issues arise, there is currently a process in which a form is submitted through the supervisor, although this is not considered an optimal arrangement. Not all candidates seem to be aware what resources are available to help when there are concerns with promoters, supervisors, workload, wellbeing etc. and a gap in engagement with the PhD Council were noted.

- *Support from supervisors.* Support primarily relied on individual supervisors, with limited involvement or intervention from HR. The Committee also received reports from PhD candidates highlighting the effective functioning of the daily supervisor model and the buddy system (T&P department, see also page 35).
- *Transparent planning.* Proposal for a more transparent planning process, facilitated by an external committee, as opposed to annual meetings with supervisors.
- *Continuation of skills.* The acquisition of equipment operation skills relies heavily on the availability of fellow candidates who can provide assistance.
- *Capacity planning and facility accessibility.* A capacity planning form technicians and lab facilities is lacking which may result in big delays. The utilisation rate of the lab facilities is also unclear. An (online) system for booking might improve the accessibility of the facilities.
- *Teamwork and cross-sectional courses.* Some PhD candidates were missing the teamwork and the possibility of following cross-section courses
- *Field work.* Some students depend on fieldwork, which is influenced by external factors such as weather conditions (e.g., sun, storms). It is crucial that PhD candidate and supervisor alike anticipate and proactively manage these risks, recognising their significance for PhD candidates.
- The PhD candidates with positive experiences like the guidelines that are in place but noted that the practical implementation was often difficult and not always accomplished. The degree to which guidelines were implemented depended on the supervisors.

The Committee recommends developing a structured approach involving the wider CE community to address the graduation challenges, considering the aforementioned suggestions from PhD candidates and the Committee [18].

One additional point of consideration concerns the mandatory status of GS. Although the Faculty has a joint graduate school it is unclear what the mandatory status is. For instance, the director of the GS is not part of the Faculty Board. What role will the GS have in the future? What should be organised at departmental level and what at GS/Faculty level?

REMARKS TRAIL RESEARCH SCHOOL

TRAIL is a research school in the area of Transport, Infrastructure and Logistics (TIL), in which six Dutch universities participate. It is established for reasons of content (a multidisciplinary education programme is provided), efficiency (join forces – efficient training of PhD candidates), quality (higher quality by selecting the excellent teachers, and community building (PhD candidates get to know many other PhD candidates and academics via TRAIL). On 01-09-2023, TRAIL had 138 PhD candidates.

The Committee acknowledges the significant role TRAIL plays as a crucial school/network for PhD candidates, emphasising the importance of maintaining connections within this community. TRAIL provides a valuable, small-scale network with numerous benefits for PhD candidates, including social events, a PhD council, a dedicated conference, and opportunities to engage with potential future employers.

Recent changes, such as replacing exams with tailor-made assignments for PhD candidates, are viewed positively by the Committee.

The Committee recognises opportunities for Life Long Learning within TRAIL and recommends exploring and expanding upon these possibilities [19].

Furthermore, the Committee believes that fostering connections with other transport groups and taking a leadership role within TRAIL is advantageous for T&P-Delft. TRAIL is an important differentiator for TU-Delft's T&P programme, and a source of considerable enrichment intellectually and professionally for its students and researchers.

While noting that the PhD duration for candidates in the TRAIL programme is a concern, it is acknowledged as being slightly better than in other CE Departments. The Committee recommends conducting a comparative analysis of PhD completion rates with other affiliated transport groups and initiating discussions with these groups to address and improve this aspect [20].

LIST OF RECOMMENDATIONS

The Committee recommends CE to19:

- [18] Develop a structured approach involving the wider CE community to address the graduation challenges, taking in consideration the suggestions from PhD candidates and the Committee;
- [19] The Committee recognises opportunities for Life Long Learning within TRAIL and recommends exploring and expanding upon the possibilities for Life Long Learning within TRAIL;
- [20] Monitor and compare PhD completion rates across the TRAIL-affiliated transport groups and initiate discussions with these groups to share best practices.

¹⁹ The list of recommendations is limited to the Committee's most crucial observations.

7.3 HUMAN RESOURCES POLICY²⁰

TALENT MANAGEMENT

The Committee acknowledges the praiseworthy effort by CE departments in adopting the "Room for Everyone's Talent" approach. However, it also observes challenges in its implementation, primarily attributed to the existing organisational structures, as discussed in the section on General CE remarks.

Overall, the Committee perceived that there should be more structural support available for junior faculty compared to tenured staff within the departments [21]. In addition, the Committee suggests to i) have structured and documented end of contract interviews, ii) use the input / feedback from the Young MT's (assuming they represent the new / next generation), iii) support / guide (especially new) managers to coach their respective employees, and iv) consider to have 360 feedback sessions. This will help to take the Department to the next level with relation to well-being, psychological safe climate, scientific performance and employee retention.

If leaders want to unleash individual and collective talent, they must foster a psychological safe climate where employees feel free to contribute ideas, share information and report mistakes.

Finally, it is recommended to develop a database (and visualisation) with stories, results and whereabouts of graduated MSc and PhD candidates to inspire, facilitate the interaction between industry and university [22].

²⁰ In accordance with the Terms of Reference (ToR), this aspect is evaluated at the CE level; hence, the comments in this section are applicable to all departments unless stated otherwise. Remarks specific to departments are detailed in their respective sections.

Academic Career Track

The Committee believes that ACT staff would benefit from a formal mentoring programme, as the existing informal mentoring varies in its level of support, depending on the individual [23]. The promotion criteria for associate professorship are not uniformly clear to all ACT staff, posing a risk of bias. Although promotion criteria exist, not all staff members are aware of them. The Committee suggests incorporating an external assessor and improving the accessibility of HR documents for all staff.

While ACT staff appreciates the early permanent contract, there is concern about the potentially longer time to promotion under the new system and the lack of clarity regarding the timeline (5 to 8 years). ACT staff members express a desire for more teamwork, increased transparency in promotion processes, professionalisation in areas like social safety, and the formalisation of HR procedures, moving away from informal practices. Additionally, long-term funding at the central university level was suggested by ACT staff.

Tenured staff

Tenured staff members occasionally express concerns about the prolonged duration before they are permitted to supervise someone, sometimes without a clear rationale. One of the reasons mentioned is the necessity to obtain a formal mandate, known as 'ius promovendi', to serve as the primary supervisor. Additionally, the Committee wishes to address the sense of underrecognition among staff members, who are not full professors, in their roles as PhD student supervisors until they achieve a certain status. While the current system does not allow them to make a change, being sensitive to this concern is still important so all staff receive official recognition for their supervisory work. Notably, the Committee observed instances where such staff members are listed as senior authors on publications derived from their supervised projects,

contrasting with situations where the official promotor is credited, which may lead to feelings of demotivation.

Furthermore, the Committee has been notified that, starting from 2018, all members began receiving a partial startup package, which was upgraded to a full package in 2020, comprising a PhD. This development is seen as very valuable and helpful for the promotion of early-career researchers and is expected to at least partially facilitate the supervision restrictions.

The workload is acknowledged as demanding, yet tenured staff perceives it as self-imposed, driven by their passion for research. Despite having the freedom to operate and feeling empowered, there is a recognition that organisational support, particularly administrative assistance, e.g. support for grants, for young faculty could be enhanced.

DIVERSITY

The Faculty demonstrates a robust and inclusive culture, welcoming students from diverse backgrounds. Inclusion and diversity are prioritised within CE, and the Committee was impressed by the existing framework. CE has diligently worked on policies, including fundamental Inclusion, Diversity, and Equity (IDE) principles, exemplified by initiatives such as bias training.

The Committee recommends the continued development of transparent processes for both PhD candidates and staff promotions [24]. This should encompass acknowledging diverse career paths, adopting measures such as ROPE (Relative Opportunity), and expanding the evaluation criteria beyond traditional metrics like citations and publication counts. The leadership has done praiseworthy work in this regard, and the Committee is confident that CE leaders can further enhance these efforts.

LIST OF RECOMMENDATIONS

The Committee recommends CE to²¹:

- [21] Provide additional structural support for junior faculty compared to tenured staff within the departments;
- [22] Develop a database (and visualisation) with stories, results and whereabouts of graduated MSc / PhD candidates;
- [23] Develop a formal mentoring programme for ACT staff;
- [24] Continue developing and applying transparent processes for both PhD candidates and staff promotions.

7.4 OPEN SCIENCE²²

TU Delft has proactively implemented a university-wide Open Access policy, achieving full integration within the research cycle. Periodic updates and information sharing with management ensure a comprehensive understanding of Open Access initiatives, and the university is recognised as a front-runner in Europe, with the former rector being a prominent leader in this domain.

Within the Civil Engineering Departments, a robust commitment to open models, open data, and open publishing is demonstrated. This commitment extends beyond publications to include the sharing of software and data sets with the wider research community, contributing to the ethos of openness and collaboration. Notably, there is a proactive

²¹ The list of recommendations is limited to the Committee's most crucial observations.

²² In accordance with the Terms of Reference (ToR), this aspect is evaluated at the CE level; hence, the comments in this section are applicable to all departments unless stated otherwise. Remarks specific to departments are detailed in their respective sections.

approach to cost discussions related to Open Access publication and data storage during the project planning stage.

While there is an acknowledgment of the development of an Open Access culture and efforts towards research data management, specific details on discipline-specific research data management, including metadata schemes and electronic lab books, are yet to be fully articulated [25].

An important consideration raised is the challenge of reconciling credit and attribution, particularly concerning the risk of "getting scooped." This poses a dilemma, especially for junior faculty members who invest in data collection but may need to make it public before receiving appropriate credit for their results. The Committee noticed that no explicit strategy is in place for the disclosure of data to competitors and recommends looking into this [26].

Lastly, a critical question is posed regarding the assessment of the value of open access publication. It prompts reflection on whether Open Access publication correlates with increased citations, greater impact, and enhanced reputations, suggesting a need for a comprehensive evaluation of the impact of Open Access initiatives [27].

LIST OF RECOMMENDATIONS

The Committee recommends CE to²³:

[25] Articulate details on discipline-specific research data management, including metadata schemes and electronic lab books;

[26] Develop an explicit strategy for the disclosure of data to competitors;

²³ The list of recommendations is limited to the Committee's most crucial observations.

[27] Perform a comprehensive evaluation of the impact of Open Access initiatives.

7.5 ACADEMIC CULTURE

In general, the Committee perceived the academic culture during the site visit as welcoming and open. Specific remarks for individual departments are detailed in their respective sections. The following comments are applicable to all CE departments.

The Committee learned that 'ways-of-working' among the departments once were substantially different, with a notably non-diverse staff. Presently, the departments are increasingly collaborating, thereby converging in academic culture. In this regard, the recent joint efforts in modernising the study programme were helpful. Governance structures should be revisited such that cross-departmental cooperation is further facilitated. The Dean emphasises the significance of the "Room for everyone's talent" principles for the Faculty, moving away from a one-size-fits-all approach. The goal is to encourage collaborations and promote a culture where individuals are mindful of one another.

A noteworthy focus at both the Faculty and TU Delft levels is on social safety, with an emphasis on prevention through measures like the 4-eye principle. A less hierarchical organisational structure and the existence of various committees, including an ethical committee, contribute to improved social safety. While safety topics are openly discussed in staff meetings, and training is provided – a praiseworthy practice – reports indicate discrepancies between the 4-eye principle on paper and its practical implementation. The Committee recommends a thorough evaluation and necessary steps to address this issue [28].

In terms of inclusiveness, the use of Dutch as the main language in the Faculty MT is considered non-inclusive. There's a perception that

learning Dutch is a prerequisite to joining the MT, creating an invisible cultural barrier to the management team. To enhance inclusivity, communications should be in English for broader accessibility.

The Faculty should actively support individuals to become visible and integrated into projects, with attention varying across departments.

Representation of young staff across the full breadth of the Faculty is not consistently achieved. The ES young management initiative (see also page 18) is cited as a positive example, and the Committee recommends exploring its implementation in other departments or even at the Faculty level [29].

The Committee identified concerns regarding safety regulations in labs, noting instances where safety measures appeared not to be taken seriously. It recommends a thorough review of safety practices in labs to address potential shortcomings [30].

The Faculty of CEG addresses research integrity and demonstrates the development of clear policies and guidelines in that regard, for which the Faculty is commended.

LIST OF RECOMMENDATIONS

The Committee recommends CE to²⁴:

[28] Evaluate and take necessary steps to address discrepancies between the 4-eye principle on paper and its practical implementation;

[29] Explore the implementation of the Young MT in all departments or even at the Faculty level;

²⁴ The list of recommendations is limited to the Committee's most crucial observations.

[30] Thoroughly review the safety practices in labs to address potential shortcomings.

CONCLUSION FACILITATE CONTINUED GROWTH TOWARDS A PROSPEROUS AND ALIGNED FACULTY

The Committee recognises CE as a top-notch institution with outstanding experimental facilities and a highly valuable staff. The Departments of CE possess the essential resources to make a significant societal impact and fulfil its mission of 'creating a better living environment for society.' To enhance this impact, collaborative efforts are needed, not only within departments, but also across faculties, necessitating a cultural shift. Despite organisational challenges, the motivation for collaboration among young staff members and PhD candidates is evident. To support this, an organisation-wide people-centric approach should be adopted, fostering an environment where everyone can unleash their talents—an invaluable "secret weapon" for success. Additionally, address concerns about PhD duration and graduation rates, aiming for an optimal supervisory process. Leverage the high quality of existing PhD candidates by listening and providing feedback. Involve young staff by implementing the successful strategy from the Young MT @ ES across all departments.

The motto of CE, 'to understand, to intervene, to improve,' resonates with the Committee's conviction that CE is a world-leading faculty poised to make a substantial impact on society. Acknowledging the dynamic challenges faced by universities, including declining student numbers and increased competition for funding, continuous improvement and an adaptive strategy are essential.

The MT's emphasis on collaboration and a unified team approach is praiseworthy. To enhance this, recommendations include removing bottlenecks, particularly addressing funding limitations, shifting focus towards external collaboration, and streamlining departmental structures. Enhancing the alignment of criteria for research quality, HR procedures, promoting criteria of staff, and guiding PhD candidates

between the departments is needed while organisational structures might differ because of decentral needs. The Committee believes that a bottom-up organisational approach can effectively address these needs. Leadership plays a pivotal role in this process by empowering individuals. Considering the CEG mission, conducting the next research assessment jointly with the two Geoscience departments is recommended for a swift transformation into a prosperous and aligned Faculty of Civil Engineering and Geosciences.

In summary, the Committee was deeply impressed by the quality of staff and facilities at CE. The vibrant atmosphere, commitment to excellence, and the shared ambition to address global challenges were notable. Most importantly, the Committee observed a fantastic collegial atmosphere, making CE, even in the brief three-day visit, seem like a Great Place to Work.

APPENDIX A CURRICULA VITAE OF THE COMMITTEE MEMBERS

Prof. Dr. G (Geert) Dewulf, Committee Chair, is Chief Development Officer and member of the Strategic Board of the University of Twente. He is also Professor of Civil Engineering and Management. He has been Dean of the Faculty of Engineering Technology of the University of Twente between 2013 and 2020 and served as vice-Dean of the Faculty between 2008 and 2012. He was the Chairman of the Deans of Engineering of the Netherlands between 2018 and 2020. From 2002 until 2012, he was the Head of the Department of Construction Management and Engineering. In 2012-2013, he was the UPS Foundation Visiting Professor and Visiting Fellow in 2013-2019 at Stanford University. Before he joined Twente University, he worked at TNO and Delft University of Technology. He holds a PhD from the University of Utrecht. He was a Visiting Fellow at Harvard University in 1990-1991 and the GEAN Visiting Professor at IIT-Madras in 2016. Geert Dewulf has written numerous publications on Public-Private Partnerships, Scenario Planning, Urban Planning and Engineering Project Management. He has been awarded with the Pathfinding Award and the Distinguished Service Award of the Engineering Project Organization Society. He has received various grants from EU Horizon, the Dutch NWO, the US National Science Foundation and from public and private companies. He was scientific president of the national BSIK programme PSIBouw, and until 2012 Scientific director of the 3TU (Federation of the Dutch Technical Universities) Center of Expertise on the Built Environment. He is also Board Member and one of the Founders of the Fraunhofer Project Center at the University of Twente.

Ir. I.A. (Anton) van der Esch, studied Civil Engineering at Avans University of Applied Sciences (BSc, 2015) and Delft University of Technology (MSc, 2020). During his studies, he was a student council member and a student assistant in structural mechanics. After working

for one year at The Hague University of Applied Sciences as a lecturer of structural mechanics, in 2021, he decided to continue his studies by starting a PhD at Eindhoven University of Technology (TU/e), where he investigates the accuracy of formulas to calculate crack widths and spacings in reinforced and prestressed concrete. Besides, he is a lecturer for one bachelor's and one master's course. From March 2023, he is also a member of the PhD/EngD Network of the Department of Built Environment, aiming to guide new PhD/EngD candidates in onboarding and help organise engaging and leisure activities. He attended the research assessment of the faculty of Built Environment at TUe. Finally, he is a working member of RILEM committee 287: Early age and long-term crack width analysis in reinforced concrete structures.

Prof. Dr. H. S. (Hani) Mahmassani, holds the William A. Patterson Distinguished Chair in Transportation at Northwestern University, where he is Director of the Northwestern University Transportation Center. Prior to Northwestern, he served on the faculties of the University of Maryland and the University of Texas at Austin. His research contributions include the areas of intelligent transportation systems, freight and logistics systems, multimodal systems modeling and optimization, pedestrian and crowd dynamics and management, traffic science, demand forecasting and travel behavior, and real-time operation of transportation and distribution systems. He is past editor-in-chief of Transportation Science, senior editor of IEEE Transactions on Intelligent Transportation Systems, founding (past) associate editor and current scientific board member of Transportation Research C: Emerging Technologies, Distinguished Advisory Board Member of Transportation Research Part A: Policy and Practice, and associate editor of Transportation Research Record. He is a past president of the Transportation Science Section of the Institute for Operations Research and the Management Sciences, a past President of the International Association for Travel Behavior Research, and the Convenor of the ISTTT International Advisory Committee. He serves on the Executive Committee of the Transportation Research Board, the Research and

Technology Advisory Committee of the US Department of Transportation's Federal Highway Administration, and the Panama Canal Authority's International Advisory Board. He was the recipient of a Distinguished Alumnus Award of the Faculty of Engineering and Architecture of the American University of Beirut in 2006, the Intelligent Transportation Systems Outstanding Application Award of the Institute of Electrical and Electronics Engineers in 2010, the Transportation Research Board (TRB)'s Thomas Deen Distinguished Lectureship in 2016, TRB's Roy Crum Award for Distinguished Service in 2022, and a Distinguished Engineering Alum of Purdue in 2022. He was elected Emeritus member of TRB committees on Telecommunications and Travel Behavior (2006), Transportation Network Modeling (2007), and Traveler Behavior and Values (2008). He was elected to the National Academy of Engineering in 2021 "for contributions to modeling of intelligent transportation networks and to interdisciplinary collaboration in transportation engineering".

Prof. Dr. Techn. G. (Günther) Meschke graduated from Vienna University of Technology with a M.Sc. degree in Civil Engineering and obtained his Ph.D. in 1989 at TU-Vienna. After a post-doctoral period at the Vienna University of Technology and a research fellowship at Stanford University (USA) he became an Associate Professor at TU Vienna in 1996 and later was appointed Full Professor of Structural Mechanics at the Ruhr University Bochum in 1998. Prof. Meschke is Member of the German Academy of Science and Engineering (acatech), the North Rhine-Westphalian Academy of Sciences, Humanities and the Arts, the Academia Europaea, an Associate Member of the Austrian Academy of Sciences. In 2023, he was awarded the Austrian Cross of Honors for Science and Arts. He is member of Editorial Boards of 11 international scientific journals. From 2016-2021 he served as member in the Austrian Science Board. Since 2022, he is Vice-Rector for Transfer and Research at Ruhr University Bochum. His research is concerned with computational and data-driven models for the simulation of

materials, structures and engineering processes with emphasis on subsurface engineering and concrete structures.

Dr. Ir. D. (David) Molenaar is managing director of Siemens Gamesa Renewable Energy B.V. in The Hague, the Netherlands. After completing high school in Purmerend, Molenaar studied Mechanical Engineering at Delft University of Technology. There he obtained his engineering degree in 1996, specializing in Measurement and Control Engineering (applied to a wind turbine). Molenaar continued his career in the wind sector as researcher and on February 18, 2003 he successfully defended his PhD thesis at the TU Delft PhD titled "Cost effective design and operation of variable speed wind turbines - closing the gap between the control engineering and wind engineering community". This research was performed in close collaboration with Lagerwey and was awarded with the DOW Energy dissertation award. Molenaar worked during his doctoral research in the period of July 2001 - January 2002 for Siemens Nederland N.V. to tender for the Dutch first offshore wind farm work. As a project manager, he was responsible for the design of a cost-support structure for the planned turbines. In 2004 he started as a project engineer at Siemens Nederland N.V. At the end of 2004 he was involved, as a technical specialist, in the acquisition of Bonus Energy A/S. In October 2005 he was appointed Business Unit Manager Wind Power. In that position Molenaar realized Siemens' final turnkey wind farm with non-Siemens turbines. From October 2007 to date, Molenaar was also responsible for establishing and expanding the Offshore Engineering Center of Competence (CoC) from Siemens Wind Power in The Hague. From January 2017 to date, Molenaar is the managing director of Siemens Gamesa Renewable Energy B.V. Molenaar is one of the inventors of the patented (NL1027103C) Ampelmann system: a vessel for transferring persons or property on an offshore installation. Molenaar is an adviser to Seaqualize, a member of the supervisory board of Stichting AandachtsLab (a child day care center for children and youth with multiply physical and mental disabilities), a board member of the NWEA (Dutch Wind Energy Association) and also a

member of the ECN / TNO industrial board. On November 21, 2019, Molenaar has been honoured by the Dutch Royal Institute of Engineers KIVI for his contribution to the Dutch offshore industry.

Prof. Dr. L. (Lutgarde) Raskin is the Vernon L. Snoeyink Distinguished University Professor of Environmental Engineering and the Altarum/ERIM Russell O'Neal Professor of Engineering at the University of Michigan (UM), where she has been a professor since 2005. Before this, she was a professor at the University of Illinois at Urbana-Champaign (UIUC) for 12 years. She received a BS/MS degrees from the KU Leuven, Belgium. Her PhD degree is in Environmental Engineering from UIUC. Raskin has served/serves as the research advisor of ~20 postdocs, ~30 PhD students, and ~80 Master's students. She was recently awarded the UM Distinguished Graduate Mentor Award for her outstanding role as a mentor. Twenty-five of her former trainees are in academic positions across the world. She has received external recognition as the 2018-2019 Association of Environmental Engineering and Science Professors (AEESP) Distinguished Lecturer and is an Elected Fellow of the American Academy of Microbiology, the International Water Association (IWA), and the Water Environment Federation, and has received numerous other external awards. Raskin has (co-)authored ~175 journal papers, has given ~150 invited lectures, and is a (co-)author on ~450 conference papers or abstracts.

Dr. K. (Kristen) Splinter is currently an Australian Research Council Future Fellow and the Managing Director of the Water Research Laboratory at UNSW Sydney. She has obtained a PhD (2009) in Geological Oceanography and a graduate certificate in Marine Resource Management from Oregon State University (USA), as well as a Master of Science (2004) in Coastal and Oceanographic Engineering (U. Florida, USA) and a Bachelor of Science (Engineering) degree (2002), with first class honours in Civil Environmental Engineering (Queen's University at Kingston, CANADA). Her research uses physical and numerical modelling as well as field data collection to better understand coastal processes. Her work on modelling shoreline variability and dune

erosion has been recognised in international journals for high citation. Her team pioneers the use of remote sensing in the coastal zone, including lidar, UAVs, satellites, and video cameras within Australia. She currently supervises 4 PhD students and 3 UG and PG Masters Research Thesis students. As a female engineer, Kristen advocates for better gender equity within engineering. She is a founding member of the Women in Coastal Geosciences and Engineering (WICGE). She currently serves as the deputy chair of the Engineers Australia NSW Coastal, Ocean and Port Engineering Panel (COPEP) and as a Senior Editor for Cambridge Prisms: Coastal Futures and an Associate Editor for JGR-Earth Surface.

APPENDIX B SITE VISIT PROGRAMME

All interviews are organised in 2.52 of the faculty of CiTG.

The lunches are organised in meeting room 2.38, except the lunch with PhD candidates: this will take place in 2.62.

DAY 0 – Tuesday December 5, 2023		
<i>Time / location</i>	<i>Activity</i>	<i>Participants</i>
17.00 Hotel	Welcome by RM	Committee + Rector Prof. T.H.J.J. van der Hagen
17.15	Travel time restaurant	Committee
17.30 – 21.30 Kruydt	Working dinner: kick-off and preparation of interviews	Committee (private)

DAY 1 – Wednesday December 6, 2023		
<i>Time</i>	<i>Activity</i>	<i>Participants</i>
08.00-08.30	Travel time	Committee
8.30 – 9.00	Preparation of interviews	Committee (private)
9.00 – 10.00	Interview Management Team CiTG.	Prof Jansen (dean) Prof de Kreuk (Water Management) Prof Sluys (3MD) Prof Metrikine (Engineering Structures) Prof Hoogendoorn (Transport & Planning) Prof Aarninkhof (Hydraulic Engineering)
10.00 – 10.15	Reflection	Committee (private)
10.15 – 11.00	Interview MT Transport and Planning	Prof Hoogendoorn (Chair) Prof Cats Prof van Lint

		Assoc prof Sharif Azadeh Assistant prof Martínez
11.00 – 11.30	Reflection + Break	Committee (private)
11.30 – 12.30	Experience Transport and Planning: Lab/ Walking Tour, and meet and greet with (junior) researchers	Associate Prof Daamen (OMDt including smart bikelane) Dr. Hoogendoorn-Lanser, Dr. Nordhoff and Oztürker MSc. (Autonomous driving passenger experience) Assistant prof Yan Feng, associate prof Duives (MXR-lab including drive and bike simulation)
12.30 – 12.45	Reflection	Committee (private)
12.45 – 13.30	Lunch	Committee (private)
13.30 – 14.15	Interview MT Hydraulic Engineering	Prof Aarninkhof (chair) Prof Pietrzak Associate prof Blom Associate prof Tsouvalas Associate prof van Prooijen
14.15 – 14.30	Reflection	
14.30 – 15.30	Experience Hydraulic Engineering: Lab/ Walking Tour, and meet and greet with (junior) researchers	Associate prof Hofland (large screen with looping video on balcony with view of lab, short lab intro) Dr. Bayle and Mol MSc. (PhD-cand.) (set-ups related to DTPL) Van der Lugt MSc. (PhD-cand., pass field measurement devices displayed outside) Assistant professor Wüthrich (visit tilting flume with live debris test ; link to HE case study 1)
15.30 – 16.00	Reflection + Break	Committee (private)
16.00 – 16.30	Interview ACT-ers	Dr Wang Dr Piaggio Dr Droste Dr Oriol Colomes

		Dr Saeednia Dr Popescu
16.30 – 16.45	Reflection	Committee (private)
16.45 – 17.15	Interview Tenured staff	Dr ir Lukovic Dr Ye Dr Pavlovic Dr ir Snelder Dr Abraham Dr ir Lourens
17.15 – 17.30	Reflection	Committee (private)
17.30-18.00	Travel time	Committee
18.00	Refreshing at hotel	Committee (private)
19.00 <i>Le Vieux Jean</i>	Working dinner: discussing and writing preliminary judgments	Committee (private)
21.30	Closure	

DAY 2 – Thursday December 7, 2023		
<i>Time</i>	<i>Activity / Assessors</i>	<i>Participants</i>
08.00-08.30	Travel time	Committee
8.30 – 9.00	Preparation of interviews	Committee (private)
9.00 – 9.45	Interview MT Materials, Mechanics, Management & Design	Prof Sluys (chair) Prof Jonkers Associate prof Bosch-Rekvelدت Assistant prof Esposito
9.45 – 10.00	Reflection	Committee (private)
10.00 – 11.00	Experience Mechanics, Management & Design: Lab/ Walking Tour, and meet and greet with (junior) researchers	Associate professor Šavija, Assistant professor Fotouhi (materials and sensing) Assistant professor Soman, Assistant professor Oval, Assistant professor Popescu (robotic construction and Parametric design) Assistant professor Rocha, Assistant professor Lesueur, Associate professor van der Meer (smart modelling) Ir Korswagen (PhD-cand.), Assistant professor Esposito, Assistant professor Messali (Structural Mechanics)

11.00 – 11.30	Reflection + Break	Committee (private)
11.30 – 12.15	Interview MT Water Management	Prof de Kreuk (chair) Prof van Lier Prof Uijlenhoet Prof van Halem Assistant professor Schoups
12.15 – 12.30	Reflection	Committee (private)
12.30 – 13.15	Lunch with PhD candidates. 2 PhD's per Committee member	Lateef MSc. Krishnan MSc. Ir. Wegman Ir. van Wiechen Ir. de Ruijter Prosperi MSc. van der Valk MSc. Goedhart MSc. Sulollari MSc. Xu MSc. (TP) Holthuizen MSc. Ir. Van der Linde Atzampou MSc. Qian MSc. (ES)
13.15 – 13.30	Reflection	Committee (private)
13.30 – 14.30	Experience Water Management: Lab/ Walking Tour, and meet and greet with (junior) researchers Pitch & questions, 10 min per lab	Associate prof Coenders: Fieldwork (education space lab) Prof van Halem (Green lab, drinking water research) Assistant prof Smith (Blue lab, research infrastructure) Dr. Pavez-Jara (Postdoc, Red lab, wastewater research and bioreactor set ups)
14.30 – 14.45	Reflection	Committee (private)

14.45-15.45	Experience Engineering Structures: Lab/ Walking Tour, and meet and greet with (junior) researchers	Dr. Sánchez Gómez (short introduction Macrolab) Assistant professor Varveri (pavement structures, multiscale analysis) Dr. Meijers (Postdoc, Small scale set-up for electromagnetic pile installation) Assistant professor Yang (Visit to V-track) Assistant professor Pavlovic and ir. Koetsier (PhD) (FRP structures) Assistant professor Chang (LIBS-based quality assessment set-up) Assistant professor Luković (novel concrete types)
15.45 – 16.15	Reflection + Break	Committee (private)
16.15 – 17.00	Interview MT Engineering Structures	Prof Metrikine (Chair) Prof Hendriks Associate prof van Dalen Assistant prof Varveri Assistant prof Kavoura
17.00 – 17.15	Reflection / Break	
17.15 – 17.45	Available time slot for interview	
17.45 – 18.00	Reflection	Committee (private)
18.00 – 18.30	Travel time	Committee
18.30 - Hotel	Refreshing at hotel	Committee (private)
19.15 - 19.30	Travel time	Committee (private)
19.30 Le Vieux Jean	Working dinner: discussing and writing preliminary judgments	Committee (private)
21.30	Closure	

DAY 3 – Friday December 8, 2023

<i>Time</i>	<i>Activity / Assessors</i>	<i>Participants</i>
08.00 – 08.30	Travel time	Committee
8.30 – 9.00	Prepare first observations	Committee (private)
9.00 – 9.30	Interview Rector TU Delft	Prof van der Hagen
9.30 – 9.45	Reflection	Committee (private)
9.45 – 10.15	Interview on PhD Policy and Training	Prof Jansen Prof Bertotti Bentivoglio MSc.
10.15 – 10.30	Reflection	Committee (private)
10.30 – 11.00	Interview on Diversity	Prof Jansen Prof Bertotti Drs Jonker
11.00 – 11.30	Reflection + Break	Committee (private)
11.30 – 12.00	Interview Research School TRAIL	Prof Marchau Prof Annema
12.00 – 12.15	Reflection	Committee (private)
12.15 – 13.15	Summarising findings and first conclusions (including lunch)	Committee (private)
13.15 – 13.45	Concluding meeting with Management Team CiTG	Prof Jansen (dean) Prof de Kreuk (Water Management) Prof Sluijs (3MD) Prof Metrikine (Engineering Structures) Prof Hoogendoorn (Transport & Planning) Prof Aarninkhof (Hydraulic Engineering) PCSA-members (v.d. Bremer, Šavija, Sharif Azadeh)

13.45 – 15.00	Discussing and writing preliminary judgments	Committee (private)
15.00 – 15.15	Oral presentation on first impression by Committee	Committee All faculty members participated invited, incl. PhD's Prof Tim van der Hagen (RM) Jessica Lambregts (SD) Birgit van Driel (SD)
15.15 – 15.45	Closure	Committee All faculty members participated invited, incl. PhD's
15.45	Travel back to hotel / station	

APPENDIX C SEP-DATA ON RESEARCH STAFF

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	107	37.7	109	38.5	115	39.7	120	41.5	138	48.3	147	51.1
- Assistant professor	50	19.1	48	18.5	50	18.0	52	19.1	65	24.1	65	23.8
- Associate professor	24	7.9	27	8.7	31	10.4	32	11.3	35	12.6	41	14.5
- Full professor	32	10.7	34	11.3	34	11.3	35	11.2	37	11.6	41	12.7
Researchers	107	73.7	112	75.2	108	73.5	125	86.2	107	72.2	109	75.1
Total research staff	214	111.4	220	113.7	223	113.2	245	127.7	245	120.5	256	126.2
PhD candidates	450	293.2	462	299.5	457	289.1	451	289.0	444	276.0	446	280.3
Support staff (research)	27	24.7	28	25.1	31	27.8	34	30.8	37	32.5	34	29.7
Total staff	691	429.3	710	438.2	711	430.1	729	447.5	726	429.0	735	436.2

Table 1: Staff embedded in all Civil Engineering departments. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	-	-	21	6.6	21	6.4	22	6.7	28	9.2	30	10.0
- Assistant professor	-	-	8	3.2	10	3.4	11	3.7	16	5.9	16	5.8
- Associate professor	-	-	5	1.3	5	1.1	4	1.1	4	1.3	6	2.1
- Full professor	-	-	7	2.1	7	1.9	7	1.8	8	2.1	8	2.1
Researchers	-	-	24	17.2	20	14.7	27	20.0	22	15.8	32	24.0
Total research staff	-	-	44	23.8	42	21.2	48	26.7	49	25.0	62	34.0
PhD candidates	-	-	50	33.8	48	32.4	51	37.5	56	40.6	60	43.7
Support staff (research)	-	-	9	9.0	10	10.1	11	11.0	13	13.1	13	11.7
Total staff	-	-	103	66.6	100	63.6	110	75.1	119	78.7	135	89.4

Table 2: Staff embedded in the ES department. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	26	8.8	28	9.1	28	8.9	30	9.8	37	11.8	39	12.0
- Assistant professor	13	5.0	12	4.6	11	3.9	13	4.6	17	6.3	16	5.7
- Associate professor	4	1.2	6	1.7	7	2.2	8	2.5	9	2.7	11	3.3
- Full professor	9	2.7	10	2.8	10	2.8	10	2.8	11	2.8	12	3.0
Researchers	21	12.9	21	13.2	21	13.0	25	16.4	26	16.5	25	15.4
Total research staff	47	21.8	48	22.3	49	21.9	55	26.2	63	28.3	63	27.4
PhD candidates	116	78.1	115	76.1	117	72.3	113	70.6	111	65.7	108	64.2
Support staff (research)	5	4.2	5	3.8	5	4.4	5	4.4	6	4.6	5	4.5
Total staff	168	104.1	168	102.2	172	98.6	173	101.2	179	98.7	176	96.1

Table 3: Staff embedded in the HE department. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	17	6.2	19	6.9	21	7.5	22	8.0	25	9.2	25	9.1
- Assistant professor	8	2.9	8	2.8	8	2.9	9	3.2	10	3.5	8	3.3
- Associate professor	4	1.4	5	1.9	7	2.4	7	2.6	9	3.4	10	3.5
- Full professor	5	1.9	6	2.2	6	2.2	6	2.2	6	2.3	7	2.3
Researchers	19	13.0	27	17.7	24	16.3	28	18.9	23	15.9	21	14.9
Total research staff	36	19.2	45	24.7	45	23.8	49	27.0	48	25.1	46	24.0
PhD candidates	59	38.4	63	40.9	68	44.5	67	40.4	60	37.0	60	40.5
Support staff (research)	4	4.0	5	4.5	5	4.9	6	5.4	5	4.3	3	2.6
Total staff	100	61.6	113	70.1	118	73.2	122	72.8	113	66.4	109	67.1

Table 4: Staff embedded in the T&P department. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	26	9.5	26	9.8	28	10.8	29	10.9	28	11.0	29	11.2
- Assistant professor	13	4.9	12	4.5	12	4.8	12	4.6	11	4.3	11	4.2
- Associate professor	7	2.3	7	2.6	9	3.2	10	3.5	10	4.0	11	4.2
- Full professor	7	2.2	7	2.7	7	2.8	7	2.8	7	2.8	7	2.9
Researchers	18	13.7	19	12.8	24	15.6	27	17.4	21	13.1	16	10.3
Total research staff	44	23.2	45	22.6	52	26.4	55	28.3	49	24.1	45	21.5
PhD candidates	143	88.8	148	88.4	136	81.5	136	84.3	139	80.4	137	75.8
Support staff (research)	4	2.9	5	3.8	6	4.5	8	6.0	9	6.5	9	6.9
Total staff	190	114.9	198	114.7	194	112.4	199	118.6	197	111.0	191	104.2

Table 5: Staff embedded in the WM department. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

	2017		2018		2019		2020		2021		2022	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	-	-	16	6.0	17	6.0	18	6.1	20	7.1	24	8.7
- Assistant professor	-	-	9	3.3	9	3.0	9	3.0	11	4.1	13	4.9
- Associate professor	-	-	3	1.2	4	1.5	4	1.6	3	1.2	4	1.5
- Full professor	-	-	4	1.5	4	1.5	5	1.5	5	1.8	7	2.4
Researchers	-	-	22	14.3	19	14.0	19	13.5	16	10.8	15	10.6
Total research staff	-	-	38	20.3	123	78.3	120	75.9	113	70.2	119	75.4
PhD candidates	-	-	87	60.3	87	58.3	84	56.3	78	52.2	80	56.1
Support staff (research)	-	-	4	4.0	4	4.0	4	4.0	4	4.0	4	4.0
Total staff	-	-	129	84.7	127	82.3	124	79.9	117	74.2	123	79.4

Table 6: Staff embedded in the 3MD department. FTE is adjusted for availability of staff member and contribution to research (40% for scientific staff and 80% for researchers and PhD candidates)

APPENDIX D SEP-DATA ON RESEARCH FUNDING

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	20307	50%	18162	44%	19311	43%	19935	46%	20851	46%	23052	45%
Research funding ²	6761	16%	7760	19%	8015	18%	7262	17%	7281	16%	6903	13%
Contract research ³	12709	31%	13899	34%	15796	36%	14631	33%	13973	31%	18809	37%
Other ⁴	1219	3%	1559	4%	1299	3%	1857	4%	2900	6%	2686	5%
Total funding	40995	100%	41380	100%	44422	100%	43685	100%	45005	100%	51450	100%
Personnel costs	32304	79%	35780	86%	37976	84%	36876	88%	38378	88%	42665	86%
Other costs	8383	21%	5759	14%	7319	16%	5150	12%	5053	12%	6725	14%
Total expenditure	40686	100%	41539	100%	45295	100%	42026	100%	43432	100%	49390	100%

Table 7: Total funding for all Civil Engineering departments. All amounts in k€.

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	0		2669	34%	2928	39%	3256	42%	3684	41%	4318	35%
Research funding ²	0		339	4%	686	9%	734	9%	832	9%	1574	13%
Contract research ³	0		4577	58%	3507	47%	3529	45%	3669	41%	6081	50%
Other ⁴	0		362	5%	323	4%	308	4%	776	9%	311	3%
Total funding	0		7947	100%	7444	100%	7827	100%	8962	100%	12283	100%
Personnel costs	4	67%	6818	82%	6359	83%	6469	84%	7034	88%	9273	82%
Other costs	2	33%	1482	18%	1279	17%	1233	16%	937	12%	2028	18%
Total expenditure	6	100%	8300	100%	7638	100%	7701	100%	7972	100%	11301	100%

Table 8: Total funding for the Department of ES. All amounts in k€.

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	4793	56%	4474	48%	4669	42%	5096	51%	5204	50%	5700	50%
Research funding ²	2467	29%	2660	28%	2532	23%	1811	18%	1734	17%	1679	15%
Contract research ³	1069	13%	1993	21%	3839	34%	2791	28%	2956	28%	3139	28%
Other ⁴	204	2%	248	3%	142	1%	340	3%	511	5%	850	7%
Total funding	8534	100%	9376	100%	11183	100%	10038	100%	10406	100%	11368	100%
Personnel costs	6749	79%	8229	88%	10167	87%	8538	89%	9284	89%	9804	87%
Other costs	1756	21%	1130	12%	1458	13%	1045	11%	1116	11%	1452	13%
Total expenditure	8506	100%	9359	100%	11625	100%	9583	100%	10400	100%	11255	100%

Table 9: Total funding for the Department of HE. All amounts in k€.

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	2785	44%	2559	37%	2578	34%	2893	39%	2858	36%	3024	39%
Research funding ²	1194	19%	1414	21%	1602	21%	1319	18%	1477	19%	1256	16%
Contract research ³	2116	34%	2459	36%	2953	39%	2627	36%	2670	34%	2781	36%
Other ⁴	220	3%	450	7%	443	6%	487	7%	908	11%	598	8%
Total funding	6315	100%	6882	100%	7576	100%	7326	100%	7913	100%	7659	100%
Personnel costs	5421	86%	6341	92%	6962	90%	7064	93%	7039	93%	7383	94%
Other costs	901	14%	583	8%	731	10%	549	7%	523	7%	456	6%
Total expenditure	6322	100%	6924	100%	7693	100%	7613	100%	7562	100%	7838	100%

Table 10: Total funding for the Department of T&P. All amounts in k€.

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	46%	4099	45%	4509	46%	4586	41%	4898	49%	5096	50%	46%
Research funding ²	23%	2648	29%	2181	22%	2565	23%	2338	23%	1425	14%	23%
Contract research ³	27%	1961	22%	2795	29%	3577	32%	2421	24%	3056	30%	27%
Other ⁴	3%	318	4%	219	2%	499	4%	369	4%	560	6%	3%
Total funding	100%	9026	100%	9704	100%	11227	100%	10026	100%	10138	100%	100%
Personnel costs	73%	7300	81%	8017	78%	8427	84%	8067	82%	8355	83%	73%
Other costs	27%	1720	19%	2239	22%	1553	16%	1808	18%	1668	17%	27%
Total expenditure	100%	9020	100%	10257	100%	9980	100%	9874	100%	10023	100%	100%

Table 11: Total funding for the Department of WM. All amounts in k€.

TOTAL	2017		2018		2019		2020		2021		2022	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding ¹	0		4254	52%	4627	54%	4105	56%	4208	55%	4913	49%
Research funding ²	0		699	9%	1014	12%	832	11%	898	12%	969	10%
Contract research ³	0		3028	37%	2702	32%	2108	29%	2256	29%	3752	38%
Other ⁴	0		181	2%	172	2%	222	3%	336	4%	368	4%
Total funding	0		8162	100%	8515	100%	7266	100%	7698	100%	10002	100%
Personnel costs	0		7092	89%	6471	80%	6378	89%	6954	91%	7851	87%
Other costs	0		848	11%	1612	20%	770	11%	669	9%	1122	13%
Total expenditure	0		7941	100%	8083	100%	7149	100%	7623	100%	8973	100%

Table 12: Total funding for the Department of 3MD. 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	# Total	Not yet finished	Discontinued
2014	39	19	58	0%	4%	9%	11%	41	2%	3%
2015	34	20	54	1%	4%	8%	11%	39	3%	1%
2016	60	26	86	2%	7%	14%	17%	56	4%	5%
2017	40	28	68	0%	5%	8%	8%	25	11%	2%
2018	41	26	67	0%	3%	3%	3%	9	16%	2%
Total	214	119	333	3%	23%	42%	49%	170	36%	13%

Table 13: Success rates of the PhD candidates at the all Civil Engineering Departments.

Enrolment (#)				Success rates (%)						
Starting year	Male	Female	Total (male + female)	<= 4 years	<= 5 years	<= 6 years	<= 7 years	# Total	Not yet finished	Discontinued
2014	6	0	6	0%	3%	9%	9%	4	3%	3%
2015	2	1	3	0%	0%	0%	3%	1	6%	0%
2016	7	0	7	3%	6%	15%	18%	6	3%	0%
2017	5	2	7	3%	9%	9%	9%	3	6%	6%
2018	8	3	11	0%	3%	3%	3%	1	29%	0%
Total	28	6	34	6%	21%	35%	41%	15	47%	9%

Table 14: Success rates of the PhD candidates at the Department of ES.

Enrolment (#)				Success rates (%)						
Starting year	Male	Female	Total (male + female)	<= 4 years	<= 5 years	<= 6 years	<= 7 years	# Total	Not yet finished	Discontinued
2014	11	8	19	1%	4%	12%	13%	14	3%	2%
2015	7	9	16	0%	2%	8%	11%	11	3%	2%
2016	20	5	25	0%	3%	13%	18%	16	8%	2%
2017	9	3	12	0%	4%	6%	6%	5	8%	0%
2018	9	8	17	0%	2%	2%	2%	2	13%	3%
Total	56	33	89	1%	17%	42%	51%	48	36%	10%

Table 15: Success rates of the PhD candidates at the Department of HE.

Enrolment (#)				Success rates (%)						
Starting year	Male	Female	Total (male + female)	<= 4 years	<= 5 years	<= 6 years	<= 7 years	# Total	Not yet finished	Discontinued
2014	1	4	5	0%	4%	6%	8%	4	2%	0%
2015	5	3	8	0%	6%	14%	14%	7	0%	2%
2016	9	8	17	8%	22%	27%	27%	13	0%	8%
2017	5	4	9	0%	10%	10%	10%	5	4%	4%
2018	6	4	10	0%	4%	4%	4%	2	14%	2%
Total	26	23	49	8%	47%	61%	63%	31	20%	16%

Table 16: Success rates of the PhD candidates at the Department of T&P.

Enrolment (#)				Success rates (%)						
Starting year	Male	Female	Total (male + female)	<= 4 years	<= 5 years	<= 6 years	<= 7 years	# Total	Not yet finished	Discontinued
2014	13	5	18	0%	4%	7%	8%	11	1%	6%
2015	9	5	14	1%	3%	5%	7%	9	4%	1%
2016	19	10	29	0%	5%	11%	14%	15	6%	7%
2017	13	13	26	0%	3%	7%	7%	8	17%	0%
2018	10	10	20	0%	2%	2%	2%	2	15%	2%
Total	64	43	107	1%	16%	32%	39%	45	42%	16%

Table 17: Success rates of the PhD candidates at the Department of WM.

Enrolment (#)				Success rates (%)						
Starting year	Male	Female	Total (male + female)	<= 4 years	<= 5 years	<= 6 years	<= 7 years	# Total	Not yet finished	Discontinued
2014	7	1	8	0%	6%	14%	16%	8	0%	0%
2015	11	2	13	2%	8%	18%	22%	11	4%	0%
2016	5	2	7	0%	4%	10%	12%	6	0%	2%
2017	8	6	14	0%	6%	8%	8%	4	14%	6%
2018	8	1	9	0%	4%	4%	4%	2	14%	0%
Total	39	12	51	2%	27%	53%	61%	31	31%	8%

Table 18: Success rates of the PhD candidates at the Department of 3MD.



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