An aerial, top-down view of a large, cluttered workshop or studio. Several people are seated at long tables, working on various projects. The tables are covered with papers, cardboard, tools, and other materials. The floor is also messy, with many small pieces of paper and debris scattered around. The overall atmosphere is one of active, somewhat chaotic, creative work.

TU DELFT | BOUWKUNDE

ARCHITECTURE AND THE BUILT ENVIRONMENT

SELF-EVALUATION REPORT ON RESEARCH '16-'21

TU DELFT | BOUWKUNDE

ARCHITECTURE AND THE BUILT ENVIRONMENT

SELF-EVALUATION REPORT ON RESEARCH '16-'21

ARCHITECTURE AND THE BUILT ENVIRONMENT

SELF-EVALUATION REPORT ON RESEARCH '16-'21

This publication forms the basis for the evaluation of the research units (departments) of TU Delft's Faculty of Architecture and the Built Environment (Bouwkunde). The chapters in the self-evaluation are written by the departments, in which they reflect on their aims, strategy and achievements during the years 2016-2021 as well as their aims and strategy for the future.

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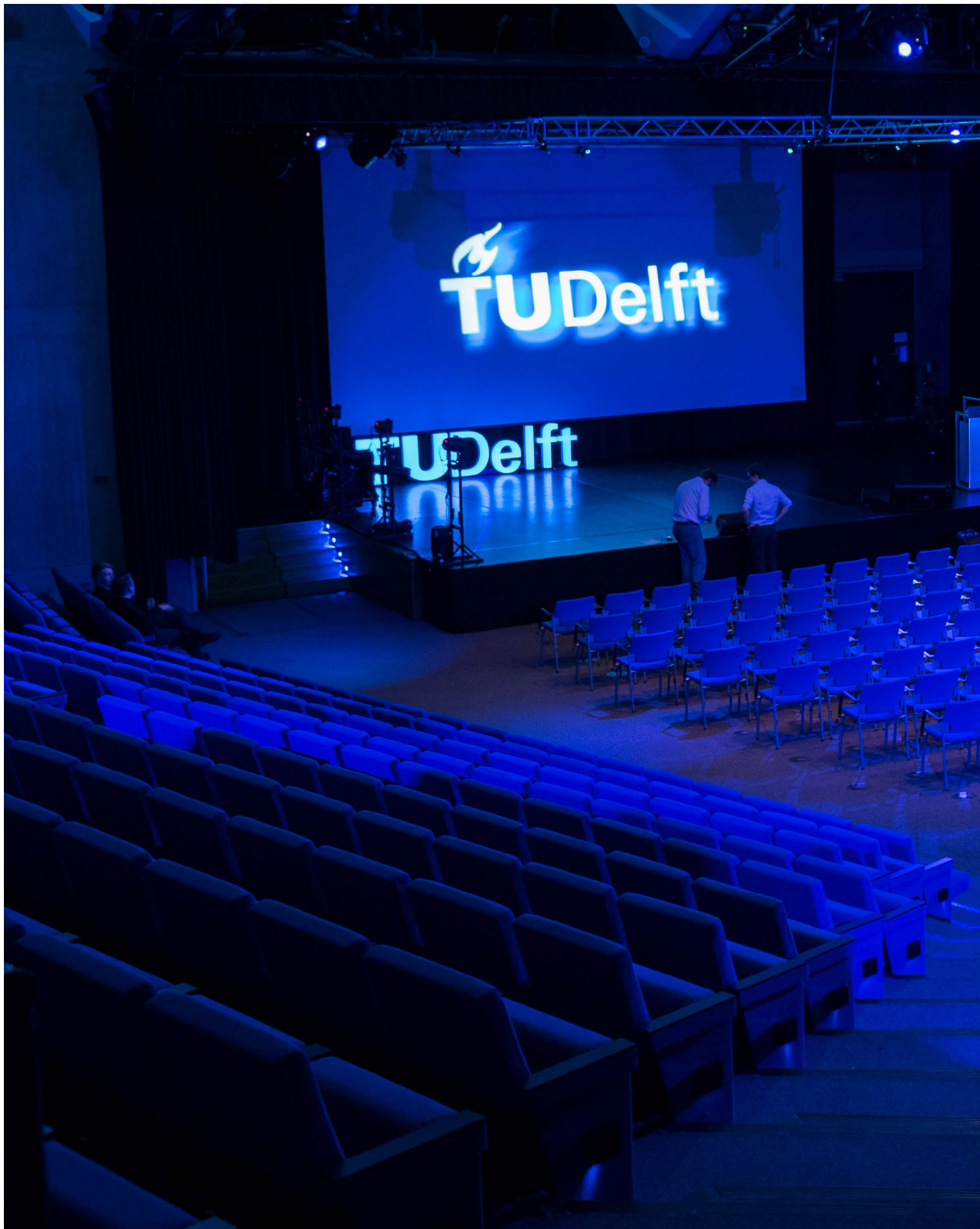
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The background of the entire page is a photograph of a large, empty lecture hall. The seats are a vibrant blue, and the stage area is dimly lit with blue spotlights. A person is visible in the distance on the left side of the stage. The overall atmosphere is modern and academic.

TU DELFT

TOP EDUCATION AND RESEARCH ARE AT THE HEART OF THE OLDEST AND LARGEST UNIVERSITY OF TECHNOLOGY IN THE NETHERLANDS. OUR EIGHT FACULTIES OFFER SIXTEEN BACHELOR'S AND MORE THAN 30 MASTER'S PROGRAMMES. OUR MORE THAN 25,000 STUDENTS AND 6,000 EMPLOYEES SHARE A FASCINATION FOR SCIENCE, DESIGN AND TECHNOLOGY. OUR COMMON MISSION: IMPACT FOR A BETTER SOCIETY.



Faculty of Architecture and the Built Environment building, commonly known as BK City

FACULTY OF ARCHITECTURE AND THE BUILT ENVIRONMENT

THE FACULTY OF ARCHITECTURE AND THE BUILT ENVIRONMENT IS ONE OF EIGHT FACULTIES OF TU DELFT. IT'S RESEARCH AND EDUCATION COVERS THE FULL SPECTRUM OF DESIGN, ENGINEERING, PLANNING, MANAGEMENT AND DATA SCIENCE OF THE BUILT ENVIRONMENT.

DEPARTMENTS

TU Delft's Architecture and the Built Environment is home to four departments:

- Architecture
- Architectural Engineering + Technology (AE+T)
- Management in the Built Environment (MBE)
- Urbanism

In the following paragraphs, we outline some of the developments, policies and instruments that the departments share at faculty level or university level. Presenting these here avoids the departments each having to explain them in their respective chapters.

VIABILITY

TU Delft has consolidated its research in the field of architecture and the built environment by absorbing the **OTB** and the **Berlage Institute**. The Berlage became a Post Master track, and the OTB initially joined as a department in its own rights. However, in 2019, the Faculty of Architecture and the Built Environment decided to reorganise the OTB department, partly in response to a dire financial situation. OTB’s remaining staff members were divided across the departments MBE, Urbanism and, to some extent, AE+T. This closed finalised a long process of integration.

In this report, we present the accomplishments of the departments as they exist in early 2022 and split the OTB legacy over the receiving departments. In the case of finances, this exercise proved to be too difficult. The amounts to be found in the annexes reflect the departments as they stood at the time.

RELEVANCE

The faculty’s research focuses specifically on improving the design and performance of buildings, districts, cities and regions to better meet the requirements and expectations of their users and communities. From that perspective, much of the research that is conducted can be understood as applied science, appealing to the curiosity and the needs of other researchers, practitioners and the broader public alike.

The research is a blend of humanities, social and engineering sciences. The humanities are strongest represented in the **Architecture** department, social sciences in the **MBE** and **Urbanism** departments, while the engineering sciences find their strongest representation in **AE+T**.

Organising and evaluating research at the department level was a strategic decision by the board of TU Delft. This approach replaced the many so-called research programmes that the faculty used to have. The new research framework streamlines management and communication but carries the risks of creating academic silos. Therefore, the faculty introduced strategic and urgent themes (or initiatives) that combine the research interests of all four departments as platforms for collaboration. Dick van Gameren, as the faculty’s new dean, put three grand challenges on the agenda linked with six themes or strategies.

TABLE 1. Research & Collaboration: 6 Faculty Themes

SOCIETAL CHALLENGES	Urban Inequality	Climate Crisis	Scarcity (of resources)
PERSPECTIVES	Sustainable Cities Urbanization/Housing	Urban Health Healthy indoor and outdoor environments	Heritage Futures Buildings/Cities/Landscapes
Strategies	Digitization & Artificial Intelligence	Climate Adaptation & Energy Transition	Circularity

QUALITY

The faculty is well on course to maintain the quality of its research, as well as its excellent international academic reputation as a leading design academy; to be an international platform for innovation in architectural design, architectural engineering, urban planning, landscape architecture, real estate management, housing, urban studies and geoinformation; and to be a platform for debate on current societal themes in the fields of architecture and the built environment. Although ranking does have its shortcomings, an indicator of our achievements is the fact TU Delft obtained a top ranking in the field-specific ranking for Architecture and the Built Environment of the QS World University Ranking. In 2022, TU Delft ranked 2nd here.

STRATEGY

The faculty's strategy is firmly focused on positioning itself as a leading research and design-oriented institute for architecture and the built environment, with strong roots in the Randstad as one of the key metropolitan regions in Europe, with a firm international ambition. The frameworks needed for this mission are already in place:

The Graduate School of Architecture and the Built Environment has firmly established itself in the faculty as the main environment for conducting PhD research and providing doctoral education.

Nationally, TU Delft's Faculty of Architecture and the Built Environment is part of:

- The **Amsterdam Institute for Advanced Metropolitan Solutions (AMS)** by TU Delft, Wageningen University and MIT. AMS is a strategic institute in Amsterdam that valorises TU Delft's knowledge and expertise in the area of metropolitan solutions.
- **4TU.Built Environment Center**, a centre within the 4TU.Federation, the Federation of the four Dutch Universities of Technology: TU Delft, TU Eindhoven, Twente University and Wageningen University.
- **LDE**, the alliance between Leiden University, TU Delft and Erasmus University Rotterdam.
- **Convergence EUR**, Erasmus MC, TU Delft, the collaboration between academic centres in the metropolitan region Rotterdam-The Hague.

Internationally, the faculty is a founding partner of the **BauHow5** alliance between TU Delft, UCL Bartlett, Chalmers, TU Munich and ETH Zurich with active groups on topics such as circularity, inclusion, diversity and equity (IDE) and doctoral education.

BK LABS

To support the research and teaching by the departments, the faculty has established a framework that combines the various laboratory initiatives that popped up over the years: **BK Labs**.

The faculty observed that the research labs lacked clarity on decision-making and (day-to-day) finances. Each of the research labs had separate leadership with few powers. Overarching representation in the faculty structure was lacking, and the visibility in the organisation was low. To remedy the situation, the faculty made a good start by clustering the first batch of labs in the west wing of the faculty building, thus increasing the recognisability and providing an opportunity to improve logistics, management, accessibility and strategy around the labs. The faculty took over responsibility for the daily management while the departments remained autonomous regarding teaching and research.

FIG. 1

Bucky Lab as one of the BK Labs



FIG. 1

GRADUATE SCHOOL – THE ENVIRONMENT FOR CONDUCTING PHD RESEARCH AND RECEIVING TRAINING

CONTEXT, SUPERVISION AND QUALITY ASSURANCE

The Graduate School for Architecture and the Built Environment (GS A+BE) is TU Delft's framework for all PhD studies at the faculty. It was launched in September 2011 as a 'local school' in the framework of the **TU Delft Graduate School (GS)**. The GS ensures that doctoral candidates receive excellent skills training, supervision and mentoring and deliver a high-quality dissertation. Furthermore, the GS distinguishes itself by supporting a structured, transparent PhD process facilitated by a monitoring system that keeps track of their progress. All efforts are geared towards producing doctors who have developed valuable skills for their future careers, either in academia or elsewhere.

The Doctoral Regulations require that all doctoral candidates follow an educational programme aiming to obtain skills and knowledge related to their discipline, to scientific research in general and to their overall personal development (transferable skills). A tailored **Doctoral Education (DE)** programme is completed before the defence of the doctoral dissertation. The Faculty Graduate School is responsible for training related to research (both general and domain-specific) and for the advancement of discipline-related knowledge, competencies and skills. Such courses could be offered by national domain-specific research schools. For most disciplines within the Faculty of Architecture and the Built Environment, such schools are lacking. Therefore, we have put much effort into developing highly appreciated courses that support the needs of our PhD candidates. The TU Delft GS offers transferable skills training courses and supports further improving doctoral candidates' professional development.

The GS strives for excellent supervision and support for its doctoral candidates. A Code of Good Practice has been developed for both supervisors and doctoral candidates. The code is a practical guideline that helps explain the (sometimes delicate) relationship between supervisor and candidate. Candidates discuss certain aspects of this code during the PhD Start Up workshops with which their doctoral training starts.

The University GS board, with support staff, develops the programme's guidelines and its regulations and facilities. This is further detailed in the Faculty Graduate Schools, which also comprise a local GS board, a director and dedicated staff.

The TU Delft believes it is important to keep a user-centred perspective. Therefore, the GS regularly holds inquiries to improve the TU Delft Graduate School and its services (surveys 2011, 2014 and a four-year survey from 2015). Also, the rector, the director of the GS and other staff members regularly meet with doctoral candidates and supervisors at formal and informal gatherings. At the faculty, we have set up a PhD council by and for the PhDs. The PhD council supports the social network of the PhDs and gives re- and proactive feedback on the programme of the GS.

SELECTION AND ADMISSION PROCEDURES

The Human Resources department developed guidelines to ensure good recruitment practices. After recruitment, the TU Delft GS initiates the registration process, followed by a further welcome at the Faculty GS. GS A+BE developed a central procedure for the applications of PhD candidates with a scholarship. In recent years this category became the majority of newcomers. Before, applicants approached a professor (or multiple) directly. This caused a chaotic situation burdening the staff and sometimes lacking up-to-date information for the applicants. Now the A+BE website provides insight into and access to the application process. Applicants are asked to provide all the necessary information about their master's diplomas, scholarship, research plan and level of English. The A+BE Graduate Office screens the documentation and forwards it to the relevant professor(-s), who concentrate(-s) on scanning the quality of the candidate and the proposal. Full proposals are sent to the relevant professors and selection committees within the departments. The selections are based on the quality of the proposal, the candidate's cv and the performance in one or more (online) interviews. Standard PhD candidates (mostly financed by external funded projects) are recruited via internationally advertised calls.

TENURE TRACK POLICY

In 2012, TU Delft started with the tenure track policy. Assistant and associate professors would no longer receive a tenured position after a short initial contract. Instead, a multiyear development track was designed.

A (tenure-track) position at TU Delft is offered for six years. Based on performance indicators agreed upon at the start of the employment contract, a decision will be made by the fifth year on whether to offer the tenure tracker a permanent faculty position. For circumstances such as having children or parental leave during the tenure track, it is possible to delay the definitive assessment and extend the tenure track employment contract to a maximum of eight years.

TU Delft expects that the tenure trackers obtain a University Teaching Qualification (UTQ) within three years in case they have less than five years of teaching experience. This is provided by the TU Delft UTQ programme. TU Delft sets high standards for the English language competency of the teaching staff and, therefore, offers training to improve English language skills. If staff does not speak Dutch, TU Delft offer courses to learn the Dutch language within three years.

At the time of writing, the tenure track policy is changing. The past decade has shown that tenure trackers experience considerable work stress due to the long temporary employment contract, while the evaluation criteria were not always sufficiently clear.

A new policy is evolving, aiming at:

- Improving recruitment and selection;
- Reduction of the duration of the temporary TT contract in the faculties;
- Supporting the tenure tracker in making a good start;
- Setting clear criteria and communicating these criteria;
- Investing in all aspects of (leadership) development throughout the academic career;
- Emphasising the role of the department chairs and deans in the process.

OPEN ACCESS AND DATA MANAGEMENT

In recent years open access and data management have become an integral part of research at the faculty and TU Delft as a whole. Open access is facilitated through three main actions:

- Collective agreements between Dutch universities and publishers;
- The TU Delft Open Science Fund, which reimburses APCs;
- Article 25fa of the Dutch Copyright Act, which allows researchers to share short scientific works (e.g. articles & book chapters), regardless of any restrictive publishers' guidelines;

Data management is supported through faculty-embedded Data Stewards who provide disciplinary support for research data management and open-science practices. Every TU Delft faculty has a dedicated Data Steward to answer questions, provide advice and help develop appropriate solutions for research data management and research output sharing, such as:

- Tailored consultations on best data management practices, including suitable data storage, first-stage ethics and privacy compliance issues, long-term data archiving;
- Project support regarding open science and research data management requirements at the grant writing stage and project implementation stage;
- Assistance with data management and open science requirements in line with national and European research funders' policies and journals' requirements;
- Information about data repositories, including the 4TU.Centre for Research Data.

ACADEMIC CULTURE

The biggest issue regarding inclusion, equality or safety is with the PhD population. The Netherlands has never really implemented the third cycle of education as it was outlined in the Treaty of Bologna. The Dutch system does not provide for PhD grants or scholarships. In other countries, there are such grants, and these grants can be used abroad. That makes for a wide variety of conditions under which PhD research is conducted. Some PhD candidates are employed for four years, some obtained a scholarship in their own country and decided to do the research in Delft, and others are self-funded. This inequality creates stress and makes candidates dependent, factors that occasionally surface in questionnaires or individual cases. The only simple solution would be to no longer accept self-funded candidates, which would, however, create yet another inequality.

Furthermore, there is the issue of recognition of the PhD diploma. In academia, it has become a condition for making steps in the academic career. In industry, it has less or very little value.



Image credit: Ecologies of Architecture research group

A photograph of an interior space, possibly a gallery or a modern office. The room has large windows with dark frames and light-colored walls. Several people are visible: a woman in a white long-sleeved shirt and light-colored trousers stands on the left, looking towards the camera. In the center, a person in a dark dress is walking, their figure slightly blurred. To the right, a man in a dark shirt and dark trousers stands near a large white pillar. Further right, another person is visible in the background. The floor is a light, warm-toned material. The overall lighting is soft and even.

ARCHITECTURE

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SUMMARY

THE CONNECTIVE TISSUE THAT BINDS ALL RESEARCH TAKING PLACE IN THE DEPARTMENT OF ARCHITECTURE TOGETHER IS ITS FOCUS ON DESIGN. THE DEPARTMENT HAS A HEALTHY STREAM OF INCOME TO SUPPORT THE RESEARCH ACTIVITIES OF ITS STAFF, WHO PERFORM WELL IN PUBLISHING PEER-REVIEWED ARTICLES IN RESPECTED JOURNALS AND CONTRIBUTE TO ARCHITECTURAL DISCOURSE (BEYOND ACADEMIA) THROUGH THE PRODUCTION OF BOOKS, CONTRIBUTIONS TO PROFESSIONAL MAGAZINES, CONFERENCES (THAT CATER TO A VARIETY OF AUDIENCES) AND EXHIBITIONS, SUCH AS THE VENICE BIENNIAL.

The Architecture department is one of four in the Faculty of Architecture and the Built Environment. Kees Kaan heads the department, and its research programme is led by Janina Gosseye, who works in close collaboration with the Department's two research committees. Anno 2021, the Department of Architecture employed 118 persons as research staff – resulting in 20.3 FTE research time – who contribute to the Department's ten agendas for research.

The research agendas are:

- 1 Architectural Pedagogies;
- 2 Architecture and the City;
- 3 Architecture, Culture and Modernity;
- 4 Borders & Territories;
- 5 Design Research;
- 6 Digital Culture;
- 7 Ecologies of Architecture;
- 8 Global Housing;
- 9 History;
- 10 Situated Architecture.

Each of these agendas is pursued by an eponymous research group within the department.

The Architecture department has an extensive research network, both within the Netherlands and beyond. In the Netherlands, we maintain close ties with other institutes for higher education, such as the Erasmus University Rotterdam, and with funding bodies, such as the Dutch Research Council (NWO). The department is also actively involved in several centres and programmes that have been set up as part of the Leiden-Delft-Erasmus (LDE) strategic alliance, including the Centre for Governance of Migration and Diversity, the Centre for Global Heritage and Development, and the PortCityFutures programme. Many staff members maintain close ties with practice. Some are practitioners themselves, while others collaborate with practitioners, as well as professional architecture organisations, such as the Branchevereniging Nederlandse Architectenbureau (BNA) and the Atelier Rijksbouwmeester. The department's researchers are also actively involved in national heritage, design and history organisations, such as Het Nieuwe Instituut (HNI), the Koninklijke Nederlandse Oudheidkundige Bond (KNOB) and the Cultural Heritage Agency.

Internationally, the TU Delft Department of Architecture is actively involved in BauHow5, a European alliance between five leading research-intensive European universities in Architecture and the Built Environment that seek to push the boundaries of current practices in architectural pedagogies, research, and practice. Many of the department's researchers are members (sometimes even board members or presidents) of prestigious international academic societies and associations, such as the European Architectural History Network (EAHN), the European Association for Urban History (EAUH), the European Association for Architectural Education (EAAE), the Society of Architectural Historians (SAH), the Society of Architectural Historians of Great Britain (SAHGB), the Society of Architectural Historians of Australia and New Zealand (SAHANZ), the Architectural Research Network (ARENA), the Global Urban History Project (GUHP), and the International Planning History Society (IPHS). Several staff members also collaborate closely with intergovernmental agencies, such as UN-Habitat, philanthropic organisations, such as the Aga Khan Development Network, and international cultural associations, such as the International Confederation of Architectural Museums (ICAM).



EAAE, annual conference, 2016 | Image credit: Mick Morssink

INTRODUCTION

THE DEPARTMENT OF ARCHITECTURE IN DELFT FOCUSES ON ARCHITECTURE AS AN EXPANDED FIELD OF EXPERTISE THAT LINKS MAKING AND THINKING, DESIGN AND RESEARCH, HISTORY AND THEORY, TYPOLOGY AND MORPHOLOGY AND CULTURE AND CONTEXT. FROM THIS UNDERSTANDING, WE ADDRESS ARCHITECTURAL PRODUCTION AS A CONCRETE SPATIAL AND MATERIAL CONFIGURATION OF CULTURAL, SOCIAL, FUNCTIONAL, PHILOSOPHICAL, ECONOMIC, AND ECOLOGICAL FACTORS.

Each research agenda relates to architecture's contemporary situation – often addressing real-world challenges, such as climate crisis, energy transition, societal diversity, geopolitical conflict, etc. – through its position, research themes and methodologies. As a cultural field of action and reflection that is strongly related to other disciplines, architecture addresses both societal and scientific questions. These range from questions on design and pedagogy, academia and practice to modernity, the public realm, border conditions, inclusive and resilient communities and digital culture. These notions are addressed in the ten research agendas of the Department of Architecture, each of which is pursued by/within a research group:

- 1 Architectural pedagogies;
- 2 Architecture and the city;
- 3 Architecture, culture and modernity;
- 4 Borders & territories;
- 5 Design research;
- 6 Digital culture;
- 7 Ecologies of architecture;
- 8 Global housing;
- 9 History;
- 10 Situated architecture.

Each staff member of the Department of Architecture can choose freely which research agenda(s) they would like to contribute to and in what ways they connect their work to the six faculty research themes:

- 1 Sustainable urbanization;
- 2 Healthy cities;
- 3 Heritage futures;
- 4 Digitization and artificial intelligence;
- 5 Energy transition and climate adaptation;
- 6 Circularity.

For more information regarding the department's ten research agendas, please see the case studies in Appendix 1.

The department has set in place several key roles and regular meetings/events/formats to ensure that productive cross-fertilizations and collaborations can arise between these ten research agendas. The Department of Architecture has, for instance, established two research committees, which are colloquially called the large and the small research committee. The large research committee, which gathers once a month, brings together the coordinators from each of the ten research agendas, along with the members of the small research committee and the department research leader. The aims of this large research committee are multiple. First, its meetings are intended to keep each other abreast of new initiatives set up within the groups pursuing one of the ten research agendas. Secondly, they are to inform the members about PhD applications and applications for guest researchers that have been received and reviewed by the small research committee. Thirdly, they are to share information on funding opportunities between members and fourth and, finally, they are to develop and organise cross-departmental research events and initiatives, such as the department research days, which are organised three times per year; the department's PhD peer review colloquia, which take place twice a year; and the PhD 'open call', which is launched once per year.

The small research committee consists of four members (including the department research leader as chair) and meets once per month. The small research committee has two main tasks. First, to review PhD applications submitted to the Department of Architecture and, second, to review applications by researchers who would like to join the department as a guest for a few weeks up to one year.

Like the other three departments within the ABE Faculty, the Department of Architecture has a research leader who represents the department in the faculty research council and who chairs the monthly meetings of the department's two research committees. The department research leader meets fortnightly with the head of the department to discuss arising issues and participates in the fortnightly meetings of the department's daily board, which brings together the head of the department, the department education coordinator and the department manager. The main responsibilities of the department research leader are to inform staff members of funding calls/opportunities, foster exchange between the department's ten research agendas (through, for instance, the organisation of department research days and PhD peer review colloquia) and set up cross-departmental calls for PhD applicants.

MISSION AND STRATEGIC AIMS OF THE PAST SIX YEARS

THE DEPARTMENT OF ARCHITECTURE APPROACHES ARCHITECTURE AS THE SCIENCE AND ART OF DESIGNING AND REALIZING BUILDINGS. THE MISSION OF ITS RESEARCH PROGRAMME IS TO BETTER UNDERSTAND THE FOUNDATIONS OF THE ARCHITECTURAL DOMAIN AND PARTICULARLY HOW BUILDINGS CAN CREATE BOTH PRACTICAL AND FUNCTIONAL VALUE AND CULTURAL AND SOCIETAL MEANING.

The Department of Architecture is a constantly evolving and innovating organisation that is well-connected to other academic and societal organisations and actively responds to changing (inter)national conditions and circumstances. The department plays a key role in the ABE faculty. Entangling research and education with a perspective on societal relevance, it attracts a large and ever-growing number of students, both from within the Netherlands and beyond. Its alumni are well-received in national and international academic and societal organisations and networks.

CHANGES MADE SINCE THE 2016 RESEARCH ASSESSMENT

In 2016, when the previous research assessment took place, the Department of Architecture's research centred on the 'Architectural Project and its Foundations', a programme that was instated in 2008 and that comprised six research groups: four related to 'the project' and two related to its 'foundations'. With regards to 'the project', there were: (1) Buildings and interiors, (2) Architecture and the city, (3) Borders and territories, and (4) Mapping *Randstad*. With regards to the 'foundations', there were: (1) Positions and (2) Revisions.

In response to the recommendations made in 2016, the department's research structure was recalibrated to ensure that research groups would have enough critical mass to become substantial centres of expertise, to explore collaborations through a more flexible structure, to enhance peer-to-peer research exchanges and PhD tutoring within the groups, to better align the projects of incoming PhD candidates with the research topics and approaches within the department and to formulate a funding strategy in connection with the research groups. The result was a research structure with five thematic research groups and three transversal research lines:

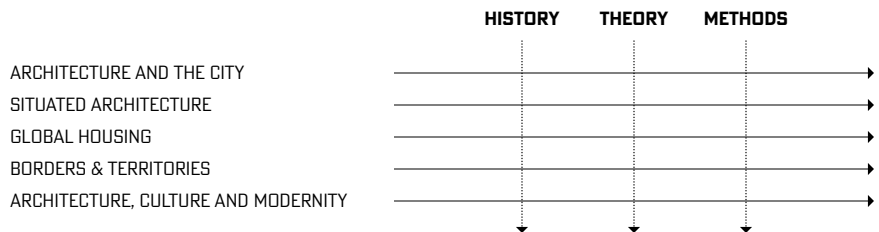


FIG. 2.1 **Research Structure 2016**

In 2016, the department's research structure was recalibrated on the basis of five thematic research groups and three transversal research lines

FIG. 2.1

Each of these thematic research groups was conceived of as a centre of expertise where peer-to-peer discussions could take place between junior, mid-career and senior academics. Since the 2016 assessment, a strategy was also developed with regards to funding. It consisted of the organisation of monthly meetings (i.e., the large research committee) to share experiences and to encourage those who had already submitted a grant application to revise and resubmit, either for the same grant or elsewhere. With regards to the guidance of PhD candidates, a structure was put in place whereby there would be four levels of guidance:

- Supervisory team;
- Research group;
- Graduate school courses;
- Departmental peer review colloquia.

These four levels of guidance still exist today and have been supplemented by the addition of a 'research clinic', which is explained in paragraphs 3 and 5.

RECOMMENDATIONS OF THE 2019 RESEARCH ASSESSMENT MID-TERM REVIEW

During the 2019 mid-term assessment, the committee acknowledged the work done by the Department of Architecture since the previous review, regarding not only the change of the research structure but also with regards to the research output, PhD training, and increase in funding. Eight recommendations were formulated following the department's 2019 mid-term review:

- 1 Strengthen research interaction and exchange between the clusters in the department by promoting cross-cluster PhD and researcher exchanges to foster cultures of cooperation, trust and inclusivity;
- 2 Continue to develop the clusters as active and creative sites of intergenerational and varied architectural research practice;
- 3 Utilise new faculty themes as the basis for research cohesion, exchange and pathways to transformation;
- 4 Review and explore how the department's research culture can be made more explicitly of value to the architectural profession, including the value of PhDs;
- 5 Use the strong connections with professional practice and the established international networks for practice-based research and research-by-design in architecture more systematically to develop the specific profile of the department in this area;
- 6 Given the difficulty of gaining grants in this discipline, establish a departmental sabbatical fund to which staff at all levels can apply;
- 7 Refer to good practice inter-disciplinary grant successes in the faculty to further develop grant applications;
- 8 Support and nurture history and theory expertise, recruitment and practices in the department.



STRATEGY OF THE PAST PERIOD AND PROCESS

The departmental strategy that was developed following the previous research assessment cycle – especially in response to the recommendations made during the 2019 mid-term assessment – focused on strengthening its (1) research structure and management; (2) academic culture; (3) PhD policy and training; (4) cross-faculty and cross-departmental collaborations; (5) relationship with practice and open science; (6) HR policy and (7) research funding.

3.1

RESEARCH STRUCTURE AND MANAGEMENT

After the 2019 mid-term assessment, the department's research structure changed. The three transversal research lines established following the 2016 assessment did not work well. Accordingly, these transversal lines were given an autonomous presence in the departmental research programme. In this process, the transversal research line 'methods' became the 'pedagogies' agenda, and two additional agendas – 'digital culture' and 'design research' – were added to bolster the department's research foci, resulting in 10 parallel research agendas. More information about these three new agendas can be found in appendix 1.

ACADEMIC CULTURE

To foster an academic culture of openness and inclusivity and to encourage conversations on topical (research-related) issues, the Department of Architecture organises four Departmental Research Days per year: one per academic quarter. The initial departmental research days that were organised following the 2019 mid-term assessment, sought to firmly establish the department's ten research agendas and to sharpen the department's three new research agendas. From 2022, the department research days have begun tackling themes that concern the department at large, such as equity, diversity, and inclusivity in architecture (which took place in April 2022), research outputs (November 2022), and PhD training (forthcoming January 2023). The themes for these research days are set by the large research committee, while the programme itself is developed by a small cross-cluster team of organisers and typically includes presentations of early- and mid-career researchers as well as senior staff. Thus, the organisation and set-up of these research days foster exchange between the various research groups of the department and between researchers who are at different points in their careers.

Each of the ten research groups pursuing one of the ten agendas organises regular meetings, ranging from once per quarter up to twice a month. At present, each of these groups includes, on average, 6 senior staff, 6 PhD candidates and 1 PostDoc researcher. The three new research agendas – pedagogies, digital culture, and design research – require further strengthening. While the more established research agendas typically have around 8 senior staff, 8 PhD candidates and 1-2 PostDoc researchers, the newly established research groups are typically composed of only one up to three senior staff and have no junior researchers (PhD candidates or PostDocs). The intergenerational strengthening of the research groups is a priority for the Architecture Department in the following six years.

PHD POLICY AND TRAINING

The four-tier system of PhD guidance – (1) supervisory team, (2) research group, (3) graduate school courses and (4) departmental peer review colloquia – that was put in place following the 2016 assessment works well and has been maintained. To further enhance the department's PhD training and to better valorize the History group's expertise in this field, several additional initiatives have been set up over the past few years. The History group, for instance, has developed a mandatory graduate school course and, in 2020, established the 'Under Construction' Research Clinic as a monthly gathering where scholars from across the department who are at various stages in their careers (from PhD candidate to full professor) present work in progress to discuss questions of methods, content, and approach in a collegial setting.

CROSS-FACULTY AND CROSS-DEPARTMENTAL COLLABORATIONS

To strengthen cross-faculty collaborations, foster research synergies, and thereby also enhance the faculty's academic culture, the ABE Faculty has defined six shared research themes: (1) Sustainable urbanization, (2) Healthy cities, (3) Heritage futures, (4) Digitization and artificial intelligence, (5) Energy transition and climate adaptation and (6) Circularity. In 2020, the faculty allocated part of its budget and received additional strategic funds from the executive board to appoint twelve new PhD students who were to further research these identified six themes. To stimulate research cohesion and exchange between the different departments, the faculty stipulated that only tenure track staff could define projects for these 12 doctoral positions and that each tenure tracker would need to team up with a promotor from another department within the faculty. Following this initiative, four new doctoral researchers started within the department – Abhijeet Chandel, Soscha Monteiro De Jesus, Ran Pan, and Halina Veloso e Zarate – whose work forms bridges between the Architecture department, on the one hand, and the Architectural Engineering and Technology, Management in the Built Environment, and Urbanism departments, on the other hand.

Another recent initiative that has strengthened collaborations within the ABE Faculty is the establishment of AiDAPT, one of TU Delft's new AI Labs, in January 2021 (see: <https://www.tudelft.nl/ai/aidapt>). The directors of this lab, which seek to use AI to facilitate the decision-making processes of architects and engineers across different scales and through different design phases, are Charalampos Andriotis, affiliated with the AE&T department, and Seyram Khademi, affiliated with the Architecture department. Charalampos and Seyram co-supervise four PhD candidates who contribute to building research bridges between the faculty's departments and whose work strengthens the faculty's relationship with practice.

In 2020, the Department of Architecture initiated the PhD 'open call'. For this PhD open call, researchers in the Department of Architecture are invited to formulate PhD topics or define broader research themes for which (self-funded) doctoral aspirants can apply. The formulation of these calls often results in cross-cluster (or cross-agenda) collaborations. The most recent call, for instance, launched in December 2021, proposed five research themes and topics. One of these five, for instance, united the 'Ecologies of architecture' and 'Borders and territories' groups, while another brought together the 'Digital culture' and 'Architecture, culture, modernity' groups.

RELATIONSHIP WITH PRACTICE AND OPEN SCIENCE

An important focus of the department's research strategy in the past six years was to make its research culture more explicitly of value to the architectural profession and to strengthen connections with professional practice, thereby also contributing to open science. To this end, the 'Design Research' agenda was established. Headed by Salomon Frausto, this new research agenda, which is explained in greater detail in one of the case studies in appendix 1, valorises the department's expertise in practice-based research and design research more systematically.

Additionally, several research projects have been initiated in the past six years that build upon the strong relationship with professional practice. The EU-financed 'CA²RE+' project, for instance, in which the TU Delft Department of Architecture is a beneficiary partner, brings together senior staff and early-career researchers to develop a collective learning environment through Evaluation of Design Driven Doctoral Training. This strategic partnership between eleven organisations for higher education and associations from eight EU countries commenced in September 2019 and concluded in August 2022. It approached Design Driven Doctoral research (DDDr) as a multidisciplinary example of an experiential learning-through-evaluation model, appropriate for identification and promoting relevance of research singularity, its transparency and recognition, to award excellence in doctoral training for creative and culturally rooted solutions of contemporary design-driven developments.

Another important international project that was initiated in the past six years, building on the strong connections with professional practice and international networks for practice-based research, is 'Communities of Tacit Knowledge: Architecture and its Ways of Knowing', an Innovative Training Network (ITN) funded by the EU as part of the Marie Skłodowska-Curie Actions (MSCA) within the European Framework Program Horizon 2020. It was initiated in September 2019 and will conclude in August 2023. This network, in which the Department of Architecture is one of the leading partners, trains young researchers to understand the specific knowledge that architects use when designing buildings and cities. To do so, this ITN has brought together ten institutes for higher education, three cultural partners, and (importantly!) nine architecture design offices from across Europe. Collaboratively these partners offer an innovative PhD training programme that includes practice-based secondments. During such practice-based secondments, each of the ten doctoral candidates involved in the ITN spent five months working part-time for/at one of the nine architectural practices involved in the network. The department's involvement in this ITN has strengthened the Department of Architecture's profile as a centre for practice-based research.

HR POLICY

In the past six years, funding has become available for new positions, which the department has strategically and successfully used to enhance the diversity of the department's staff and to create opportunities for early- and mid-career researchers (see paragraph 6). The staffing problem in the Ecologies of Architecture (formerly Theory) group, which was identified at the 2019 mid-term assessment, has been addressed by the group's new profiling as Architecture Philosophy and Theory (education) and its research group, Ecologies of Architecture, formally recognized by the department. Recently, the staff was increased with the partial appointment of Robert Gorny, who replaces retired Patrick Healy. In 2020, Georg Vrachliotis was appointed full professor for Theory of Architecture and Digital Culture and although the department did not succeed in appointing a full professor of Architectural Theory *pur sang* since the previous research assessment (despite repeated attempts), another innovative and ultimately very successful strategy has been adopted to address this lacuna: the 'Theories of Architecture Fellowship Program'. As part of this programme, which is spearheaded by Heidi Sohn, Klaske Havik and Dirk van den Heuvel, one (sometimes two) 'theory fellows' are appointed every semester. These theory fellows commonly give a public lecture at the department, lead a workshop for the department's PhD candidates and give feedback during one (or more) master's courses. The programme has been extremely successful, bringing renowned scholars such as Nishat Awan and Irénée Scalbert (Fall 2020), Gökhan Kodlak (Spring 2021), Eeva-Liisa Pelkonen (Fall 2021), and Naomi Stead (Spring 2022) to Delft. The visits of these scholars not only introduced the department to different voices and viewpoints regarding architectural theory but also created more opportunities for cross-departmental exchanges.

The mid-term committee's suggestion to establish a sabbatical fund for staff to focus on research or grant applications for a certain period of time was highly welcomed and proposed to the department's daily board. Sadly, this recommendation has not (yet) been adopted due to financial constraints. At present, alternative pathways are explored, as explained in the 'funding' strategy for the next six years (paragraph 6).

RESEARCH FUNDING

The large research committee was established within the Department of Architecture following the 2016 assessment as a venue where experiences regarding grant applications could be shared between the different research groups. These exchanges occur in this forum but are generally limited to the more technical aspects of particular funding opportunities (e.g. submission dates, eligibility criteria, etc.). At the ABE Faculty level, the 100% research team provides excellent support regarding the development of grant applications, offering advice and formulating recommendations regarding the pitch, the structure of the proposal, the budget, etc. Nevertheless, there is still room for improvement regarding the development of grant applications. This will be a key action point of the department's strategy moving forward (see paragraph 6).

A WORKSHOP AND DISCUSSION FORUM ON THE REPRESENTATION OF GENDER, SEXUALITY, ETHNICITY AND DISABILITY IN ARCHITECTURAL EDUCATION, PRACTICE AND RESEARCH.

BauHow5

IN COLLABORATION WITH THE BAUHOW5 ALLIANCE

A WORKSHOP AT THE
FACULTY OF ARCHITECTURE
& THE BUILT ENVIRONMENT
TU DELFT

09:30-18:30
16 MAY 2018
BERLAGE ROOMS
OPEN TO ALL

SEXUALITY GENDER
ETHNICITY
BUILDINGDIVER

INDICATORS

COUPLING FUNDAMENTAL AND APPLIED RESEARCH, THEORY AND PRACTICE, THE DEPARTMENT OF ARCHITECTURE HAS A LONG TRADITION OF VALORISING ITS RESEARCH NOT ONLY THROUGH STANDARD ACADEMIC CHANNELS, SUCH AS PEER-REVIEWED JOURNALS, ACADEMIC BOOKS, BOOK CHAPTERS, BOOK SERIES AND ACADEMIC LECTURES, BUT ALSO THROUGH CONFERENCES AND SEMINARS, CONTRIBUTIONS TO PROFESSIONAL MAGAZINES, BOOKS WITH A BROADER (BOTH ACADEMIC AND NON-ACADEMIC) READERSHIP, MEDIA APPEARANCES AND EXHIBITIONS FOR A BROADER PUBLIC.

Embedding and entangling research in/and education, one of the strongest expressions of the relevance of the department's output for society is the work of the numerous practitioners trained at the department who are today shaping our built environment, both in the Netherlands and beyond.

TABLE 4.1 Categories of evidence for the quality domains of research quality and relevance to society

	RESEARCH QUALITY	RELEVANCE TO SOCIETY
Demonstrable products	Research products for peers	Research products for societal target groups
	Journal articles	Exhibitions
	Books	Articles published in professional magazines and newspapers
	Book chapters	Books with a broader readership
	Conference papers	Conferences
	PhD dissertations (see appendix 2: 'completed doctoral dissertations')	
Demonstrable use of products	Use of research products by peers	Use of research products by societal target groups
	Research citations	Media appearances
	Downloads and reads of articles, book chapters and books	Citations in popular media, including newspapers and online platforms (e.g. <i>Dezeen</i> and <i>ArchDaily</i>)
		Contract research
Demonstrable marks of recognition		Projects in collaboration with societal partners, including architectural offices, governmental ministries, etc.
	Marks of recognition from peers	Marks of recognition by societal target groups
	Research grants	Invitations to curate (or contribute to) international exhibitions, such as the Venice Biennale
	Editorship of book series and academic journals	Membership/chairpersonship of societal organisations (see appendix 3: 'connections')
	Membership of scientific councils and committees (see appendix 3: 'connections')	
	Organisation of international scientific events (e.g. a thematic EAHN conference in 2017 and an IPHS conference in 2016)	
	Honorary doctorates ¹	

1 In 2022, Klaske Havik was awarded an Honorary Doctorate from Tampere University (Finland), in recognition of the study of architectural writing and of texts on architecture and urban planning.

ACCOMPLISHMENTS DURING THE PAST SIX YEARS

5.1

HR POLICY

The total number of research staff affiliated with the Department of Architecture has steadily increased over the assessment period, from 79 in 2016 to 118 in 2021. This is an increase of 150%. The FTE research time has, however, not increased apace. With an increase of 4,3 FTE (from 16 FTE in 2016 to 20.3 FTE in 2021), the increase in FTE research time has only been 126%. This disparity can be attributed to the fact that the most significant increase in research staff has occurred in the PhD cohort (from 28 PhD candidates in 2016 to 54 in 2021).

In terms of the diversity of the research staff affiliated with the Department of Architecture, strides have been made since the previous research assessment. If in 2016, the research staff affiliated with the Department of Architecture consisted of only 30% of women (measured in FTE), in 2021, 45% of the research staff (measured in FTE) were women. Significant changes can also be noticed regarding the nationalities of the research staff affiliated with the department. In 2016, 61% of the staff were Dutch, 34% were from elsewhere in Europe, and only 4% originated from outside Europe. In contrast, in 2021, only 38% of the research staff stemmed from the Netherlands, 53% were from elsewhere in Europe, and 9% originated outside Europe.

RESEARCH FUNDING

The main source of income for the Department of Architecture is ‘direct funding’ (*basisfinanciering*), which is provided by the Dutch government and determined by the number of students that enrol each year as well as the number of credits offered within each faculty/department. With this direct funding, all personnel costs of the Department of Architecture are covered, and full-time staff at the level of full professor, associate professor and assistant professor are commonly (contractually) guaranteed that 40% of their time can be spent on research. Over the past six years, research grants only accounted for 1 to 3% of the department’s research funding. Apart from direct funding, the other main sources of income are ‘contract research’, which is obtained from external organisations, such as industry, government ministries, European organisations and charitable organisations, and ‘other funding’, which includes speakers’ fees, publication royalties, participation in (external) PhD committees, etc.

5.2.1

RESEARCH GRANTS

Thanks to the research funding strategy pursued in the past six years, the Department of Architecture has successfully attracted small to medium-sized grants, ranging from 15,000 euros up to half a million euros, as well as a few larger grants, ranging from half a million up to three million euros in funding.² The three main funding bodies from which grants have been obtained are the Delft University of Technology proper, the Dutch Research Council (NWO), and the European Commission Horizon 2020 (now Horizon Europe) programme.

The department has been very successful in obtaining grants from the Delft University of Technology. The Delft Deltas, Infrastructures & Mobility Initiative (DIMI) that the university launched in 2014 to encourage research related to the impact of climate change, rising sea levels, economic development and increasing urbanisation on our infrastructure has resulted in several research projects with clear societal relevance. One such project was the ‘Role of stations in future metropolitan areas’ project (2017-2018), which received 80,000 euros in funding, and another the ‘City of the Future’ project (2017-2019), which received 537,793 euros in funding from DIMI along with two national ministries and five municipal governments, who all seek to develop an attractive and future-proof urban environment in an integrated way. The department has also actively applied for and obtained funding from the TU Delft Global Initiative, which encourages scholars from TU Delft to use their expertise to find concrete solutions for global problems in close cooperation with local partners. The ‘Global Housing; Dwelling in Addis Ababa’ project (2019-2020) was among the selected projects for the initiative,

² Please note that as many of these grants involved collaborations with other institutions, the funding amount was often distributed over several institutions.

receiving 30,000 euros in funding. Apart from such project grants, the department staff has also been successful in obtaining personal grants. In the past year, for instance, Nelson Mota and Angeliki Sioli both obtained a Comenius grant. Although these grants are predominantly geared toward enabling teaching staff to put their ideas regarding educational innovation into practice, these projects are heavily informed by the research conducted by these scholars, thus creating a strong bridge between research and teaching. Finally, the Department of Architecture has also successfully obtained Delft Technology Fellowships, another type of personal grant designed to offer tenure-track positions to outstanding female academics researching themes in which the TU Delft faculties want to become stronger. In 2020, two Delft Technology Fellows were awarded to the Department of Architecture, Janina Gosseye and Anne Kockelkorn, who received 200,000 and 100,000 euros in research funding, respectively.

Another important funding body for the Department of Architecture is the Dutch Research Council (NWO). The department has achieved good results in attracting start-up funding (so-called 'Kiem' funding) from the NWO, which encourages exploratory research in the field of the creative industry. Such Kiem funding has, for instance, been obtained for 'The Next Public Library' project (2017-2018) and 'WritingPlace Journal' (2017-2018), which both received 15,000 euros. In both cases, the researchers involved in these Kiem projects have leveraged this start-up funding into larger projects for which larger research budgets were obtained (see the 'Maker-lab' and 'Writing Urban Places' projects further down). The department has also been successful in obtaining project grants from the NWO, including for 'The Critical Visitor' (2020-2025), which received 500,000 euros in funding, and the 'Addis Ababa Living Lab' (2019-2023), which is co-funded by NWO and TU Delft for 500,000 euros. Although researchers affiliated with the Department of Architecture have actively applied for personal grants from the NWO in the past six years, the success rate for these grants has been rather low. The only large personal grant obtained in the past six years was a Veni grant for Amy Thomas's 'Her Office' project (2021-2024), which has received 250,000 euros in funding from the NWO. So far, only two people in the department have obtained a Veni grant, while no one has ever been granted a Vidi or Vici grant which target mid-career researchers and established scholars.

The department has been relatively successful in obtaining funding from the European Research Council Horizon programme. In terms of personal grants, the biggest successes have been achieved for individual (postdoctoral) fellowships. Since the 2019 mid-term assessment, Alejandro Campos Uribe, Alexandar Stanicic and Cathelijne Nuijsink have, for instance, obtained such a postdoctoral fellowship. The department, however, has been less successful in obtaining personal grants from the ERC for mid-career researchers and senior scholars. So far, no one in the department has obtained an ERC Consolidator or Advanced grant, and in the past six years, only one ERC Starter grant has been obtained by Nishat Awan for the 'Topological Atlas: Mapping Contemporary Borderscapes' project (2018-2023), which has received 1,498,349 euros in funding.³ Greater successes have been achieved in obtaining network-driven project funding from the ERC, including the COST Action 'Writing Urban Places' (2019-2023), which received 600,000 euros; the 'Time Machine' project (2019-2020), which was awarded 997,930 euros; and the 'Communities of Tacit Knowledge: Architecture and Its Ways of Knowing' project (2019-2023), which has a project budget of 2,711,998 euros.

3 Sadly, Nishat Awan has since left TU Delft and moved to the University College London urban laboratory.

In the past six years, staff members of the Department of Architecture have actively applied for other (private) foundation-driven funding and have done so quite successfully. Noteworthy are the ‘State Policies, Technological Surveillance and Spatial (Cross-) Boundary Practices’ project (2017-2022), which received 116,760 euros in funding from the Gerda Henkel Stiftung, the ‘LDE PortCityFutures’ project (2020-2024), which received 472,000 euros in funding from the LDE University Consortium, the ‘ArchiMedia: Enriching and linking historical architectural and urban image collections’ project (2017-2020), which received 476,000 euros from the Volkswagen Foundation, the ‘CA³RE+: Collective Evaluation of Design Driven Doctoral Training’ (2019-2022) project, which received 450,000 euros in funding from the Erasmus+ Strategic Partnership and the ‘Maker-lab’ project, which has received a grant of 480,290 euros from the Pica Foundation.

5.3

RESEARCH OUTPUT AND OPEN SCIENCE

Between 2016 and 2021, the Department of Architecture has published more than 220 refereed articles in internationally recognized journals. Our department’s most important journal outlets are *Urban Planning*, *Planning Perspectives*, *Bulletin KNOB: Koninklijke Nederlandse Oudheidkundige Bond*, *Sustainability* and *Spool: Journal of Architecture and the Built Environment*. Apart from these five key outlets, research of members of the Department of Architecture is also regularly featured in *ABE Journal*, *Architectural Histories*, *Architectural Theory Review*, *Architecture and Culture*, *ARQ: Architectural Research Quarterly*, *Environment and Planning C: Politics and Space*, *Grey Room*, *Historic Environment: Policy and Practice*, *History and Technology*, *Home Cultures*, *International Journal of Islamic Architecture*, *Journal of Architectural Education*, *Journal of Environmental Studies and Sciences*, *Journal of Housing and the Built Environment*, *Journal of Planning History*, *Journal of Urban History*, *Oase: Tijdschrift voor Architectuur*, *Political Geography*, *JSAH*, *The Journal of Architecture*, and *Urban Geography*. The breadth of the research agendas pursued at the Department of Architecture is reflected in the wide range of topics addressed in these refereed articles. They, for instance, examine the efficacy of participatory workshops as a tool for building inclusivity in new towns in Africa, analyse living concepts suitable for elderly homeowners, study port city infrastructures and petroleumscapes, question the contemporary value of traditional craftsmanship, highlight the effect of climate change on cultural heritage, bring to light the work of female architects, scrutinize the impact of global flows on architectural design, ponder theoretical/philosophical questions, propose the implementation of new methods (e.g. literary methods) in architectural education and even address the design-to-robotic-production of underground habitats on Mars. This list only offers a glimpse of the multitude of topics that are addressed in refereed articles published by members of the Department of Architecture, which contribute both to local architectural culture and global questions of architectural design. Importantly, over the past six years, the percentage of refereed open-access articles by members of the Department of Architecture has steadily increased, from about 50% in 2016 to 90% in 2021 (see fig. 5.1).

Many of the department's researchers are also members of editorial and advisory boards of academic journals such as *The Journal of Architecture*, *Journal of Urban History*, *Spool*, *Planning Perspectives*, *Journal of European Landscapes*, *ArchIDoCT*, *Home Cultures*, *Urban Planning*, etc.

The Department of Architecture also supports/funds the publication of five journals: *Footprint*, *DASH*, *OverHolland*, *WritingPlace* and *OASE*. Apart from *DASH*, these journals are all open-access; licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence. *Footprint*, set up in 2007 and published twice a year, encourages the study of architecture and the urban environment as a means of comprehending culture and society and as a tool for relating them to shifting ideological doctrines and philosophical ideas. *DASH* (Delft Architectural Studies on Housing) is a thematic serial devoted exclusively to housing design. The first issue appeared in 2009, and since then, *DASH* has consistently analysed historical and contemporary dwelling projects to give new impetus to innovative housing design. Addressing both the academic community and practitioners, *DASH* is conceived as a tool for tackling contemporary housing questions in an innovative manner and for developing and disseminating new information on housing design. *Over Holland: Architectonische Studies voor de Hollandse Stad* is published by the Koninklijke Nederlandse Oudheidkundige Bond (KNOB) on behalf of the Department of Architecture. Seeking to link urban analysis and architectural design, *Over Holland* includes both typological and morphological urban studies and questions architectural interventions in the context of Dutch cities. *Writingplace: Journal for Architecture and Literature* is the most recent addition to the journals supported by the Department of Architecture. Launched in 2018, *WritingPlace* is a vehicle for the exchange of knowledge on the relationship between architecture and literature and to address and promote alternative ways of looking at and designing architecture, urban places and landscapes through literary methods. Next to academic articles, the journal is open to accounts of experiments in education and works of design or spatial analysis in which literary tools have been explored. All material submitted to the *Writingplace* journal is subject to a peer-review process. Finally, *OASE*, which was founded in the mid-1980s and appears three times per year, is an international, peer-reviewed journal for architecture that brings together academic discourse and voices from design practice. *OASE* advocates for critical reflection in which the architectural project, positioned in a wider cultural field, occupies a central position.

Another key output of the department's research programme are books, book chapters and book series. These not only seek to reach an academic audience but address a broader readership, specifically in the professional and cultural fields. Therefore, apart from publishing with academic publishers, such as Routledge, Bloomsbury, gta Verlag, and others, many researchers affiliated with the Department of Architecture opt to publish with Nai010, Jovis, Vantilt, Architectura&Natura, etc.

Several members of the Department of Architecture are commissioning editors for book series. In 2021, 'Architectural Borders and Territories' was launched. This book series, edited by Marc Schoonderbeek and published by Routledge, seeks to highlight the intrinsic critical relationship and inherent complexities between architectural 'borders' and 'territories'. The series is theoretical and historic in its scope and presents discussions relevant to contemporary international scholarship in architecture. Another book series emanating from the Department of Architecture is 'Global Housing'. Edited by Nelson Mota and Dick van Gameren and published by

Jap Sam Books in cooperation with the Delft University of Technology, this series examines the housing conditions of cities across the globe through thematic essays, developed in co-production with local actors, on the one hand, which are combined with prospective design projects produced by students at TU Delft, on the other hand. Also noteworthy is the 'Bloomsbury Studies in Modern Architecture' book series, edited by Janina Gosseye and Tom Avermaete (ETH Zurich). Launched in 2017, this series aims to create a more comprehensive history of the modern movement by bringing to light the work of a wide range of architects whose significance is being reappraised in contemporary scholarship. In 2018, Henriette Bier and two colleagues launched the 'Springer Series in Adaptive Environments'. This book series presents cutting-edge research around spatial constructs and systems that are specifically designed to be adaptive to their surroundings and inhabitants. Contributing to the department's open science goals are the three open-access book series, published by BK Books, in which Carola Hein is involved: (1) the 'CPCL Series', which explores cultural heritage, creative practices and the city; (2) the 'Inaugural Speeches and Other Studies in the Built Environment' series, which presents inaugural lectures – translated into English and contextualized with scholarly introductions – to unlock information for comparative research and set the stage for new investigations; (3) the 'Studies in International Planning History' series, which brings back to print influential texts from around the world about the study and practice of city and regional planning.

Between 2016 and 2021, the Department of Architecture published 211 book chapters and 28 books. The books include Mark Pimlott's *The Public Interior as Idea and Project* (2016), Salomon Frausto's *Scenes from the Good Life: Nine Investigations into the Forms, Figures, Tropes, and Types of an Architectural Goodness* (2016), Sabina Tanovic's *Designing Memory: The Architecture of Commemoration in Europe, 1914 to the Present* (2019), Reinout Rutte and J.E. Abrahamse's *Historical Atlas of Amsterdam: A Metropolis in Maps 1200-2015* (2021), Andrej Radman's *Ecologies of Architecture: Essays on Territorialisation* (2021), Willemijn Willems-Flöet's *Oases in de Stad: Het Hofje als Architectonisch Idee* (2021), Vanessa Grossmann and Benoît Pouvreay's *Oscar Niemeyer: Un Exil Créatif* (2021), and Tom Avermaete and Janina Gosseye's *Urban Design in the 20th Century: A History* (2021) – to name only a few.

Other very important research outputs produced by the Department of Architecture are conferences and exhibitions. Several members of the department are the driving forces behind recurring (annual) conferences. Between 2016 and 2021, Dirk van den Heuvel and Jorge Mejía Hernández, for instance, organised six annual conferences in collaboration with the Jaap Bakema Study Centre (Rotterdam). Between 2017 and 2019, the Ecologies of Architecture group organised a series of 3 conferences focused on 'Cartographies', and Roberto Cavallo and Alper Alkan are the driving forces in the CA²RE Community for Artistic and Architectural Research, which organised six conferences over the past three years, including one in Delft. Apart from these recurring conferences, the Department of Architecture has also hosted several significant singular conferences between 2016 and 2021. In 2016, Carola Hein and the History group organised the IPHS conference, which was attended by more than 600 people. In 2017, Tom Avermaete and Merlijn Hurx hosted the fifth thematic European Architectural History Network (EAHN) conference in Delft, which promoted a deeper cultural investigation of the 'Tools of the Architect' (also the title of the conference). In 2018, Amy Thomas organised 'Building Diversity' in collaboration with the BauHow5 Alliance, a conference focused on diversity, equality and inclusion in architectural education, research,

and practice. That same year, Carola Hein chaired the 'PortCityFutures' conference in Rotterdam, which examined how strong port city cultures might help resolve spatial development questions generated by contemporary urgencies, such as the energy transition, climate change, new technologies, and transformations of work conditions and Manuela Triggianese organised a two-day conference in Paris on 'Stations of the Future'. In 2019, Aleksandar Staničić hosted the 'Architectural Heritage: Affordances, Affect, Politics' colloquium at TU Delft Faculty of Architecture which explored links between affordances, affective tonalities, shifting politics, collective memory and the design of architectural heritage, and in 2021 Janina Gosseye co-chaired 'Histories of Urban Design' with Tom Avermaete, a conference collaboratively organised between ETH Zürich and TU Delft.

The Department of Architecture also has a strong track record in (co-)curating exhibitions, in part due to its fruitful collaboration with the Jaap Bakema Study Centre at Het Nieuwe Instituut (HNI, Rotterdam), which resulted in exhibitions such as 'Habitat: Expanding Architecture' (2018), 'Animal Encounters: From Parrot Perch to Systems Theory' (2019) and 'Art on Display 1949-69' (2021). The latter exhibition was a collaboration with the Calouste Gulbenkian museum in Lisbon. The department also regularly contributes to the Venice Biennale. In 2018, ten BK Booths were spread throughout the city to present the latest research produced at the TU Delft Faculty of Architecture and the Built Environment. Some of these booths were developed and designed by members of the Architecture department. In the 2021 edition of the Venice Biennale, the department was also well represented through two contributions by members of the Global Housing group: Anne Kockelkorn's co-curated station on 'Cooperative Conditions' at the Arsenale examined the power of cooperative housing as a conceptual counterpoint to both public and private housing, while Nelson Mota, Harald Mooij, and Dick van Gameren's 'Housing the Urban Invisibles', displayed at the European Cultural Centre in Venice (ECC), explored alternative approaches for the design of mass housing as a key component of sustainable development. Apart from these exhibitions resulting from a close collaboration with Het Nieuwe Instituut, and the various contributions to the Venice Biennale, members of the Architecture department are also regularly involved in 'one-off' exhibitions that have resonated widely in both professional and public media, both in the Netherlands and beyond. In 2016, for instance, Jurjen Zeinstra and Herman van Bergeijk curated an exhibition on Tessenow entitled 'Housing the Interior: The Case of Heinrich Tessenow'. In 2017, Janina Gosseye and Tom Avermaete curated 'Shopping Towns Europe' at the Flanders Architecture Institute, which received echoes in two national (Belgian) newspapers and on Flemish radio. In 2018, Rohan Varma and Nelson Mota collaborated with KRIVIA (India) on an international travelling exhibition on the housing designs of Charles Correa. In 2019, Maria Novas Ferradás set up 'That Exhibition That Happened in the Corridor' at TU Delft, a collaboration between students and researchers exploring alternative perspectives on diversity and equality in architectural education and practice. In 2020, Georg Vrachliotis curated 'Models, Media, and Methods: Frei Otto's Architectural Research' at the Yale School of Architecture. The examples mentioned in this paragraph are only a small fraction of the approximately 25 curatorial activities (both big and small, local and international) undertaken by members of the Department of Architecture between 2016 and 2021. Together, these efforts attest to the department's strong conviction that research should not only engage with other researchers/academics but also with students and resound loudly beyond the walls of academia.

Finally, researchers of the Department of Architecture also regularly contribute to professional journals such as *De Architect* (the primary Dutch professional magazine on architecture), *S&RO* (Stedenbouw en Ruimtelijke Ordening) and Archined (an important digital forum on architecture and urbanism). The work of the department's research is also regularly cited or discussed in other popular media. The research of our staff has, for instance, been cited in *Archdaily*, *Dezeen*, *Architecture d'Aujourd'hui* and *The Times of India* and published in *The Guardian*, the *Architects' Journal*, *De Groene Amsterdammer*, *De Standaard*, *De Tijd* and *Het Parool*. Several of the close to 200 media appearances recorded in the past six years are also contributions to radio and television.

5.4

PHD POLICY AND TRAINING

In the period 2016-2021, 26 PhD theses were completed in the Department of Architecture (an overview can be found in appendix 2). Between January 1, 2016 and January 1, 2021, more than 30 PhD students enrolled in the Architecture department. At TU Delft, a full-time PhD project will typically take four years. PhD candidates are well supervised throughout their education. They generally have one promotor, a co-promotor and a daily supervisor. The daily supervisor is a more junior scholar who has not yet obtained the *Ius Promovendi* (which requires being an associate professor/*universitair hoofddocent* and having supervised minimally two PhD students to completion). During this time, PhD candidates need to be enrolled in the Graduate School for Architecture and the Built Environment [A+BE], one of the eight graduate schools at TU Delft. During their PhD studies, doctoral candidates are required to obtain 45 graduate school credits: 15 credits in 'Discipline-related skills', 15 credits in 'Research skills' and 15 credits in 'Transferable skills' (i.e. on-the-job learning). The Department of Architecture currently offers (or is involved in the instruction of) several discipline-related courses. These are:

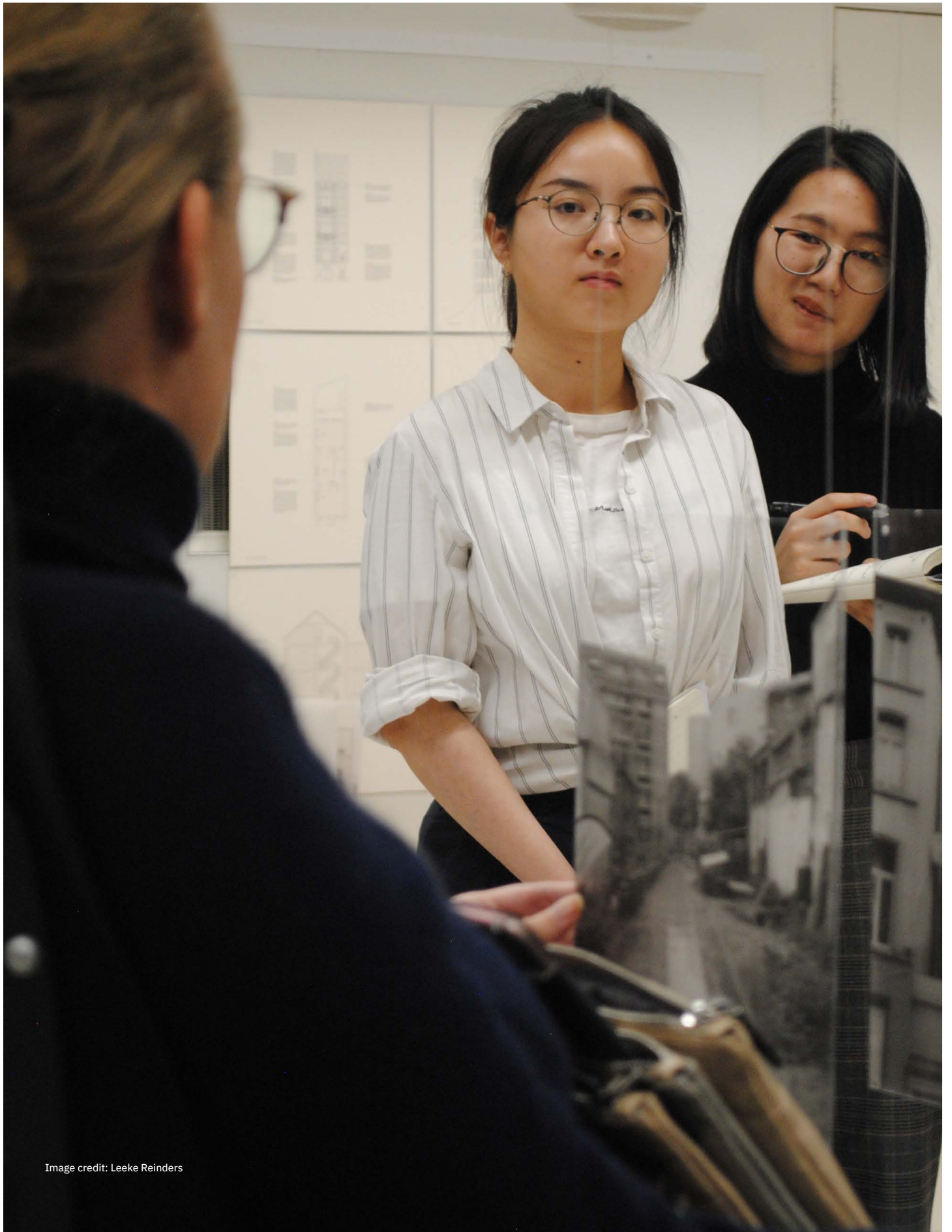
- **ABE009** | 'Research Proposal for Architecture & the Built Environment' (mandatory course);
- **ABE016** | 'Topics in global flows and dynamic landscapes: Port Cities between global networks and local transformations';
- **ABE020** | 'Cultural contexts';
- **ABE008** | 'Advanced architectural theory seminars';
- **ABE0210** | 'The Dog, the cook and the map-maker: Modes of architectural writing in research';
- **ABE012** | 'Architecture and Diversity'.

Doctoral students enrolled in the A+BE graduate school can also obtain credits by participating in summer schools and enrolling in courses offered by other institutions.

Apart from regular meetings with their supervisory team and the courses they receive through the A+BE doctoral school, PhD candidates enrolled in the Department of Architecture are also supported in other ways. The department regularly organises PhD Peer Review Colloquia. These events, which currently occur twice per year, are to bring together PhD researchers at different points in their PhD trajectories to encourage peer-to-peer learning. These events also encourage cross-fertilization between members of different research groups (pursuing one of the department's 10 Research Agendas). The PhD Peer Review Colloquia are generally organised around the 'go/no-go' of one or two of the department's doctoral candidates. Go/no-go meetings take place nine to twelve months after the start of the PhD. For this meeting, doctoral candidates submit an overview of results achieved in the first year, as well as a perspective on the next three years (project plan), including a time schedule and a self-assessment. A select number of other PhD candidates are invited to present their work-in-progress during this PhD Peer Review Colloquium as well, thus making optimal use of the external guests (these can be national or international scholars). They are invited to comment on the go/no-go dossiers presented during the event, which also helps the PhD students expand their academic network. Printed proceedings are produced for each of these colloquia.

Also noteworthy is the 'Under Construction' Research Clinic, which was initiated by the History group as a monthly gathering that invites scholars to present work in progress and to discuss methods, content, and approach questions in a workshop setting. The coordinators of the research clinic, Rachel Lee, and Gabriel Schwake, generally invite a PhD candidate and a more established researcher to each give a 10-minute presentation on their current research with a particular issue/problem/challenge that they are experiencing. Following each of these two presentations, there are 30 minutes for feedback and discussion with the rest of the participants. The research clinic meetings are informal in nature and are held on Zoom. Beyond exploring research challenges at hand, this initiative also contributes to strengthening the research community within the department and the ABE Faculty at large.

Additionally, the doctoral candidates also receive support through the Research Groups with which they are affiliated, and in case of issues arising during their PhD trajectory, candidates can approach Heidi Sohn, the department's PhD Mentor.



EVIDENCE BY NUMBERS

This section includes the quantitative data that supports the self-evaluation of the indicators and also supports the discussion about the strategy and the accomplishments during the past period. In particular, it presents information about the numbers of research staff, PhD candidates, funding and research output.

PERCENTAGE OF OPEN ACCESS PUBLICATIONS BETWEEN 2016 AND 2021

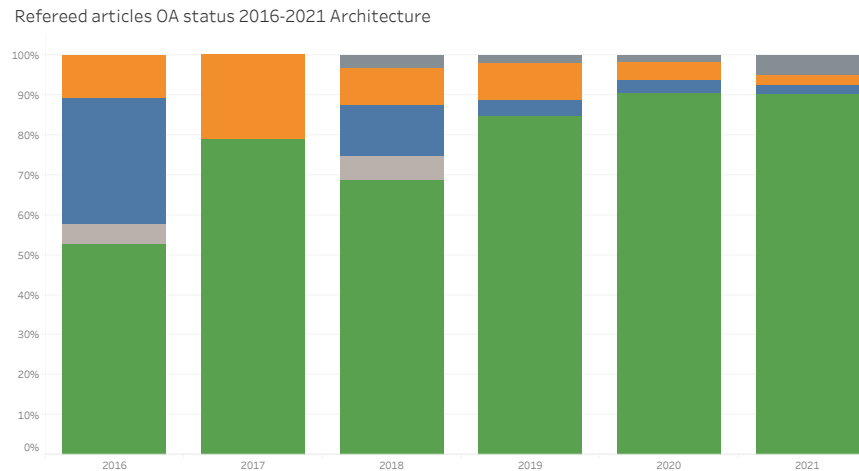


FIG. 5.1
Percentage of open access publications
between 2016 and 2021

FIG. 5.1

RESEARCH STAFF

TABLE 5.1 Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities.

	2016		2017		2018		2019		2020		2021	
	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE
Scientific Staff	37	10.1	32	9.8	34	9.8	36	9.9	43	11.2	43	13.3
Full professor	7	2.0	7	2.0	9	1.9	8	1.7	10	1.9	10	2.3
Associate professor	10	2.6	9	3.1	9	3.0	9	3.1	10	2.6	8	2.8
Assistant professor	20	5.5	16	4.7	16	4.9	19	5.1	23	6.7	25	8.2
Researchers (incl. Postdocs)	14	5.9	22	8.1	25	11.5	23	10.6	16	7.5	21	7.0
PhD candidates	28	-	33	-	41	-	49	-	48	-	54	-
TOTAL RESEARCH STAFF	79	16	87	17.9	100	21.34	108	20.5	107	18.7	118	20.3

Scientific staff: profiles HL, UD, UHD, permanent and temporary. Researcher: UFO profile OVWOZ (onderzoeker 1, onderzoeker 2, onderzoeker 3, onderzoeker 4, Post-docs), permanent and temporary. PhD candidate: standard PhD (employed) and contract PhDs (externally or internally funded but not employed). Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities. The indicated number of FTEs takes into account that scientific staff and researchers are considered to spend respectively 40% and 80% of their appointment on research activities.

FUNDING

TABLE 5.2 Overview of funding and expenditure for the period 2016-2021.

	2016		2017		2018		2019		2020		2021	
	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
FUNDING												
Direct funding (1)	2,585	79%	2,450	73%	2,222	66%	2,733	66%	2,878	71%	3,242	72%
Research grants (2)	109	3%	75	2%	50	1%	66	2%	202	5%	151	3%
Contract research (3)	294	9%	372	11%	631	19%	784	19%	641	16%	790	18%
Own contribution	-60	-2%	-133	-4%	-168	-5%	-303	-7%	-304	-7%	-181	-4%
Other (4)	338	10%	584	17%	638	19%	863	21%	648	16%	513	11%
Total funding	3,266	100%	3,348	100%	3,372	100%	4,142	100%	4,065	100%	4,515	100%
EXPENDITURE												
Personnel costs	-2,812	88%	-2,478	85%	-2,368	84%	-3,559	88%	-3,708	92%	-4,139	93%
Other costs	-399	12%	-421	15%	-451	16%	-475	12%	-338	8%	-332	7%
TOTAL EXPENDITURE	-3,211	100%	-2,899	100%	-2,819	100%	-4,034	100%	-4,046	100%	-4,471	100%
RESULT	55		449		553		108		19		45	

Note 1: Direct funding (basic funding/lump-sum budget)

Note 2: Research grants obtained in national scientific competition

Note 3: Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, European organisations and charitable organisations

Note 4: Funds that do not fit into the other categories

PHD CANDIDATES

TABLE 5.3 PhD candidates' graduation time related to their year of enrolment.

ENROLEMENT			SUCCES RATE												
STARTING YEAR	MALE	FEMALE	TOTAL M+F	GRADUATED IN YEAR 4 OR EARLIER		GRADUATED IN YEAR 5 OR EARLIER		GRADUATED IN YEAR 6 OR EARLIER		GRADUATED IN YEAR 7 OR EARLIER		NOT YET FINISHED		DISCONTINUED	
2012	0	2	2	0	0%	0	0%	0	0%	1	50%	1	50%	1	0%
2013	1	0	1	0	0%	0	0%	3	0%	4	0%	0	0%	1	100%
2014	4	0	4	0	0%	0	0%	1	25%	1	25%	1	25%	1	25%
2015	3	2	5	0	0%	1	20%	1	20%	2	40%	0	0%	1	20%
2016	4	8	12	0	0%	1	8%	0	0%	0	0%	10	84%	1	8%
2017	2	3	5	1	20%	0	0%	0	0%	0	0%	4	80%	0	0%
TOTAL	14	15	29												

PhD candidates' graduation time related to their year of enrolment. The table includes PhD candidates enrolled in the period 2012-2017 who are expected to graduate in the review period, by 2021. The expected duration of a PhD is four years.

RESEARCH OUTPUT

TABLE 5.4 Research output for academics and professionals.

	2016	2017	2018	2019	2020	2021
Peer-reviewed articles	19	19	32	53	62	39
Non-refereed articles	3	4	6	5	6	4
Books	9	1	6	3	3	4
Book chapters	29	35	42	35	39	31
PhD theses	2	3	4	4	6	7
Conference papers	24	17	20	9	17	13
Professional publications	61	41	51	55	18	19
TOTAL PUBLICATIONS	147	120	161	164	151	117

DIVERSITY: GENDER AND NATIONALITY

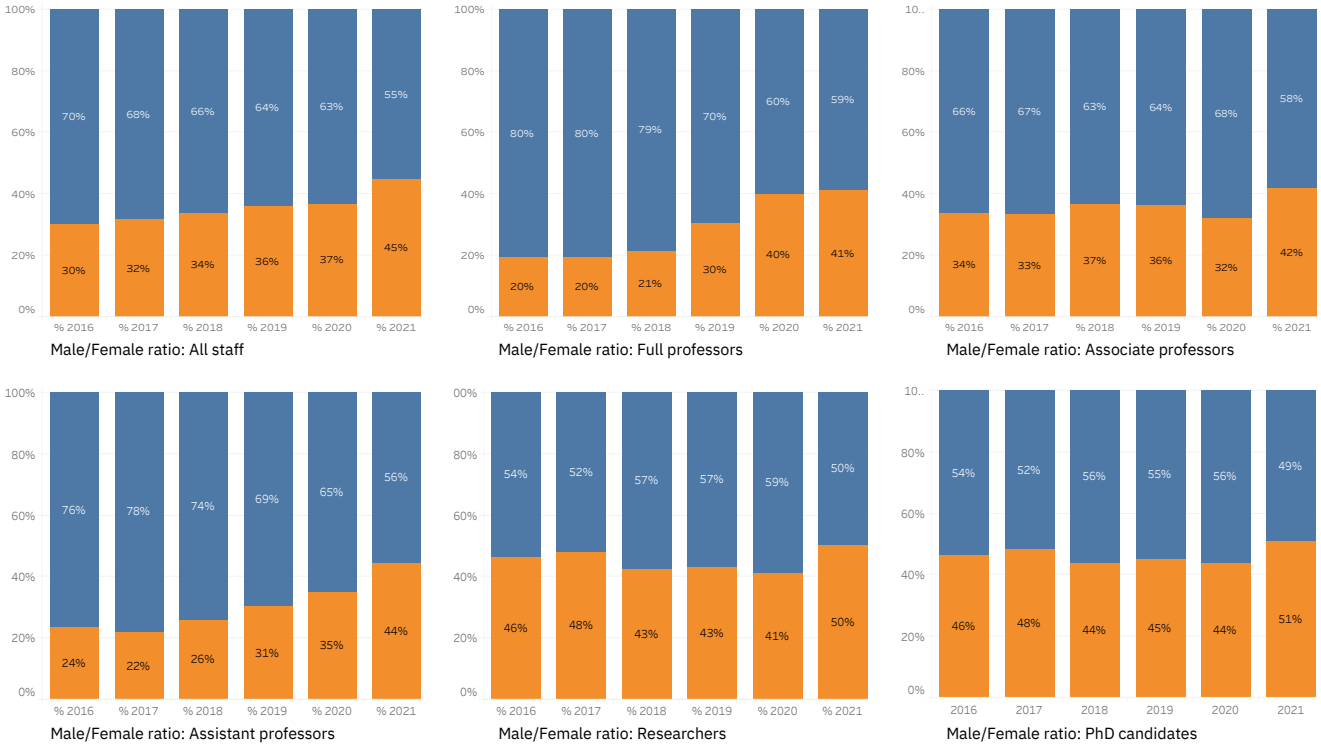


Fig. 5.2 a-f Gender ratio faculty staff: Male (blue)/Female (orange)

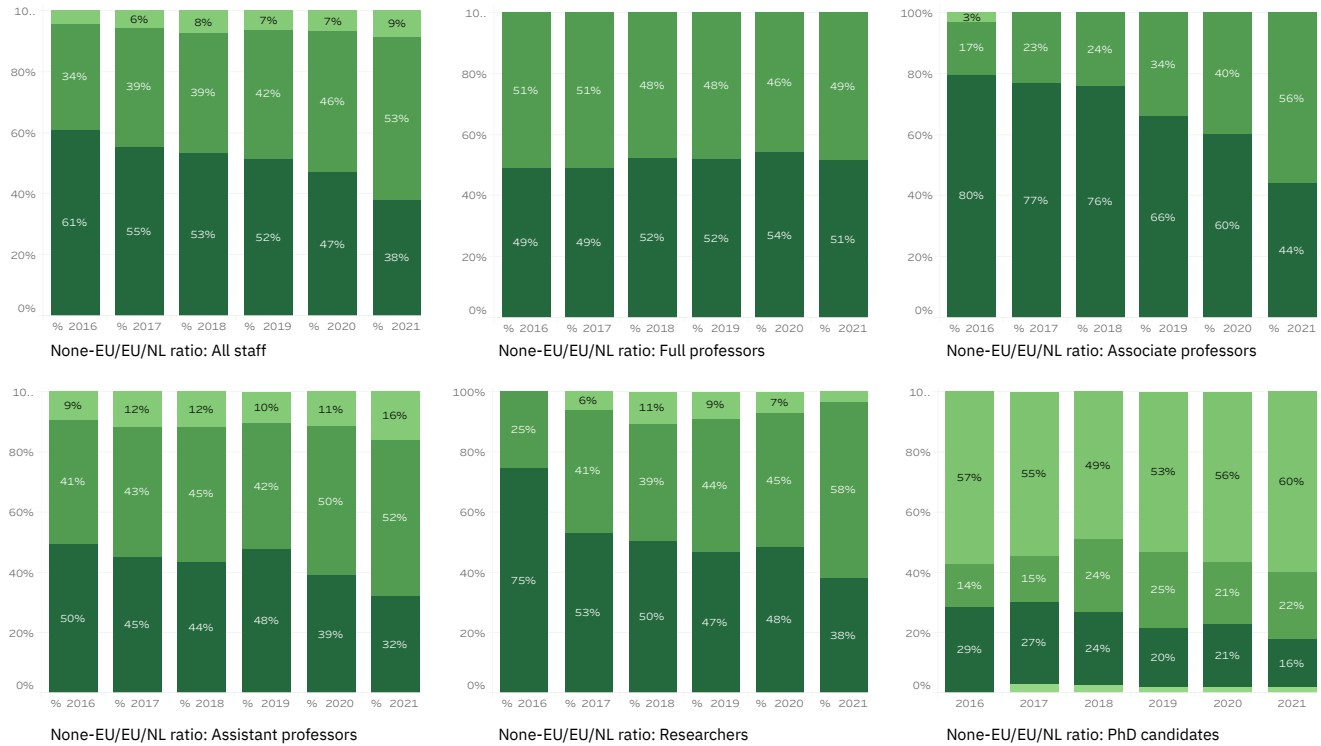


Fig. 5.3 a-f Nationality ration faculty staff: None-EU (light green)/EU (green)/NL (dark green)

STRATEGY FOR THE NEXT SIX YEARS

For this research report, the Department of Architecture undertook a qualitative comparison with the UCL Bartlett Department of Architecture (see the full report in appendix 4), as well as other architecture departments that are part of the BauHow 5 alliance. Through this qualitative comparison, the department's major strengths, weaknesses, opportunities, and threats were identified, and a departmental strategy was developed for the following six years.

6.1

SWOT ANALYSIS THROUGH QUALITATIVE COMPARISON

STRENGTHS

- The Department of Architecture has a strong management structure in place to monitor and support research within the department and to respond effectively to opportunities and problems that (may) arise.
- The Department of Architecture offers its staff members excellent structural financial support for research. As part of the '*basisfinanciering*' that the department receives from the Dutch government, all academic staff can devote 40% of their time to research.

- The Department of Architecture can boast a healthy instream of PhD candidates. Between 2016 and 2021, the number of PhD candidates enrolled at the department increased from 28 to 54.
- To accommodate its doctoral candidates, the Department of Architecture has developed a strong, multi-level PhD guidance system, allowing doctoral candidates to obtain feedback not only from their supervisory team but also from other members of the department. Such (broader departmental) feedback takes place in different settings, including research group meetings, departmental PhD peer review colloquia and the ‘Under Construction’ Research Clinic gatherings.
- The departmental research days, which take place four times per academic year and the department’s PhD peer review colloquia, which take place twice per academic year, are formats that strengthen the department’s academic culture. They bring together researchers affiliated with different groups and encourage exchange between them.
- Members of the Department of Architecture are actively involved in national and international networks, contributing to the department’s strong (inter)national reputation.
- Thanks to its close relationships with practice, its strong focus on design, its varied output (including exhibitions, media appearances, contributions to professional journals, etc.), and its efforts in publishing predominantly open-access, the research conducted at the Department of Architecture resonates strongly beyond the walls of academia.

WEAKNESSES

- The department’s current research structure – composed of ‘ten agendas for research’, each pursued by one research group – has resulted in fragmentation. It is, furthermore, disconnected from the department’s educational structure (shown in appendix 5), making the department’s overall organisation unnecessarily complex and, therefore, ill-understood. Although numerous fruitful exchanges between research and education have occurred within the department over the past six years, the organisational structure of the department could be fine-tuned to further facilitate and strengthen such exchanges; to recalibrate the organisational structure so research can more easily be introduced into education and, vice versa, to engage students in the research groups’ research endeavours.
- At present, the Department of Architecture has little external funding for research. Over the past six years, external grants accounted for only 1 to 3% of the department’s research funding. Although successes have been achieved in attracting personal research funding for young/emerging scholars (mostly PostDocs), the success rate has been lower for those at the mid-career level and the department’s senior scholars.
- Although the team of 100% research, which operates at the faculty level, provides excellent support and advice to those within the Department of Architecture developing grant applications, they do not possess expertise specific to the topic of each of the grant proposals. The feedback thus often remains on a more general level.

- The steep increase in numbers that occurred since the previous research assessment in PhD candidates enrolled in the Department of Architecture against the only marginal increase in staff who hold the *Ius Promovendi* means that the supervision of doctoral candidates (administrated as ‘research time’) puts a strain on the time that senior staff can spend on developing grant applications and publishing their own work. Furthermore, most full professors at the Department of Architecture (6 out of 10) are ‘professors of practice’, focused on teaching. They have part-time appointments (commonly two days per week) and, thus, little time allocated to research in their contracts. This places a large burden on the other (full-time) full professors and those (few) associate professors who have already obtained the *Ius Promovendi*.
- Although the department has a healthy instream of PhD students, many (if not most) of these doctoral candidates do not have structural financial support. Most of the PhD candidates (62%) currently enrolled in the Department of Architecture are self-funded. As a result, there is a significant attrition rate, and many candidates take a long time to complete their PhD, as they often need to find (part-time) employment elsewhere to finance their doctoral research. As Table 5.3 shows, most doctoral candidates take more than the allocated four years to complete their research and quite a few of those who start eventually discontinue their doctoral research. In 2014, for instance, four PhD candidates enrolled. Of these four candidates, one completed their PhD in six years’ time, one in seven years’ time, one is not yet finished, and one has discontinued their PhD research. That said, since 2017, strides have been made in this respect, with a higher percentage of PhD candidates completing their doctoral dissertations within the allocated time.

OPPORTUNITIES

- Since the 2019 mid-term assessment, the Department of Architecture has had a large influx of new staff (mostly early and mid-career researchers). Dan Baciu, Janina Gosseye, Vanessa Grossman, Rachel Lee, Angeliki Sioli, and Aleksandar Staničić are among those who joined the department in the past three years. In the following year, four more ‘strategic’ positions will be created within the Department of Architecture following the so-called *Sectorplannen* (sector plans) announced by the Dutch government. Space should be created for these emerging scholars to help set the course for the department’s future research agenda without creating more fragmentation within the department’s research structure.
- Over the past six years, the gender diversity of the research staff has increased. Since 2016, two more women have been appointed full professors (Nathalie De Vries and Klaske Havik), bringing the total number up to three versus the six male full professors affiliated with the Department of Architecture. Since 2016, strides in correcting the gender imbalance have been made at the level of assistant professor (the FTE of female assistant professors increased from 24 to 44%) and, to a lesser extent, at the level of associate professor (the FTE of female associate professors increased from 34 to 42%). The Department of Architecture should nurture and support the careers of these women so that the gender imbalance at the top (three women versus six men) can be corrected soon.

- The nationalities of the research staff affiliated with the Department of Architecture have diversified since the previous research assessment. However, the stark difference between the diversity of the cohort of senior researchers (full professors and associate professors) and the cohort of younger/emerging scholars (assistant professors and doctoral students), as shown in Table 5.3, is noteworthy. The Department of Architecture should nurture and support the careers of young non-European scholars to create greater diversity among senior staff.
- The funding available through the newly announced governmental *Sectorplannen Ontwerpende Ingenieurswetenschappen* offers an opportunity to create funded PhD positions on a regular (annual or biennial) basis.
- The Theory Fellowship that had a ‘trial run’ (2019-2022) has come to an end. Given the success of this programme, the department should decide to continue it and thereby introduce different voices and different perspectives on architectural theory into the debate.
- The Department of Architecture could do more to position itself as a leader in Europe in the field of equity, diversity, and inclusivity in architecture. At present, there is a large group of researchers at the department – Robert Gorny, Rachel Lee, Janina Gosseye, Amy Thomas, Dirk van den Heuvel, among others – with specific expertise in this area. In the past (and presently still), the activities and initiatives of these individuals have been quite dispersed, spread over several research groups and projects. In 2017, for instance, Dirk van den Heuvel and Robert Gorny edited a special issue of the journal *Footprint* entitled ‘Trans-Bodies/Queering Spaces’, in 2018, Amy Thomas organised ‘Building Diversity’ in collaboration with the BauHow5 Alliance, in 2019, Maria Novas Ferradás set up ‘That Exhibition That Happened in the Corridor’ at TU Delft, which was a collaboration between students and researchers exploring alternative perspectives on diversity and equity in architectural education and practice, etc. A major opportunity lies in bundling the efforts of these individuals in a strong department-driven research agenda.
- The department has invested in AI – the AiDAPT lab is a good example. Such strategic investments, along with the development of the flagship project The New Open (explained in appendix 1) create opportunities to expand the department’s research in this field and, in doing so, strengthen the department’s contribution to open science.
- A significant portion of the staff working in/for the Department of Architecture are (part-time) practitioners. At present, this staff is not optimally involved in the department’s research programme. A huge opportunity lies in better integrating and involving these practitioners in the department’s research and in valorising the contributions to knowledge that they make through their designs.

THREATS

- The lack of structural financial support for doctoral candidates and the (resulting) high proportion of self-funded PhD students within the Department of Architecture results in rather uneven PhD experiences and long PhD trajectories. In the long run, this will reflect poorly on the department.
- The staff in the Department of Architecture has a very high workload. They play an important role in the educational programme of the faculty. Although time for research is contractually guaranteed, education often eats into staff's research time. This means that if staff members choose to spend their research time writing a grant application, there is typically little research time left for doing other kinds of research tasks (such as writing a paper). If then the grant application is not awarded, this can have a severe negative impact on someone's research profile. Therefore, many staff members work more hours than contractually obliged, leading to stress and sometimes also burnout.
- While the career paths for those joining the department with an academic background (a PhD degree) are clearly defined – they typically progress from assistant professor to associate professor and, sometimes, full professor – this is not the case for staff with a more mixed/diverse profile. Those who work part-time in practice and part-time in academia either join the department as (full) professors of practice or as design tutors. Those in the latter category have no clear career path within the Department of Architecture unless they commit to pursuing a doctoral degree.

6.2

STRATEGY FOR THE NEXT SIX YEARS

The department's strategy for the next six years will focus on strengthening its research structure, as well as its research management and academic culture, its PhD policy and training, its capacity to attract external research funding, its HR policy, and its approach to open science. The main objectives of the strategies proposed (and pursued) in each of these areas are to further enhance the department's research quality (RQ), its societal relevance (SR), and its viability (V).

RESEARCH STRUCTURE

- To encourage greater exchange between the different research agendas and foster closer relationships between research and education, the department will reassess its research programme; possibly by developing larger research clusters that have a greater critical mass (a suggestion formulated following the 2016 research assessment) and correspond more closely to (or even mirror) the department's teaching sections. This reassessment of the department's research structure will take place in tandem with the development of the strategic personnel plan that is currently being developed. The latter takes account of upcoming retirements, internal promotions, new positions created through *Sectorplan* funding, and the perspectives created by the faculty's research themes. (RQ, SR, V)
- The department research days will be used more strategically still to foster collaboration within and across the research clusters and outline a strong departmental research agenda. (RQ, V)

RESEARCH MANAGEMENT AND ACADEMIC CULTURE

- While the department's management structure is very strong (see paragraph 1), no terms have been established for how long someone should (maximally) serve as either department research leader or as a member of the small research committee. To make optimal use of the ideas of new research staff, who bring expertise from other schools and institutions, and to create opportunities for the department's mid-career researchers to gain experience in research management, we propose to instate a 4-year term for members serving on the small research committee and a 6-year term for the department research leader. The timing of the research leader's term should be adapted to the department's research assessment cycles (also every six years), so the term concludes shortly after the mid-term assessment and well before the next formal assessment. (RQ)
- At present, the large research committee has no representation from the department's PhD cohort. We propose (as a test case) to invite two PhD representatives – one salaried and one self-funded – to join the large research committee to encourage the exchange of ideas and to ensure that issues arising in the PhD cohort can be dealt with effectively. (RQ)
- To foster closer relationships with practice, industry, and other societal stakeholders, a director enterprise could be appointed, either at the departmental or the faculty level. The person fulfilling this role would be charged with organising regular events (e.g. round-table discussions, industry lunches, etc.) with external stakeholders to identify synergies between departmental research interests and societal needs and ambitions. (SR, V)

- To further strengthen the societal relevance of research conducted within the department, the professors of practice will be given a greater presence in the department's research programme. (SR)
- To foster a culture of openness and inclusivity within the department, we propose that every two years, a two-day research retreat is organised in the Netherlands (but not on campus) for all full professors, associate professors and assistant professors affiliated with the Department of Architecture. During these retreats, the strategy for the department's research will be discussed collectively, taking into particular account the quality of the research, its societal relevance and its viability. (RQ, V)

6.2.3

PHD POLICY AND TRAINING

- A large proportion of the department's PhD candidates is self-funded. Some have obtained a scholarship (either from their home country or a non-governmental organisation), and a small proportion receives a regular salary from TU Delft. These differences in funding have resulted in unequal PhD experiences within the department (and between researchers across different research groups) and confusion with regard to the rights and duties of each individual PhD candidate. To alleviate this confusion, the department is already now developing a PhD policy that sets out the rights of each 'category' (salaried/self-funded) of PhD candidates affiliated with the Department of Architecture. (RQ, V)
- The department will use the additional funding that (since this year) has come available through the government's *Sectorplannen* to create more funded PhD positions within the department and use this opportunity to encourage cross-group (or cross-cluster) collaboration. The department could, for instance, launch a call each year to all assistant, associate, and full professors to submit a proposal – that respond to the list of topics outlined in the government's *Sectorplannen* – for a doctoral project. Cross-cluster (collaborative) proposals will be encouraged, and the proposal selected by an independent panel will be allocated funding. (RQ, SR)
- The department will more actively involve its assistant professors, as well as its professors of practice in PhD supervision. This approach (1) will eventually alleviate the department's bottle-neck in *Ius Promovendi*; (2) will foster the career progress of the department's assistant professors so that by the time they are promoted to associate professor, they will immediately be able to obtain the *Ius Promovendi*; (3) will involve the department's professors of practice – who hold extensive expertise in research across both design practice and academia – in the department's research in general, and (4) begin building a design/practice-based PhD programme within the department. (RQ, SR)
- At present, the department provides (or is involved in) six courses for doctoral students. These discipline-related courses offered by the department are generally well received. However, they do not make optimal use of the human resources (the wide range of

research expertise) that exists within the department. In the next six years, the department will revise the discipline-related doctoral courses offered by the department to ensure that they are complementary (offer a good variety) and make optimal use of the knowledge and expertise of our research staff. (RQ, V)

6.2.4

RESEARCH FUNDING

- The Department of Architecture has long teaching semesters and (generally) very high teaching loads. As the supervision of doctoral students is administrated as 'research time', little time is left for the department's professors (across the levels) to develop grant applications. During the 2019 mid-term assessment, the suggestion was formulated for the department to establish a sabbatical fund. Due to financial constraints, this recommendation has not been adopted. At present, a proposal is being considered by the department's daily board which seeks to ensure that staff who have been continuously employed at the Department of Architecture for a minimum of four years (and who have both a teaching and research assignment) are entitled to one teaching-free semester every two years or, alternatively, one teaching-free quarter every two years, during which they can spend (minimally) 80 per cent of their time (exclusively) on research. The idea is that supervisors will discuss with each individual member of their team which model – the quarter-model or the semester-model – best suits their needs during the annual appraisals and that the teaching responsibilities of the person on research leave will be divested to other members of the team and/or to casual staff. (RQ, V)
- Although the department's large research committee was initially established with the aim of exchanging knowledge about funding applications, these gatherings are generally not used for discussing grant applications under development. If the 100% research office (which operates at the level of the ABE Faculty) offers feedback on a general level (for example, regarding the pitch, the budget, the structure of the proposal), what is missing still is a system of peer review for grant applications. It would be greatly beneficial for those developing grant applications to receive input from colleagues with content-related expertise. The department, therefore, proposes to establish a 'research funding' taskforce consisting of a group of 4-6 people who will act as peer-reviewers for grant applications developed within the department. The aim of this taskforce is to encourage collegial support in the development of grant applications. In parallel to the PhD peer-review colloquia, which take place twice per academic year, this taskforce could organise two peer-review colloquia per year, where those preparing grant applications can present their work, offer feedback and receive feedback from those who are on the 'taskforce' committee, as well as one or two external guests with special expertise related to the topics of the proposals under development. Those who visit the department as Theory Fellows could play a role in such events as well – if the programme is continued. (RQ, V)

6.2.5

HR POLICY

- Close attention will be paid to diversity in the department's future hiring policy. The 'quirks' that exist within the cohort of researchers will be addressed (or at least considered) when new appointments are made. Dirk van den Heuvel, the department's equity, diversity and inclusivity representative, will play an active role in this endeavour. (V, SR)
- Given the success of the Theory Fellowships, the department proposes to extend the programme for (at least) another three years. (RQ)

6.2.6

OPEN SCIENCE

- The Department of Architecture will continue to support the open-access publication of its research outputs and divulge its research findings through exhibitions, contributions to professional journals, and public (and social) media. (SR, V)
- One of the department's new flagship projects is 'The New Open', which seeks to explore the role of open data for design and social change. This project aims to unite the theory and practice of open data design development by connecting cross-disciplinary practitioners in the fields of architecture, design, AI, tech, and environmental research (see: <https://www.newopen.design/>). For more information, see appendix 1. (RQ, SR, V)





ARCHITECTURAL ENGINEERING + TECHNOLOGY

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SUMMARY

THE DEPARTMENT OF ARCHITECTURAL ENGINEERING AND TECHNOLOGY (AE+T) MUST, BY DESIGN, PERFORM A BALANCING ACT BETWEEN ENGINEERING SPECIALISTS ADDRESSING TECHNICAL ASPECTS OF MATERIAL SCIENCE, HEAT TRANSFER, MECHANICS AND INDOOR HEALTH AND DESIGN GENERALISTS COMBINING THE ARCHITECTURAL DESIGN OF NEW OR REUSED (HISTORIC) STRUCTURES AND FAÇADES WITH THE POSSIBILITY OF ADVANCING THE ENGINEERING FIELD.

What unites our specialists and generalists is that all societal challenges in the built environment have a substantial technological component.

We must educate and persuade generalist architects and specialist building technologists to collaborate in resolving these challenges. Therefore, shaping such collaboration and interaction is foremost on our minds. However, while recognizing that human and societal aspects are critical and reaching out to involve scientists with the required expertise, we remain true to our focus on engineering and technology.

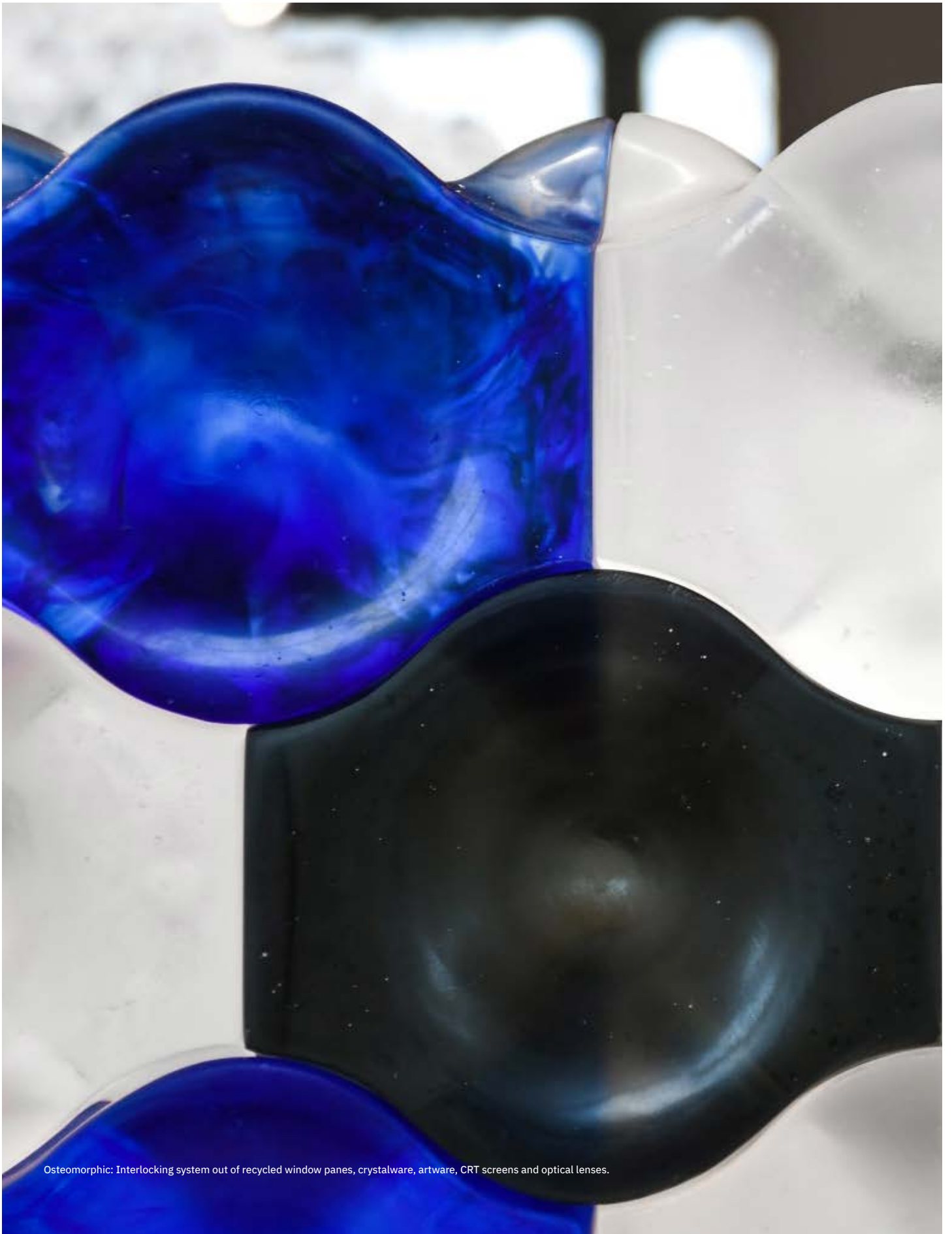
Our mission is to advance technology to enable the design of a better-built environment considering our planet's finite resources and with added value for people and nature. To achieve this goal, we aimed at developing excellent research content and output through interdisciplinary collaborations that address the complexity of the built environment; while maximising our impact through valorisation and external visibility to reach different societal actors and building industry stakeholders.

During the current review period, 2016-2021, we worked on a strategy based on a collaborative academic culture that allows for individual development. Different research programmes were merged into one overall research unit at the department level to create an improved organisational research structure and facilitate closer collaboration. The people in our department are the ones that materialise our mission, and we take great care to attract the right experts and provide them with possibilities for academic growth. In alignment with our strategic plan to strengthen certain disciplines, we have appointed several full professors, professors of practice and assistant professors in tenure tracks who ensure the department's future. In addition, we worked on a more effective policy for the PhD candidate's selection and training.

Our output supports the transition towards a better-built environment if the knowledge is adopted not only by academics but also by key actors. Such actors are the policymakers, the planners and designers, the building industry and the users and residents of the built environment. To this end, it is crucial to develop design methodologies, demonstrate real-world implementation and collaborate with stakeholders to influence their practices. Our commitment to open access not only regarding scientific publications but also regarding data and education, such as the development of open online courses, supports this goal.

Internationally, our department is a recognisable and authoritative unit with expertise in building engineering and design and a desired partner in international consortia and committees. This recognition materialises in our research staff members being part of numerous international research and academic networks. We continuously seek to enlarge those networks and create strong links between industry and academia. The collaboration goes beyond dissemination activities and often includes setting up joint research projects and networks.

AE+T's investment in the topics of energy transition, climate adaptation, health and comfort, circularly, digitisation and heritage is a vital contribution to the sustainability of the built environment and, ultimately, life on earth. Operating within those broad topics are a variety of specialisms at regional to façade to interior and component scale. Specialisms that are confidently growing toward greater societal engagement through dissemination approaches that form a bridge of trust, knowledge and aspiration between specialists, industry, and citizens.



Osteomorphic: Interlocking system out of recycled window panes, crystalware, artware, CRT screens and optical lenses.

INTRODUCTION

THE DEPARTMENT OF ARCHITECTURAL ENGINEERING AND TECHNOLOGY (AE+T) IS BRIDGING THE DISCIPLINES OF ARCHITECTURE AND BUILDING SCIENCE AND ENGINEERING BY DEPLOYING AN ENGINEERING AND TECHNOLOGY-DRIVEN APPROACH TO THE DESIGN OF BUILDINGS.

This unique profile requires a multidisciplinary view on the design and materialisation of buildings, including aspects of climate design, energy use, heritage, values, comfort and health, computational methods and technologies, and circularity to support innovation. The focus is on both existing and new buildings to address the vast and complex building task. In that respect, the department comprises different disciplines which complement each other to benefit our individual and collective scientific development. A total of 287 department employees contribute to Research and Education on departmental and faculty levels with a constellation of expertise, methods and practices.

Since the previous review period ending in 2015, the previously established research programmes of Computation & Performance (C&P), Green Building Innovation (GBI), (a part of) Design & History (D&H) and (a part of) Geo-information Governance and Technology were merged into one overall research unit at the department level to improve the organisational structure for research and facilitate closer collaboration.

In the current review period, the department has grown by appointing new full professors and incorporating existing chairs. In 2018, the newly appointed professors were Tillmann Klein (Building Product Innovation), Ana Pereira Rodgers (Heritage & Values) and Uta Pottgiesser (Heritage & Technology). In 2019, Mauro Overend (Structural Design & Mechanics) and James O'Callaghan (Architectural Glass) were appointed. In 2021, Atze Boerstra was appointed Professor of Building Services Innovation and a new professorship in Timber Construction was announced. The new appointments ensure the continuity and repositioning of research and education in their respective academic fields.

Furthermore, three full professors and their teams joined our department in 2021: Philomena Bluysen (Indoor Environment), Laure Itard (Building Energy Epidemiology) and Peter van Oosterom (Geographic Information Systems technology). This merging resulted from the faculty's realignment, considering the affinity of the expertise, methods and synergies with the AE+T department.

Next to full professors, eight assistant professors following a tenure track (TT) have joined the department to strengthen different disciplines, ranging from energy, daylight and circularity to values-based design, artificial intelligence and GIS applications. The information presented in this report considers the changes that took place during the current review period, and the data are presented “in retrospect” (except for the funding figures in table 5.7). This approach means that we include the output and accomplishment of groups that were not part of the AE+T department in 2015 but were by the end of the review period.

The AE+T department is structured into four sections, each consisting of several chairs (Figure 1.1). The scientific staff is also organised into research groups related to the research topics, methodologies and expertise; a content-driven structure better interaction and mutual support between the researchers.

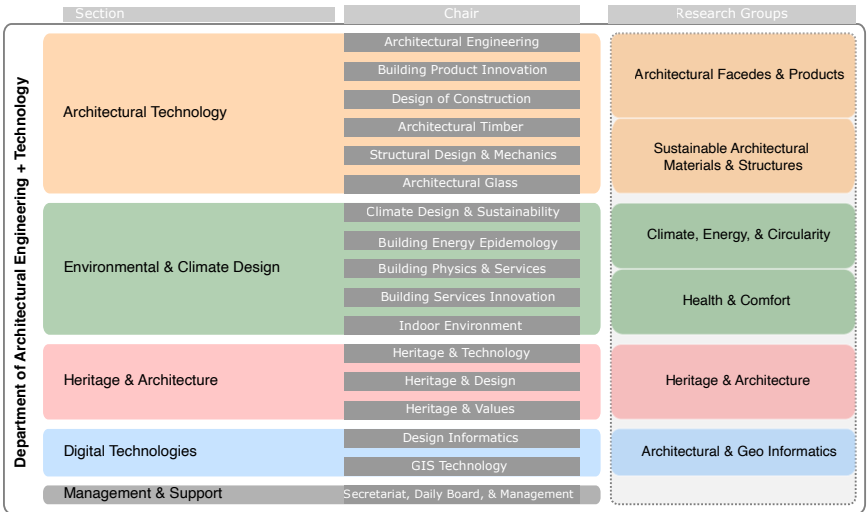


FIG. 1.1
 AE+T department structure relating to sections, chairs and research groups.

FIG. 1.1

The department head leads the broader department dialogue, the decision-making process and fixed meetings, such as the management team (MT) and the strategic board (SB), the scientific development/positioning (research/education/valorisation portfolio) and the operational functioning of the department, as well as representing the department to the faculty, university, and the external world. Supported by the daily board (DB), the department head is also responsible for the operational management of the department as well as the financial administration and reporting, operating within the applicable rules and procedures and the general framework of policy and management of the university and the faculty, accountable to the dean.

All topics formally mandated by the department head, including the allocation of staff and financial resources, are discussed and collectively decided on by the AE&T management team (MT). The MT consists of the department head, department manager*, four section leaders, the education and research coordinators, and the HR* and finance* officer (the asterisk indicates non-academic staff). The section heads are responsible for academic matters, operational and HR management of the section and financial administration and reporting, in line with the department. They coordinate

the decision-making process across the section and are required to take part in departmental management team decisions on behalf of the section. AE+T's strategic board (SB) includes all professors and portfolio holders of the department. The SB meets approximately four times a year and is the department's scientific think tank and platform that exchanges ideas and advises on the department's policy, strategy, positions and goals. Finally, department-wide meetings are held regularly to involve and interact with all department staff members.

1.1

FEEDBACK FROM PREVIOUS REVIEWS

This section highlights the critical comments and recommendations received by the review committee in February 2017 regarding the research of the period 2010-2015. At that time, the faculty was organised in research programmes. What today constitutes the AE+T department research unit was spread over four research programmes. The feedback from the Mid-term Review in 2019 is also taken into account, as it helped shape the strategy of the current review period.

The committee discussed the ambition to be recognised by the building industry and research funding institutes as partners for sustainability and innovation research. The recommendation was to cherish, maintain and advance the relevant relationship and collaboration with the AEC (Architecture, Engineering and Construction) and the building policy sector, as well as the benefits from the interaction with the students involved in the research, as it is a valuable way to contribute to the proper mindset of students. The mid-term review in 2019 acknowledged the success of the AE+T department in combining research and education in the field between architecture and civil engineering and maintaining high societal impact through strong relations with relevant stakeholders, especially the industry.

The recommendations further focused on the synergies and integration between programmes and new chairs. In particular, merging the programmes GBI and C&P was proposed to facilitate collaboration and steer strategic research towards technological advances. In some programmes, the reviewers identified a lack of critical mass (DH and Geo) and suggested reconsidering the programmes' structure and strengthening internal collaborations. Regarding administration, the complexity of handling budgets and employing scientific staff was seen as challenging. Recommendations to reduce administrative workload included seeking administrative support in managing research projects at a supra-research group level. In addition, the mid-term review committee suggested less organisational and management burden by reducing the many protocols in place. Finally, the review outlined the lack of laboratories and equipment and addressed the need for additional space for (large-scale) testing. The mid-term review further recommended developing a funding strategy for long-term maintenance and upgrading new facilities.



Double Face | A lightweight, adjustable, optimized Trombe wall based on phase change materials and additive manufacturing

MISSION AND STRATEGIC AIMS OF THE PAST SIX YEARS

FOR ARCHITECTURAL DISCIPLINES, THE COMING DECADES WILL BE MORE IMPORTANT THAN EVER. BY THE YEAR 2050, PER THE PARIS AGREEMENTS, THE ENTIRE BUILT ENVIRONMENT HAS TO BECOME CARBON NEUTRAL. THIS REQUIRES INNOVATIVE AND SUSTAINABLE DESIGN AND CONSTRUCTION METHODS AND, MORE IMPORTANTLY, A PRAGMATIC APPROACH TO THE EXISTING BUILT ENVIRONMENT, ADDRESSING QUALITIES AND VALUES.

Furthermore, striving for net-zero-energy buildings should be considered, simultaneously improving users' comfort and health.

In addition, partly because of the climate goals, but more so due to the depletion of valuable resources, supply chains must become more durable and circular, requiring a focus on existing buildings, innovation in building products and materials and new ways of manufacturing, assembling and disassembling. Society and the built environment are more complexly organised in networks of different scales. Computational technologies and methods will enable smart buildings and cities to deal with this complexity. Digitalisation will lead to a paradigm shift in design and building processes. Hence, the traditional ways of designing and engineering are coming to a close; they should be left behind with new élan, providing hope, opportunities and improved living conditions.

DEVELOPMENT OF MISSION AND STRATEGIC AIMS AND ALIGNMENT WITH THE UNIVERSITY AND FACULTY THEMES

In conjunction with the Strategic Framework 2018-2024 of TU Delft, we developed our own departmental strategic plan for the years 2018-2024. This plan has been the driving force behind the research mission and strategy of the current review period. We aim to increase the outcomes of our research to reach a higher “Impact for a better society”; the motto of the university’s Strategic Framework. We recognise the challenges outlined by the faculty in the Multi-annual plan, particularly with regard to Urban Inequality, Climate Crisis and Scarcity of resources. Furthermore, our faculty has formulated six perspectives and strategies along which teaching and research are categorized, namely Sustainable Urbanisation, Healty Cities, Heritage Futures, Digitalisation and Artificial Intelligence, Climate Adaptation & Energy Transition, and Circularity in the Built Environment.

AE+T is taking that responsibility seriously and provides the means and insights to tackle the following societal challenges, which are aligned with our faculty’s strategy:

- The transition towards a sustainable built environment for new and existing buildings, addressing climate adaptation and mitigation;
- The transition towards a circular economy;
- The need for a healthier and more comfortable built environment;
- Best performing buildings and cities by means of informatics methods and techniques.

Hence, we envision the Department of AE+T to be world-leading in innovation for a sustainable and healthy built environment, developed through knowledge-based design and supported by digital technologies, which are key research domains within the Department of AE+T.

MISSION

At AE+T, we have formulated our vision as follows: “Meeting the demand for better buildings considering our planet’s finite resources.”

A vision that translates directly into the department's mission: Through integrated research and education in architectural engineering, we advance technology **to enable the design of a better-built environment considering our planet's finite resources and with added value for people and nature.**

2.3

STRATEGIC AIMS

To achieve our mission, we have set a number of strategic aims, which are relevant from different perspectives, both individual and collective. The following strategic aims collectively contribute to the key aspects of academic culture, open science, human-resources policy and PhD policy and training.

DEVELOPING EXCELLENT RESEARCH CONTENT, WHICH:

- Is beneficial to our individual and collective scientific development;
- Facilitates interdisciplinary collaborations between specialists where needed to address the complex nature of the built environment;
- Allows a holistic and unique approach to span architecture and civil engineering.

FOSTER FRUITFUL COLLABORATION AND BEHAVIOUR TO:

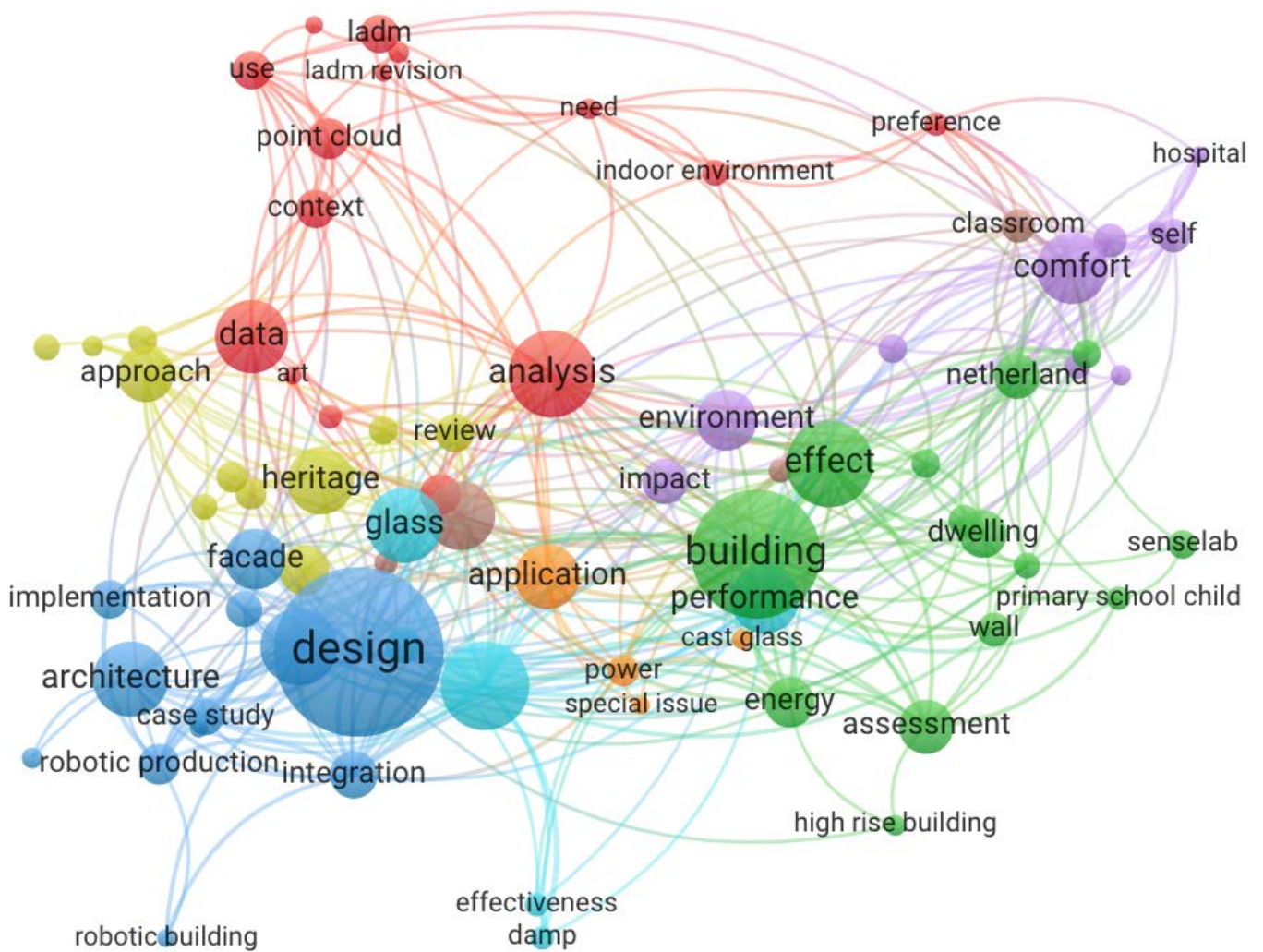
- Nurture the sense of belonging within a team, engaged in the daily routine, whilst receiving the benefits of being associated with a larger organisation;
- Reduce internal competition while encouraging mutual understanding and respect;
- Capitalise on the combination of our expertise in organising and delivering research and education;
- Facilitate a supportive relationship with other departments/faculties.

PROVIDE A MEANINGFUL ORGANISATION, WHICH:

- Allows independence and academic freedom whilst respecting the organisational framework;
- Enables challenge-responsiveness and the sharing of organisational burdens;
- Allows having the 'right size' and having enough carrying capacity;
- Facilitates internal and external communication;

MAXIMISE IMPACT THROUGH VALORISATION AND EXTERNAL VISIBILITY TO:

- Strengthen individual visibility affiliated to strong community;
- Support innovation in the synergy between the disciplines;
- Form a stronger, clearly identifiable entity with more leverage over external society actors;
- Attract top talents and excellent students.



The network of AE+T topics, as extracted from the publication titles (source: VOS viewer).

Key topics such as design, performance, energy, comfort, façades, glass and heritage are identifiable, as well as links between those clusters.

STRATEGY OF THE PAST PERIOD AND PROCESS

3.1

ACADEMIC CULTURE

In AE+T, we share the enthusiasm and passion for making a difference in society through our diverse disciplines of the built environment. The faculty members' and researchers' shared attitude and behaviour are content- and quality-driven, aiming for excellent research output that reaches the correct society actors.

We achieve that by bringing together people with different expertise in the broader building design and engineering field. We practice an open and inclusive culture; teamwork is promoted, and the input of individual researchers is valued. Researchers are encouraged to take the initiative and develop their direction and expertise, further strengthened by integrating different disciplines within the department. Various research proposals and awarded grants have been collaborations between the different research clusters within the department, where the researchers have the opportunity to develop joint research output and learn from each other. Despite the diversity of research approaches, we discuss the different scopes and replace unconstructive internal competition with synergies.

Research integrity is embedded in our academic culture. In accordance with the Netherlands Code of Conduct for Research Integrity and the Strategic Framework 2018-2024 of TU Delft, our department supports and facilitates good research practices. Good practices start with the design and execution of research and continue with reporting and communication. Such practices include selecting relevant research questions and methodologies that can produce valid scientific results, requiring ethical approval – particularly when the research includes human subjects – and making research data, collection methods and results public and crediting them to

the contributing researchers. Our scientific staff are aware of those practices and are committed to follow and educate master students and PhD candidates about them. Regular communication about ongoing research within the department contributes to maintain the high-standards, as it constitute a peer-assessment of research integrity.

The topics we address have evolved over time but have always maintained the same overarching themes with high societal relevance. The strategic selection of research lines derives from funding and collaboration opportunities that appear to be interesting, relevant and fit our expertise. Our long-standing tradition of operating closely with industry stimulates a two-way interaction with practice; design and construction issues create research questions, while our results can be applied to advance the building industry practice. Our research is characterised by a focus on application, implementation and high technology readiness levels.

3.2

HR POLICY FOR GROWTH OPPORTUNITIES AND CAREER DEVELOPMENT

Recruitment of new staff members is fundamental to maintaining our high-quality and high-impact research output. As mentioned before, several new full professors joined the department, aiming at providing expertise and continuity to research and education, but also critical mass to the department, particularly following the merging of the research programmes.

Another strategic development was to appoint industry-affiliated professors. These are experienced and well-recognised practitioners who are integrated into the department with small appointments to bring their expertise, experience, practical perspective and professional networks to our department, benefiting research and education. Shining examples are James O'Callaghan, famous for pushing the boundaries of materiality, performance, form, energy, and the aesthetics of architectural glass and Atze Boerstra, an expert on building services, health and comfort, with years-long experience in consulting and participation in international organizations.

The development of our department has greatly benefited from the faculty's tenure-track (TT) programme. Between 2016 and 2021, eight tenure-track assistant professors joined our department with a provisional temporary contract of 6 years and the intention to get tenure after five years upon reaching their performance goals. Additionally, 4 TTs hired before the current review period were positively evaluated and received tenure. The hiring process was part of the strategy to strengthen certain disciplines and research and education themes. The recruitment focussed on the expertise and the personal qualities of the candidates, whom we see as an investment for the department's future. The TT policy aimed at attracting top talented young academics whilst increasing the independence of young staff.

Next to the recruitment of new research staff members, the university has a process in place to offer internal career paths. The objective is to keep talent and provide career development options for our existing staff, who are invested in our department and show excellent performance. Ten department members were promoted to higher academic ranks during the current review period. However, those possibilities have mainly been implemented in the junior academic staff environment, such as promoting PostDoc researchers to assistant professors and assistant professors to associate professors.

Regarding gender balance, of the staff working in the AE+T department as of 1-5-2021, 65% identify as men and 35% as women. Based on fte numbers, the department has seen an increase from about 30% women in 2015 to about 40% women in 2021. Particularly for research staff, approximately 50% of the PhD candidates, 30% of our assistant professors, 50% of our associate professors, and more than 35% of our full professors are female (see Appendix, Table 1 for year-on-year development). Even though a complete gender balance has not been achieved, we have been making progress and are determined to do better. The department AE+T fully adheres to the DEWIS mission to reach a male-female ratio that more accurately reflects society and adheres to the TU Delft diversity policy. Whenever possible, we take advantage of opportunities to improve gender balance, such as the TU Delft Technology Fellowship, which offers high-profile tenure-track positions to outstanding female academics. During the current review period, Prof. Bluyssen, assigned through the fellowship in 2012, got tenure. We have also put gender balance in the foreground of the recruiting process, ensuring that female candidates are included in the shortlist. It is worth highlighting that half of our tenure-track assistant professors, employed mainly during the current review period, are female. This is a significant achievement since the current tenure trackers are the future of our department.

Regarding the organisation of the department's research staff, we have been adhering to the classical chair model. In contrast, relevant national and university policies have changed in favour of a principal investigator (PI) model, where junior scientists have significant independence earlier in their careers. We try to balance coherence and collaboration with individual excellence. Tight-knit groups and industry-oriented engineering departments gravitate towards collective approaches. A consequence of this structure is that the department is lagging in personal grants. Many successful funding applications are developed and executed by junior staff. However, the chairholder often leads the proposal, which may hinder the career development of our junior staff. Identifying the structure that best supports junior academics is an ongoing process. A PI structure has the potential for personal development but might impede collaboration. In 2019, the department had extensive discussions on the advantages (more visibility for young talents, more flexibility for exploring new themes and embracing new developments) and the disadvantages (pressure on integration of education and research, pressure on distribution of organisational tasks, dependence upon external funding, risk of research being scattered and difficulty to grow within one domain) of the PI-model. This led to a kind of middle ground. During the review period, we followed a hybrid setup, where the professor is leading the chair, but should allow freedom for individual development (serving leader model). Younger researchers are encouraged to define their goals early and to be in control of their own development.

OPEN SCIENCE

Open science has developed to be a priority and has been actively stimulated at all levels to make the research of the AE+T department as widely available as possible. Our output's research integrity and impact have benefitted from the university's Open Access and Data Management policy, which we have embraced and taken full advantage of. As a result, open-access publications are continuously growing in numbers, accounting for over 90% of our publications in 2021 (Appendix, Figure 1).

Understanding the importance of open access has been underpinned by the open-access scientific journals (Appendix, Table 12) that members of our department have established and continue to publish as editors-in-chief. Such activities make our department a front-runner in promoting open access.

Furthermore, the researchers are requested and trained to submit a data management plan at the beginning of projects and are directed towards open-access publications and repositories. The department also stimulates the publication of codes developed as open-source software.

Last but not least, the department has been very active in creating and promoting online courses (Massive Open Online Courses MOOCs). Appendix, Tables 17-18 provide an overview of the online courses developed by members of our department. The material in those courses is licenced under open-access licences, further disseminating open science and knowledge.

PHD POLICY AND TRAINING

Our PhD candidates are paramount for our research output, as they are the force behind much research development. Therefore, the selection of PhD topics and PhD candidates is instrumental. There are different approaches to recruiting PhD candidates. Firstly, PhD candidates are employed through vacancy announcements, mostly funded by research projects. To reach those candidates, we use our network and the standard dissemination channels of the university. Secondly, there are several “homegrown” PhD candidates; students coming from our own master's degree courses, continuing their academic development as PhD candidates, often with own funding or employed in research projects, or already working in the department as researchers or teachers and developing their PhD research in parallel with their other duties. Finally, we have a regular inflow of open applications. Candidates with a global background are attracted by the department's international reputation and research excellence, bringing their own funding to conduct PhD research on their proposed topic, fitting the department's interests. The different approaches create a diverse and international group of PhD candidates that benefits our department with its different expertise and experiences.

Even though the employment status differs between the PhD groups, as some are paid department employees while others are guest researchers, they all have the same opportunities and obligations as PhD candidates.

A PhD selection committee is in place to ensure excellence in PhD candidates and the relevance of their topic to the department and societal challenges. Consisting of research staff members with varied expertise and ample experience in PhD supervision, the committee evaluates the quality of the open applications and helps in finding adequate supervisors. The committee's tasks have recently been extended to the vacancy candidates, with a committee member involved in the hiring process. To improve the effectiveness of the PhD selection evaluation, we have taken steps to clarify the requirements and obligations of the different PhD candidate types. Moreover, we are developing content themes that are broad enough to allow flexibility but specific enough to enable targeted research development within the department themes.

Once the PhD candidates are accepted, they must follow the requirements of the university and faculty's graduate school (GS), which includes participating in doctorate education courses and yearly development milestones. The department fully engages in the GS structure, as we consider it a solid baseline for development and support for the community of researchers.

Lastly, restructuring the department's office space and relocating all PhD researchers to one room has strengthened the PhD community. The physical presence in the same room enables the exchange of ideas and experiences, which greatly benefits the development of the researchers, and, consequently, the department. However, the connection with the rest of the scientific staff and the department activities has been limited, and extra care from the supervision team is required to ensure that the PhD candidates are included in the group development, for example, with regular PhD colloquia and events.

Overall, these strategies have improved the PhD trajectory, as proven by the increase in the percentage of PhD candidates graduating before five years and a decrease in the number of discontinued PhD projects (Table 5.8.).

3.5

BK-LABS AS RESEARCH FACILITIES

The assessment committee mentioned the unfortunate lack of laboratory space in 2016. In the last six years, the situation of the laboratories at AE+T has evolved considerably: new laboratories have been set up (Sustainable structures lab, Glass lab, Heritage & Technology lab, Genesis lab), and some have moved to AE+T (SenseLab, Geo-Database Management Center lab), while others have further broadened and developed (Laboratory for Additive Manufacturing in Architecture, Virtual Reality lab and Robotic Building Lab). More details about the labs, research projects, output and collaborations can be found in Appendix 4.

The next challenge was to develop a sustainable model for the creation, operation and maintenance. Funds for laboratory equipment have been mostly acquired via external funding of national, international and industrial (so-called 2nd and 3rd money stream) research projects. As the acquisition of laboratory equipment strongly relies on granted projects, the lack of structural funding to maintain these facilities has been addressed by the lab coordinators in collaboration with the faculty administration. Starting from 2022, when involving safety-related issues, maintenance is taken care of at the faculty level. The same applies to adaptations to the building possibly needed for new equipment. Other maintenance costs, as well as consumables, are budgeted and approved at the section level in collaboration between the lab coordinator and the section leader, considering both the needs of the lab and the acquired external funding.

Moreover, actions have been taken recently at the faculty level to facilitate the organisation and collaboration between the laboratories: e.g., several labs have been clustered at one location in the building, easily accessible and visible to visitors; meetings among AE+T lab coordinators have been organized; some facilities, such as those related to safety and laboratory personnel, have been reorganised and clustered at the faculty level to provide higher flexibility and resilience. As a result of these actions, the AE+T laboratories have overcome their initial fragmentation and moved towards a synergistic, interdisciplinary collaboration. They have become a place to share knowledge and fertilise ideas across several disciplinary fields. The AE+T laboratories, part of BK-Labs, have the common aim to support research and education in answering the questions posed by a rapidly changing society.

3.6

COLLABORATIONS

Collaborations, both internal – within the department, faculty and university – and external – outside the university – have been a noteworthy strategy for our research development and the accomplishments of our research mission. The current review period started with restructuring the research programmes and merging them into one research unit. Strengthening internal collaborations was the main motivation behind those actions.

The department also actively participates and has a leading role in strategic faculty and university-wide and supra-university groups, such as the cross-faculty theme of 1M Homes, the Circular Built Environment Hub (CBE), the TU Delft Climate Action Programme, the Green Village (a living lab on TU Delft's campus) and the Amsterdam Institute for Advanced Metropolitan Solutions (AMS institute, a collaboration between TU Delft, Wageningen University and Research and MIT). CBE was initiated and is led by members of our department. Moreover, members of the AE+T department lead two out of the six themes of the TU Delft Urban Energy Institute (UEI), a university-wide initiative to support a rapid, just and equitable transition to a carbon-free built environment. Furthermore, as part of the Climate Action Programme, prof. Andy van den Dobbelsteen was appointed as TU Delft's sustainability coordinator. In addition, the department is leading one of the flagship projects of the TU Delft Climate Action Programme: Cool and Clean Buildings.

A faculty-level initiative, related to the perspectives and strategies identified in the Multi Annual Plan, led to the creation of twelve PhD positions supervised by tenure trackers paired with promoters from a different department than theirs. The AE+T department engaged in this research and collaboration framework of the faculty and, as a result, we received two new PhD positions while being involved in supervising other departments' PhD candidates. This is challenging as the PhD candidates need to be skilled in multiple disciplines and need to identify innovation in more than one field. However, the scheme is successful in bringing together disparate research groups within the faculty and in promoting high-level innovation that could never happen in research silos.

Internationally, our department is already a recognisable unit with expertise in building engineering and design and a desired partner in international consortia and committees. This recognition materialises in our research staff members being part of numerous international research and academic networks.

We seek to continuously expand these networks and create strong links between industry and academia. The collaboration goes beyond dissemination activities and often includes the set-up of joint research projects and networks, such as with the façade industry association (VMRG) and the companies collaborating in the Solar Decathlon competition or the IEBB research project with 124 participating companies. Appendix 5 provides further insights into the role of such activities in the collaboration with external parties, as well as the synergies between research and education.

Establishing visiting professorships was another important action towards engaging with successful international professionals and academics. Even though lasting for a limited time, these activities were very advantageous for our department. The visiting professors were James O'Callaghan (before becoming a professor), Kasper Jensen (2018-2020), senior partner of 3XM (Denmark), Anne Lacaton from Lacaton & Vassal architectural office (France), Achim Menges, professor at Stuttgart University (Germany), Ben Croxford, professor at UCL (UK), Stephan Behnisch of Behnisch + Partner architectural firm (Germany), and Paul Kalkhoven, architect at Foster and Partners (UK).

3.7

VISIBILITY

While striving for significant impact to address societal challenges, visibility of our activities and output is key to engaging with relevant actors and bringing knowledge forward. Fostering for better visibility has also been a comment of previous research reviews. Visibility can be seen as internal (between the members of the department and the faculty) and external (towards other academic, industrial and societal actors). Of course, our activities aim at increasing both.

A clear path to make our research and our department more visible is through scientific output, in the form of refereed articles, conferences presentations etc. (see Table 5.9. for detailed numbers on research output). During the review period, our focus has shifted from professional publications to peer-reviewed scientific articles, the number

of which has been steadily increasing. Our research on the current issues of energy transition and health and comfort in the built environment, as well as our outstanding innovations attract a lot of attention, resulting in media appearances, exhibitions and awards (see key activities in Appendix, Table 8-16. The chairs on health and comfort have played a particularly significant role toward promoting a healthy environment. Various media appearances have brought issues such as Covid-19 spread through aerosols to the broader public. Moreover, physical interaction with schoolchildren and citizens in the Senselab informed societal actors about the importance of indoor air quality.



FIG. 3.1

FIG. 3.1

SenseLab

Primary schoolchildren exposed to different environmental conditions in the Experience room of the SenseLab, while following a workshop on how to improve the indoor environment in their own classroom (spring 2018).



FIG. 3.2

FIG. 3.2

The Glass Zip Truss

Extruded glass structure, exhibited during the Dutch Design Week, 2021.

With regard to internal visibility, we have tried to keep each other updated on our research findings and activities. One approach was to organise regular meetings where all scientific staff was invited and had the chance to discuss the latest developments, share ideas and discuss our departmental research output and strategy. Since September 2020, those meetings have been moved online and scheduled monthly to compensate for the limited contact due to COVID-19 restrictions. Although not replacing the regular formal and informal meetings on campus, those monthly meetings were important in keeping our research visible to existing and new colleagues.

Another aspect is physical visibility. Our work is highly visual. Next to scientific output, we work with modelling and real-life prototyping, which becomes a visible focal point to the university and the wider public. One example is the Product Development (PD) Test Lab, which was designed as part of a two-year research project built by students on our faculty's site. The lab is open to researchers, teachers as well as students and others interested in using the building. In our efforts, we have engaged the possibilities offered by the Green Village, a space open to the public that exhibits research results, such as the prototypes of the Solar Decathlon exhibition, the PDLab, and experimental living labs.

Finally, as part of knowledge accessibility and dissemination to a broader audience, we are emphasising the development of online courses, such as Massive Open Online Courses (MOOC) and professional education courses (ProfEd). In the last years, we have developed an ever-expanding portfolio of online courses (Appendix, Table 17-18), covering a range of topics that our department works on, including circularity, design and engineering, energy and comfort. Promoting life-long learning by making knowledge accessible to a broader audience and professionals is a priority. Not only has it contributed to informing society, industry and policymakers, but also to expanding the visibility of our department and university, establishing us as experts on those topics.



FIG. 3.3

FIG. 3.3

The PD Lab

..while being transferred to the Green Village.
After it was built and stayed on our faculty's site for three years, it was installed in the Green Village, where it can be visited and used as a meeting room and test ground.



FIG. 3.4

FIG. 3.4

The Co-Creation centre at the Green Village

A location where different societal and industry actors can come together for events while being able to visit the various prototypes on site.



Salt efflorescences on repair mortar applied on tuff stone

INDICATORS

FOR OUR DEPARTMENT'S SELF-EVALUATION, THE INDICATORS WE LOOK AT REFER BOTH TO SCIENTIFIC AND SOCIETAL IMPACT, IN ALIGNMENT WITH OUR MISSION TO MEET THE DEMAND FOR BETTER BUILDINGS CONSIDERING OUR PLANET'S FINITE RESOURCES. TO ACHIEVE EXCELLENT RESEARCH QUALITY, WE NEED TO MEET THE NEEDS OF SOCIETY, AND OUR RESULTS SHOULD BE ADOPTED BY THE RELEVANT SOCIETAL ACTORS.

In that respect, the indicators relate to the products of our research and their use, both by the scientific community and society in general. The scientific impact can be measured by the research output in the form of publications and PhD dissertations. It is also indicated by the participation in academic networks, projects and events, where we present our output contributing to the body of knowledge. Those indicators align with our first strategic aim to develop excellent research content. Moreover, the indicators demonstrate the recognition of the department's staff by our peers, leading to the awarding of research grants to further develop our research output and excellence, as well as the participation in editorial and academic network activities, which underpin our aim for collaboration and external visibility.

Most importantly, to maximise our impact, which is one of our strategic aims, and support the transition towards a better-built environment, we strive for the knowledge to reach and be adopted by key actors, such as policymakers, planners and designers, the building industry and the users of the built environment. To this end, developing design methodologies, demonstrating real-world implementation, and collaborating with stakeholders to influence their practices are crucial. Furthermore, the dissemination of knowledge through exhibitions and media appearances has the potential to reach a wider audience. Finally, a significant impact can be achieved through collaboration with institutional bodies that help shape policy-making.

TABLE 4.1 Categories of evidence for the quality domains of research quality and relevance to society

	RESEARCH QUALITY	RELEVANCE TO SOCIETY
Demonstrable products	Research products for peers	Research products for societal target groups
	Scientific publication	Concepts, methods and process designs, prototypes
	PhD dissertations	Real-world implementation
Demonstrable use of products	Use of research products by peers	Use of research products by societal target groups
	Collaborative research projects	Consultancy, bilateral and multilateral collaboration
	Publication of open-source software	Contribution to policymaking
	Awards	Exhibitions
Demonstrable marks of recognition	Marks of recognition from peers	Marks of recognition by societal target groups
	Organisation of international scientific events	Media attention, invitations for public communication events
	Editorships and Academic network roles	Participation in multi-stakeholder platforms (professional memberships etc.)

ACCOMPLISHMENTS DURING THE PAST SIX YEARS

5.1

CONTEXT

The department of AE+T actively collaborates with various specialisms to strengthen research networks and attain broader scientific knowledge and reach in the context of societal challenges. We follow an informal approach in which individual and invested connections between colleagues have generated research themes on which researchers, their chairs, sections, and the department focus. Long-established and trusted partnerships with the industry have been built upon those interpersonal relationships.

Methods of working “with” society rather than “for” society have grown in strength and uptake within our thinking. Research dissemination that transforms from a linear process of completion and publication to a circular metabolism in which diverse communities take a contributory living lab role. A shift that facilitates the exchange of knowledge, experience and feedback between local stakeholders and global experts. Ensuring that radical and complex concepts are understood from the outset.

The department nurtures and extends these themes, networks, and collaborations by identifying interfaculty opportunities. In staff recruitment, departing and new are interchangeable in personal motivation, amenability, and collaborative character. An opportunity to champion inclusion and diversity within our research culture was taken through TU Delft’s female fellowship scholarship.

An achievement bringing further reward is the SenseLab, the department's world-class indoor environment research facility, initiated by Prof. Bluysen. Sponsored by 25 companies and organisations, the lab's findings, numerous publications, and worldwide media interest have significantly contributed to combating the global spread of Covid19.

In 2017, a university-wide opportunity to promote an exchange of circular built environment knowledge was led and initiated by department researchers through the Circular Built Environment Hub (CBE), a multidisciplinary cross-faculty collective in which department specialisms combine with those of the departments of Urbanism, Management in the Built Environment and Architecture. Details about the CBE's approach and activities are described in Appendix 3.

5.2

CHALLENGE & COMMITMENT

Debates on climate change and its effect on cities and neighbourhoods are no longer topics up for discussion. Ratifications of the Paris Agreements have formally set out the challenge to nations, cities, neighbourhoods, buildings, specialists, and most significantly, humanity. The department of AE+T is committed to averting climate change and contributing to the well-being and other Sustainable Development Goals within the built environment through its interrelating themes and multi-scaled specialisms. It aims to be at the forefront of innovation, guidelines, and processes in supporting cities through their energy transition. Determined to better methods to evaluate the current and future environment, to better understand and communicate the challenges and solutions ahead.

5.3

APPROACH

The departmental facilities and equipment of the AE+T labs, our contribution to the architecture faculty's extensive portfolio of Bouwkunde (BK) labs, are a major factor in meeting those challenges, demonstrating research ambition, leadership, and global standing across academic and industrial communities. The Labs are a physical embodiment of our research endeavours. As custom-designed and industry-sponsored spatial entities, they serve to accelerate our understanding of indoor environments and the re-cyclability of bio-based and digitally manufactured building products. Each constitutes a highly visual flagship that showcases our communal, collaborative and open agenda.

Accompanying the BK labs, we have developed an increasing portfolio of living lab initiatives. The department has incrementally re-defined how we, as scientific researchers, can meaningfully engage with society. Steady progress has been made to adapt traditional research approaches to better negotiate a two-way dialogue with the current and future inhabitants of the intelligent and climate-responsive city. The living lab method has been successfully applied at various knowledge hotspots across TU Delft's educational landscape. At the Green Village, a TU Delft affiliated field lab for sustainable innovation, several full-scale building prototypes have been built: three award-winning Solar Decathlon projects and the Product Development Lab building are located there. Furthermore, AE+T has realized projects on the TU Delft campus, such as a 2600m² leasing façade at the Faculty of Civil Engineering and the research on the design of solar devices for the new TU Delft building PULSE. We also contribute to campus operations, for example, with the project Brains4Buildings, an artificial intelligence research focusing on fault detection using energy management system data of three campus buildings.

FIG. 5.1

PULSE Building research.

The department supported the design and execution of the new TU Delft Campus building. Studies also included the performance of sun shading, for which advanced computational optimization processes were applied to integrate daylight, structural and manufacturing criteria – later published in scientific papers.

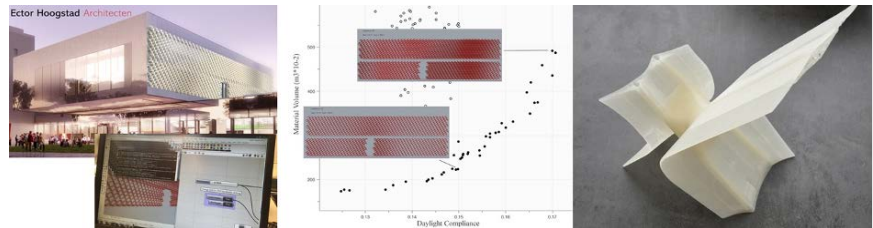


FIG. 5.1

Real-life and real-time rhythms and rituals of university life were creatively reimagined to effectively monitor, evaluate, and adapt interior and exterior building products and systems. The projects have been realized in collaboration with the industry and students, inspiring them and future researchers by immersing them in evolving innovation and adding value to research and education.

Next to the prototypes on campus, real-life prototypes and constructions demonstrate the implementation of our research. Within the framework of the KaDER project and together with the Province of Gelderland and the contribution of our students, a renewed policy framework for the province of Gelderland was worked out regarding a more sustainable approach to the conservation of built heritage. Another real-life implementation is the co-creative initiative described by the EU as a success story; The 2ndSKin façade live lab exploring minimum disturbance zero-energy renovations in twelve occupied apartments. The 2ndSKin project, being inherently collaborative, interdisciplinary and open access, achieved continuous research funding to bring together the public and the non-profit sector to accelerate the market uptake of products.



FIG. 5.2

FIG. 5.2

2ndSkin

Façade Refurbishment of multi-storey social housing, 2014-2019. Implementation and experimenting are important steps in research. During the 2ndSkin, we evaluated the construction process and resulting performance through the realisation of case studies, mock-ups and real-life implementation of the renovation.



Vehicles for outreach deployed by the department are symbiotically local and global in scale: active participation of families and their primary school children in studies to improve indoor air quality in state-of-the-art facilities; sustainability roadshows visiting cities and neighbourhoods across Europe to work alongside people of all backgrounds and ages to define a sustainable zero carbon city vision.

Instant communication and networking techniques, capable of meeting tomorrow's demands on society, are growing across the department's dissemination strategy. For example, SenseLab demonstrated rapid response in research action and media agility when answering the worldwide call to prevent the spread of COVID19 through the aerosol route. The sustainability roadshow live labs use various social media platforms to inspire citizens to be part of sustainable solutions. The department's Massive Open Online Courses (Appendix, Table 17-18) have created global networks of local people who wouldn't otherwise have the opportunity for high-level education. In 2020, the department was awarded the edX Prize for Exceptional Contributions in Online Teaching and Learning for the Zero Energy Design MOOC. With approximately twenty-five thousand learners to date for this course alone, it constitutes a demonstration of Zero-Energy Design research and education merging for educational added value and societal outreach.

Besides research into the critical societal needs, such as health and energy, we also conduct research that results in innovations to address specific niches in the building industry (like the glass research which is a front runner innovative for specific niche applications). Special explorative projects promote innovation, adding value to the visibility of the research in the built environment and the department's reputation and feeding back to the department with additional knowledge and creativity. Our department's research on 3D printing and innovative glass applications helped identify the potential and create pathways for practical implementation of such applications. In our role as a testbed for explorative technologies for the future, we have gained international recognition as innovation front-runners.

FIG. 5.3

Re3 Glass

Research on recycling glass waste via casting)
exhibited in the European Parliament

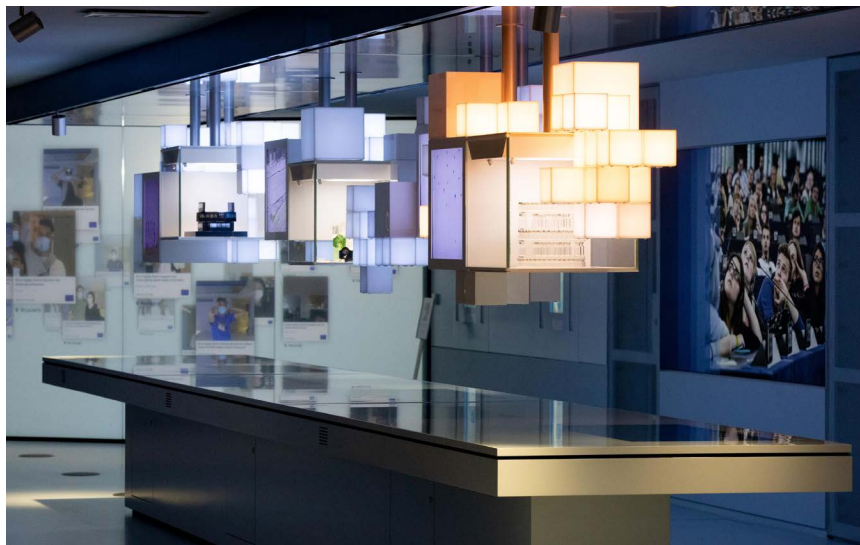


FIG. 5.3

Engagement with the public has also been achieved strategically through highly visual installations and prestigious events. For example, on the European political stage with a curated exhibition at the EU headquarters' Parliamentarium targeting the climate change challenge. Or the department's leading contribution to TU Delft's Solar Decathlon entries. Each sustainable house design for the Solar Decathlon competition is a travelling incubator of departmental research themes that dynamically and rapidly re-assembles in real-time in front of crowds of family homeowners, constructors, entrepreneurs, industrial sponsors, international media, researchers, students, and politicians.

5.4

RELEVANCE

Mapping societal relevance with our various specialist activities is a key objective. In our heritage-related studies, this relevance focuses on policymaking for the sustainable conservation & maintenance of buildings. Research achievements raise policymakers' awareness and responsibility by providing coherent rules for more effective funding policies. The sustainability roadshow works with policymakers across Europe, evidencing societal impact from Belfast to Nicosia in the short term through the mindset change of stakeholders and in the medium to long term in triggering such policies as Menorca's 2030 Decarbonisation Roadmap.



FIG. 5.4

City-zen

Ten roadshows were successfully realized as part of the City-zen project (2014-2020). EU commissioners have identified City-zen as one of the gems of the FP7 programme, specifically highlighting the roadshow methodology as a game changer in the process of the urban energy transition.

FIG. 5.4

Other policy influences relate to open science. Next to the increasing amount of open access research output, lighthouse examples of promoting open access are the department's well-established and internationally recognised scientific journals for façade design (JFDE) and architectural and building history, urban planning history, cultural landscape, and heritage (Bulletin KNOB). Next to publications, open access software and data sets allow others to understand the software, improve parts of the codes, and keep developing them by building upon it collaboratively. When integrated into education, it also helps engage students in applied examples of open science principles.

AE+T's investment in the themes of the energy transition, climate adaptation, health and comfort, circularly, digitisation and heritage is a vital contribution to the sustainability of the built environment, and, ultimately, life on earth. Operating within those broad themes are a variety of specialisms from regional to façade to interior and component scale. Specialisms that are confidently growing toward greater societal engagement through dissemination approaches that form a bridge of trust, knowledge and aspiration between specialists, industry, and citizens.

EVIDENCE BY NUMBERS

This section includes the quantitative data that supports the self-evaluation of the indicators, as explained in paragraph 4, and also supports the discussion about the strategy and the accomplishments during the past period. In particular, it presents information about the numbers of research staff, PhD candidates, funding and research output. Further quantitative data and an overview of key activities can be found in Appendix 1.

Refereed articles OA status 2016-2021 AE&T

Open Access Status

- Onbekend
- Closed
- Indeterminate
- None
- Open

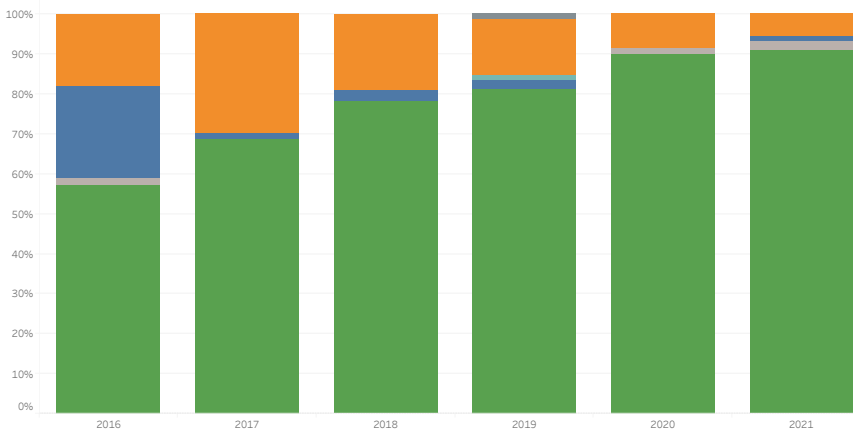


FIG. 5.5
Percentage of open access publications between 2016 and 2021

FIG. 5.5



FIG. 5.6
AE+T department in numbers

FIG. 5.6

RESEARCH STAFF

TABLE 5.6 Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities.

	2016		2017		2018		2019		2020		2021	
	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE
Scientific Staff	47	13	46	12.8	46	13.1	42	12.2	39	11.6	46	13.7
Full professor	14	3.2	12	2.8	13	3.3	14	3.5	13	3.7	16	4.3
Associate professor	10	3	12	3.6	14	3.8	13	3.7	11	3.8	10	3.4
Assistant professor	23	6.8	22	6.4	19	6	15	5	15	4.1	20	6
Researchers (incl. Postdocs)	32	14.4	33	15.7	27	10.5	28	9.9	27	9.0	31	16.0
PhD candidates	61	-	65	-	55	-	61	-	69	-	68	-
Total research staff	140	27.4	144	28.5	128	23.6	131	22.1	135	20.6	145	29.7
Visiting Fellows	22	4.5	26	7.3	33	6.5	32	6.7	28	7.4	21	4.0
TOTAL STAFF	162	31.9	170	35.8	161	30.1	163	28.8	163	28	166	33.7

Scientific staff: profiles HL, UD, UHD, permanent and temporary. **Researcher:** UFO profile OVWOZ (onderzoeker 1, onderzoeker 2, onderzoeker 3, onderzoeker 4, Post-docs), permanent and temporary. **PhD candidate:** standard PhD (employed) and contract PhDs (externally or internally funded but not employed).

Visiting fellows: employee group "Gast en GastWP", profiles HL, UD, UHD, OVWOZ (onderzoeker 1 t/m4).

Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities. The indicated number of FTEs takes into account that scientific staff and researchers are considered to spend respectively 40% and 80% of their appointment on research activities.

FUNDING

TABLE 5.7 Overview of funding and expenditure for the period 2016-2021.

	2016		2017		2018		2019		2020		2021	
	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
FUNDING												
Direct funding (1)	2,361	48%	2,334	57%	2,070	54%	2,563	58%	2,686	55%	2,915	49%
Research grants (2)	545	11%	726	18%	395	10%	319	7%	447	9%	975	16%
Contract research (3)	2,147	44%	1,295	31%	1,527	40%	1,716	39%	1,790	37%	2,149	36%
Own contribution	-275	-6%	-538	-13%	-333	-9%	-382	-9%	-397	-8%	-569	-10%
Other (4)	112	2%	302	7%	176	5%	235	5%	360	7%	497	8%
TOTAL FUNDING	4,890	100%	4,119	100%	3,835	100%	4,451	100%	4,886	100%	5,967	100%
EXPENDITURE												
Personnel costs	3,998	80%	-3,660	84%	-3,393	87%	-4,156	86%	-4,369	87%	-5,182	88%
Other costs	-974	20%	-681	16%	-516	13%	-653	14%	-672	13%	-721	12%
TOTAL EXPENDITURE	-4,972	100%	-4,341	100%	-3,909	100%	-4,810	100%	-5,042	100%	-5,903	100%
RESULT	-82		-223		-74		-358		-156		64	

Note 1: Direct funding (basic funding/lump-sum budget)

Note 2: Research grants obtained in national scientific competition

Note 3: Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, European organisations and charitable organisations

Note 4: Funds that do not fit into the other categories

PHD CANDIDATES

TABLE 5.8 PhD candidates' graduation time related to their year of enrolment.

ENROLEMENT			SUCCES RATE											
STARTING YEAR	MALE	FEMALE	TOTAL M+F	GRADUATED IN YEAR 4 OR EARLIER		GRADUATED IN YEAR 5 OR EARLIER		GRADUATED IN YEAR 6 OR EARLIER		GRADUATED IN YEAR 7 OR EARLIER		NOT YET FINISHED		DISCONTINUED
2012	6		6	0	0%	1	17%	3	50%	4	67%	1	17%	1
2013	4	2	6	0	0%	1	17%	3	50%	4	67%	1	17%	1
2014	6	2	8	1	13%	2	25%	3	38%	5	63%	2	25%	1
2015	4	1	5	1	20%	2	40%	4	80%	5	100%	0	0%	0
2016	4	4	8	2	25%	4	50%	4	50%	4	50%	3	38%	1
2017	6	4	10	1	10%	4	40%	4	40%	4	40%	6	60%	0
TOTAL	30	13	43											

The table includes PhD candidates enrolled in the period 2012-2017 who are expected to graduate in the review period, by 2021.

The expected duration of a PhD is four years.

RESEARCH OUTPUT

TABLE 5.9 Research output for academics and professionals.

	2016	2017	2018	2019	2020	2021
Peer-reviewed articles	56	67	74	79	71	91
Non-refereed articles	1	5	6	6	5	5
Books	4	-	-	-	1	5
Book chapters	14	15	17	14	10	22
PhD theses	8	10	7	4	8	13
Conference papers	94	81	89	62	42	62
Professional publications	56	48	40	29	16	29
TOTAL PUBLICATIONS	233	226	233	194	153	227
OTHER RESEARCH OUTPUT	69	78	121	43	54	56
Media contributions and coverages ¹	19	45	79	14	43	32
Editorial work ²	13	6	5	7	4	5
Memberships ³	9	9	18	10	3	2
Talk or presentation ⁴	28	18	19	12	4	17
TOTAL PUBLICATIONS	302	304	354	237	207	283

¹ Media contributions and coverages: appearances on radio/tv, interviews and written articles for papers etc.

² Editorial work: editorships of journals, member of the editorial board of journals

³ Memberships: memberships of committees, boards, councils, networks

⁴ Talk or presentation: invited, keynote speaker at a conference

CHANGES IN NUMBER OF SCIENTIFIC OUTPUT

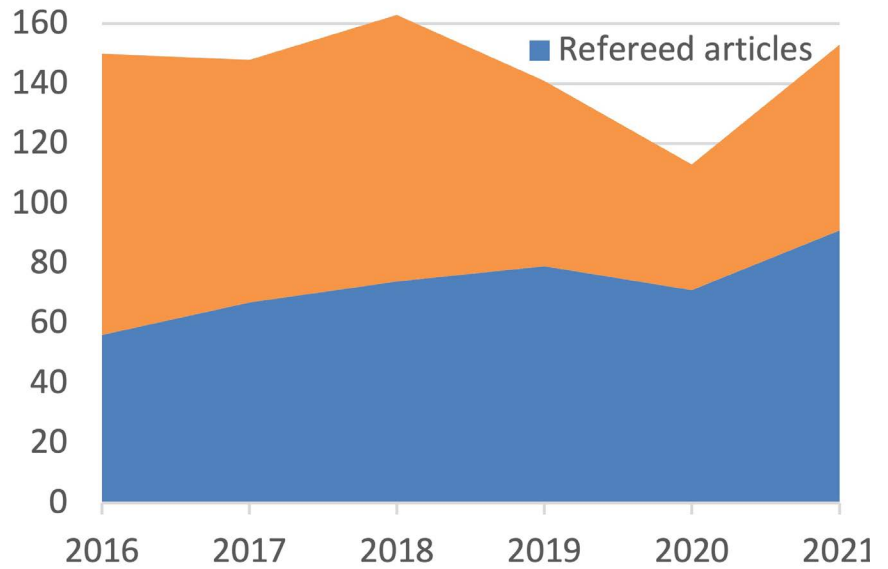


FIG. 5.7
Changes in the number of scientific output during 2016-2021.

CHANGES IN NUMBER OF NON-SCIENTIFIC OUTPUT

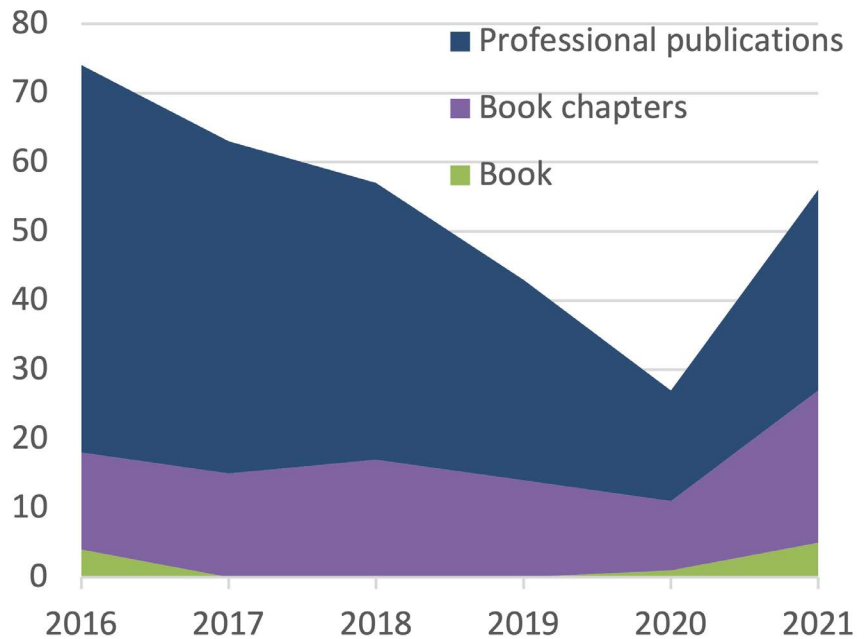


FIG. 5.8
Changes in the number of non-scientific output during 2016-2021.

DIVERSITY: GENDER AND NATIONALITY

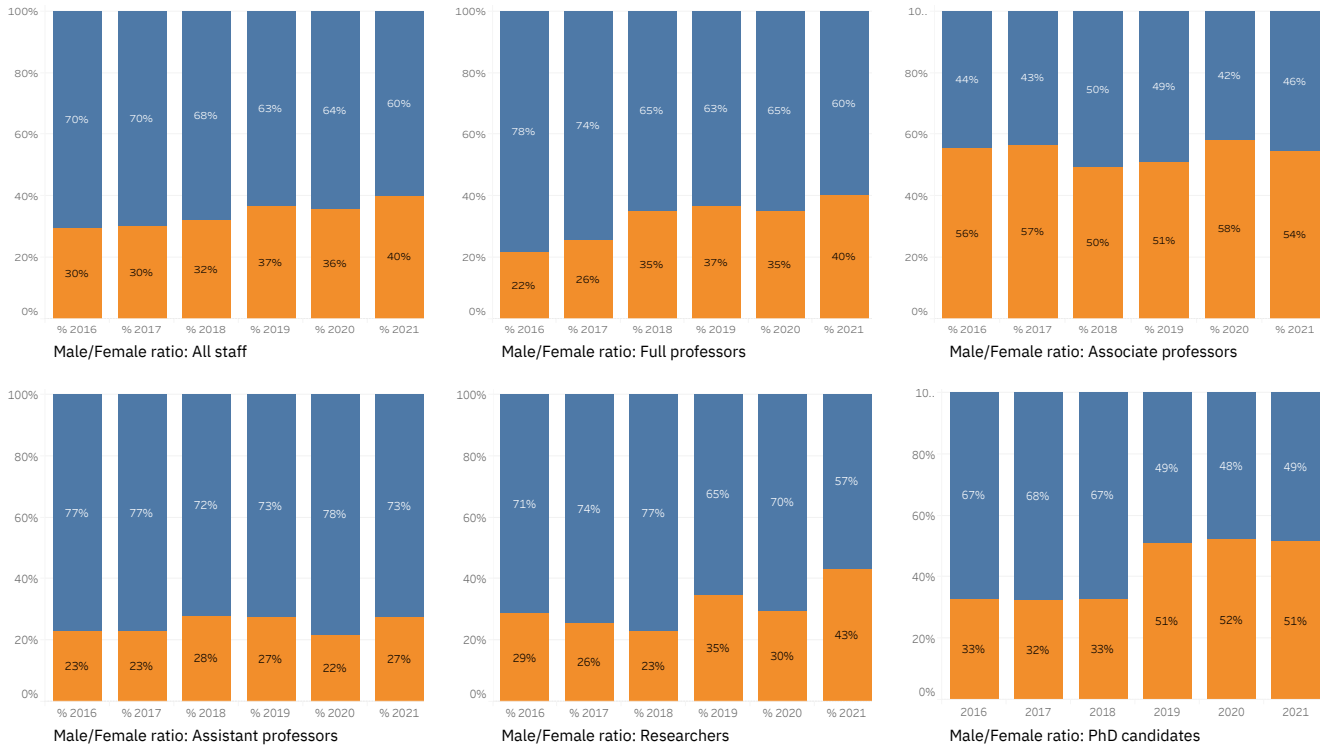


FIG 5.9 a-f Gender ratio faculty staff: Male (blue)/Female (orange)

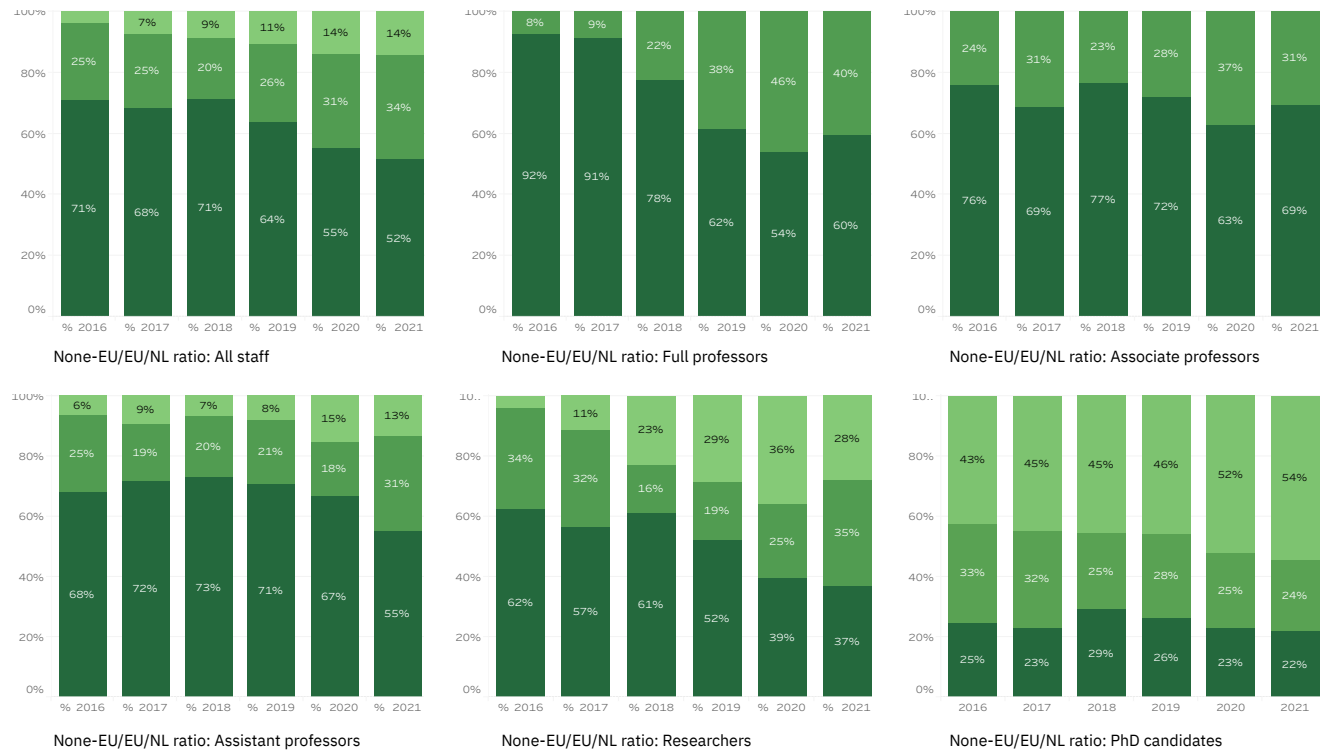


FIG 5.10 a-f Nationality ratio faculty staff: None-EU (light green)/EU (green)/NL (dark green)



2nd Skin | Façade Refurbishment for Multifamily Social Housing. Credits image: Marcel Bilow.

STRATEGY FOR THE NEXT SIX YEARS

6.1

SWOT ANALYSIS

A SWOT analysis was conducted as part of defining the future strategy of the AE+T department. The analysis presented below is the result of discussions and brainstorming within different groups, including faculty members and research staff, that took place in early 2022.

STRENGTHS

- Expertise covering both design and technology;
- Strong alignments with societal challenges, like energy transition, climate adaptation, circularity, digitisation;
- Inter-disciplinarity and synergies within the department's expertise;
- Strong link between Research and Education;
- Applied research, Prototyping and experiment;
- Steady increase in scientific output;
- Good connection with external parties (municipalities, housing associations, industry);
- Societal relevance of expertise and research themes;
- Well defined Research groups, communicative, approachable and accessible for collaborations;
- Diverse research project portfolio from various funding streams;
- Well connected to the structured and organised PhD training and development (e.g. Go/No Go process, yearly review), supported by the Graduate School;
- PhD selection committee that evaluates the PhD candidates' applications;
- Internal career possibilities and paths are flexible in creating multiple career paths.

WEAKNESSES

- Some fragmentation and lack of overview because of the department's size and diversity;
- High complexity of research administration;
- Lack of personnel capacity and support for acquisition (e.g. leading a big EU proposal);
- Limited time for strategic planning and shared long-term vision;
- High work pressure leading to lower effectiveness;
- Heavy teaching load, where research often comes second;
- Synergies in the department are not utilised to their full potential;
- Limited possibilities for young talent in research;
- Difficulty in keeping a balance between continuity in research (lifelong contracts) and flexibility in contracts;
- Limited staff mobility (PostDocs, sabbaticals, exchange programmes).

OPPORTUNITIES

- Availability of funding opportunities, due to close alignment with relevant societal challenges;
- Strong and extensive network with international and national organisations;
- Direct collaboration and funding from industry;
- International reputation of the faculty and the department, which attracts top talents and self-funded researchers/PhDs;
- Design and engineering are increasingly accepted as mature academic activities;
- Diversity in career paths, enabled by focus on impact and quality, e.g., with the DORA declaration.

THREATS

- Uncertainty of funding for research personnel and facilities;
- R&D culture and investments in the construction industry, creating difficulties in establishing large contract research project;
- Highly competitive national and international research funds. As a result, lower success rate and much time spent on writing research proposals;
- Collaboration with industry partners sometimes requires embargoes on knowledge because of IPR, preventing Open Science;
- “Missing the train as trendsetters”: Missing out on the latest developments.

MISSION

The department of Architectural Engineering and Technology (AE&T) is at the forefront of one of the most important challenges of the 21st century: meeting the demand for better buildings considering our planet's finite resources. This major challenge requires a fundamental shift in the way the built environment is valued, designed, built, exploited, maintained, transformed and dismantled. Our mission is, therefore, to contribute to a built environment with added value for people and the planet, in both a creative and intelligent way, through knowledge, experiment and design. Positive values derived from solutions based on renewable resources, sustainable, circular, healthy and digitally empowered.

We do this through an integrated approach that is inspired by and based on innovation in building technology, values-based decision-making, installation technology, construction, architectural and spatial informatics and design. This is combined with a keen eye for the more aesthetic, comfort- and health-related characteristics of the built environment.

In line with our vision and mission, our ambition is to operate as front runners in engineering innovations that enable architecture, bridging the different disciplines. AE&T's research is centred on the following four major themes, which are also aligned with the six strategic faculty research themes:

- A sustainable built environment for new, existing and heritage buildings, with attention to a broad range of values, climate adaptation and mitigation, resilience, energy positivity, renewable energy and nature inclusion;
- A circular built environment, focusing on already existing buildings, efficient use of materials and resources, product design, manufacturing and new product service systems;
- A safe, healthy and comfortable built environment, addressing aspects of indoor environmental quality, ventilation and the prevention of the spread of diseases;
- A smart built environment, employing digitalisation as a tool for decision-making in all built environment processes - supporting data, information and implicit knowledge in all phases of design, manufacturing, construction and use.

FUTURE STRATEGY

6.3.1

ACADEMIC PROFILE

The make-up of the department will be maintained in the sense that groups and sections will persist as recognizable pillars forming the foundation of the department. Within each section, shifts in focus are expected as professors retire and new recruits are brought in. We will strive for senior positions with a strong link to architectural and building technology practice in each section, next to fully academic positions. We will seek to further increase the number of scientific staff taking leadership positions in research, teaching and valorisation. Currently, the department is spread thin in this respect: often, only a single viable candidate can be identified for senior leadership roles. These senior staff members will preferably be developed internally, through coaching, training and structured career development, or otherwise recruited from outside. In line with this approach, we continue to focus on junior academic hires in our evolving tenure track policies, where we have been successful in recruiting in the internal arena.

6.3.2

FUNDING STRATEGIES

New national strategic funds to strengthen teaching and research will allow the department to consolidate the recent growth in staff with sufficient financial room to breathe freely. In particular, the research staff currently has annual targets to channel project funding to the department to cover the base salary costs of permanent staff. This has several negative consequences: of course, projects are left underfunded, but staff also targets smaller annual projects with ample room for billable hours for staff members themselves, at the expense of larger projects for PhD students and PostDocs with more academic pay-off. An important target, in line with the faculty policy, will be to reduce these financial targets to zero, using the newly available strategic funding, and to let the overhead that is included in most projects flow to the sections, where they can be used wisely in consultation with the project leaders. This way, we create a robust financial operation where stable base funding is used for base costs (i.e., permanent staff and their overhead cost), and fluctuating external revenues are used for temporary staff such as PhD students and PostDocs, related overhead, and lab/infrastructure investments. Both the national and European funding landscape has increased the opportunities for truly multidisciplinary grants that span multiple chairs, sections or departments, and personal grants, especially for junior staff to foster earlier independence and autonomy.

This puts pressure on funding strategies organized around grants for a single group headed by a single chair that executes a coherent research programme, mostly within a single subdiscipline. Currently, the department is successful in the first category of grants and has yet to channel support and effort to the second category. As a result, we miss out on funding opportunities that require targeted strategic action: we will train junior staff to apply for substantial grants by themselves earlier. At the same time, senior staff will identify and act on multidisciplinary opportunities with many stakeholders earlier. Fostering the relationship with stakeholders is key for the department's development, and we should benefit from a common ambition and strategy towards that goal. Our visit to the Institute of Technology in Architecture (ITA), D-ARCH, ETH Zurich (Appendix 2) showed us some approaches for the successful engagement of stakeholders.

6.3.3

VISIBILITY

Coherence in research and more substantial interaction on academic matters is expected to create more shared ambition. We believe this to be the best way to create a unified outward communication strategy: it has to be based on actual unified ambition. Outward focus on stakeholders is always under threat because non-urgent yet important work is easily swamped by urgent educational tasks. Lifting the internal targets will be instrumental in creating room in the heads of our staff to prioritize interactions with significant academic pay-off.

6.3.4

ACADEMIC CULTURE

Teamwork in science is an important ingredient of engineering sciences, in particular. For the built environment, subdisciplines must work together to seek positive interactions that strengthen the quality of buildings as a whole. As a result, we are expanding interaction across subdiscipline boundaries. We will expand department-wide interaction on content (thematic teaching and research discussions). We aim to create a culture where all staff members enjoy a safe environment in the daily interaction with their co-workers, which is, at the same time, stimulating, diverse and inclusive and facilitates achieving high standards of academic integrity.

OPEN SCIENCE

During the review period, we have already made open science our priority, with a constant increase in the percentage of open-access output and embedding of open data, education and publishing in our practices. In accordance with the TU Delft Open Science Programme 2020-2024, we aim to further develop those practices by continually educating and facilitating existing and new scientific staff about open science in their research development and communication, which underpins research integrity and impact.

PHD POLICY

We continue to improve our selection procedure: the process is working, and we see room for improvement in clarity and more content-driven discussions (see also the benchmark chapter). Most of our PhD candidates successfully complete their doctorate. Some of our students have gone on to work for some of the most innovative building technology firms in the world. We observe that self-funded PhD students face a much more difficult trajectory towards a doctorate. Personal finances are often tight and funds for overhead cost, such as travel and conferences, are limited. Also, self-funded PhD students have more say in the topic of their doctorate, which sometimes creates a mismatch with the expertise of the proposed supervisor. In contrast, funded positions almost automatically agree with the department's research agenda, because proposals are closely evaluated on that match. While we want to remain open towards those that have scholarships, private or public, we aim to have a higher share of PhD students as salaried employees. This will also make it easier to involve these co-workers in education and research in the department. We foresee that this will improve the overall rate of completion of the dissertation.

To stimulate the interaction of PhD candidates from different research groups, we have successfully placed them together in a single office environment and will further develop this interaction with the programming of collective actions. Also, the management team will meet with representatives of the PhD students annually to discuss issues important to them. Next to formal meetings, we want to take steps so that the PhD candidates are more involved in the department dynamics through informal meetings related to content and research output updates. Understanding the needs of the PhD candidates and keeping our policy and doctorate education updated accordingly should be encouraged during the interactions within the department and the supervision team, supported by existing structures such as the PhD council, the graduate school and the PhD mentor.

GOVERNANCE

As the department strives for more coherence and synergy between its various parts, its organisational structure will also change. The department's current structure, with administrative roles at chair, section, and department levels, is too complicated and fragmented. The result is too many meetings with diffuse roles and responsibilities. We have decided to minimize the management role of the "chair": full professors retain academic oversight over assistant and associate professors. The other administrative roles will be consolidated at the section level, where section leaders are members of the departmental management team that meets regularly. This creates clear mandates and transparent decision processes, which can minimize time spent on procedures to make room for academic content. Academic choices are then made in the section, a larger body of scientists, with frequent exchange of ideas through the management team. We will have more plenary meetings, thematically organized, to solicit the opinions of the staff as a whole on which topics should be elaborated. The first of such meetings, held on education in the spring of 2022, was received positively. Our exchange with the Institute of Technology in Architecture (ITA) of, D-ARCH, ETH Zurich (Appendix 2) also highlighted that meetings on content exchange are necessary for strategy development.

HR POLICIES

Hiring, tenure and promotion decisions are the most critical actions for the department, and we will broaden the involvement of the entire department in them. One change will be to involve the entire department in academic hiring choices, a considerable step away from the chair-centric recruitment process. This will strengthen strategic discussions at the department level and increase broad support for new hires in the department. Tenure decisions will evolve to favour earlier permanent contracts dictated by law, tightening labour markets and shifting preferences of junior staff. Simply put, the war for talent no longer allows years of job insecurity. Promotion decisions have been changed at the university level in the past decade to remove restrictions on internal promotions. Notably, the concept of a finite number of "chair" positions has been dropped: all qualified academic staff can advance without the need for a vacancy. The department will embrace these possibilities with targeted career paths, long-term perspectives and transparent expectations for advancement. It should be stressed, though, that the current TU Delft policies implicitly assume staff that focuses exclusively on academic excellence from graduation to retirement. Our department often benefits from staff that spends significant portions of their career outside academia, which requires careful consideration. Such career paths currently exist next to fully academic tenure(-track) positions. Part-time architecture professionals who bring an outside perspective serve our students and staff well. However, the moment such careers shift more to academia so that the loose connection becomes tighter requires a careful discussion of the expectations.



Project: Housing for zero Energy: Affordable and sustainable housing through digitization



MANAGEMENT IN THE BUILT ENVIRONMENT [MBE]

EDITORS

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SUMMARY

MANAGEMENT – THE PROCESS OF GOVERNING, ORGANISING AND MANAGING – IS AN ESSENTIAL PART OF THE CONTINUING CYCLE OF THE WAY WE USE, (RE)DESIGN AND (RE)DEVELOP, MAINTAIN AND UPGRADE OUR BUILDINGS, PORTFOLIOS, URBAN AREAS AND REGIONS. THE RESEARCH OF THE MANAGEMENT IN THE BUILT ENVIRONMENT (MBE) DEPARTMENT IS CONCERNED WITH DEVELOPING AND APPLYING THEORIES, METHODS AND TOOLS FOR MANAGING THE BUILT ENVIRONMENT. HEREIN, THE DEPARTMENT INTERACTS CLOSELY WITH PRACTITIONERS.

Based on the recommendations of the 2016 MBE research assessment and in line with the faculty strategy, MBE formulated four strategic research aims:

- Better integrate research aims of separated research programmes into one larger, department-wide research programme and search for coherence, collaboration and integration, both in content and organisation;
- Improve scholarly rigour in further developing sound, theoretically and methodologically substantiated research;
- Attract more PhD candidates and develop better procedures in supervision and progress monitoring;
- Become more aware of and steer on developing our academic culture to foster safety, diversity, inclusiveness and research integrity.

Part of the result of the 1st action was one overall MBE research mission: to theoretically understand governing, organising and managing in the built environment to design interventions for societal challenges and transitions, translated into the following objectives:

- Develop novel perspectives and translate these into designing innovative strategies, solutions, methods and tools;
- Improve governing, organising and managing that can impact future designs in the built environment;
- Engage with societal stakeholders and users within and across different functions and scales (buildings, portfolios and urban areas) and different project phases and lifecycle stages (from initiation, design and construction to use, management, maintenance, and redevelopment);
- Develop knowledge for next-generation leaders in management in the built environment.

Together, the strategic research aims have contributed to a single and more coherent MBE research programme, which helped the programme participants to raise more longer-term research funding. This increased the research capacity of contracted PhDs and PostDocs, allowing for more scholarly rigour in developing and applying novel theoretical insights and increased academic output in terms of journal articles and impact. The coherence of these research projects also enabled MBE to have a more agenda-setting position in the field, academically and societally.

Even though we have shown progress in all four strategic research aims, they will need continued attention in the 2022-2027 period. The visit to KTH in Stockholm, in preparation for our MBE Research strategy 2022-2027, helped us to reflect on our research in the previous period and to learn from our peers for the next period. The visit inspired us to formulate actions on: Substantiation of the MBE Research programme, Strategic personnel plans, Funding strategy, Societal impact, visibility and identity, Open Science, Academic culture and PhD policy. Based on our SWOT in paragraph 6, we believe that MBE research is in a better situation than six years ago and that our strategy will allow for further development.



MBE department portrait

INTRODUCTION

RESEARCH OF THE MANAGEMENT IN THE BUILT ENVIRONMENT (MBE) IS CONCERNED WITH DEVELOPING AND APPLYING THEORIES, METHODS AND TOOLS FOR MANAGING THE BUILT ENVIRONMENT. THE MBE RESEARCH PROGRAMME 2016-21 WORKED TOWARDS A SUSTAINABLE BUILT ENVIRONMENT BY FOCUSING ON SOLUTIONS FOR THE DEVELOPMENT AND MANAGEMENT OF BUILDINGS, PORTFOLIOS AND URBAN AREAS AND ON DELIVERING KNOWLEDGE TO THE EDUCATION OF NEXT-GENERATION PROFESSIONALS IN THE BUILT ENVIRONMENT, ALL WITH A PARTICULAR FOCUS ON THE INTERESTS OF THE END-USER (I.E. OCCUPANT, TENANT, CITIZEN).

The MBE department is one of four departments in the Faculty of Architecture and the Built Environment. Within the faculty, we distinguish ourselves from the other departments by focusing on governing, organising and managing in the built environment to design interventions for societal challenges and transitions, whereas the other departments focus on design in its different forms. Paragraph 2 will present the MBE research domain in more detail.

As of July 2019, parts of the former OTB department joined the MBE department (see also the Faculty chapter). At the same time, the research programmes Innovation in Management in the Built Environment (IMBE), Housing in a Changing Society (HCS), and parts of Urban and Regional Studies (URS) started merging into one coherent MBE research programme. With these developments, MBE is structured in three sections: Design and Construction Management (DCM), Real Estate Management (REM) and Urban Development Management (UDM). Each section has its own focus within our research domain. The sections – each with several full, associate and assistant professors, PostDocs and PhD candidates – have a section leader¹ supported by a section coordinator in managing day-to-day issues.

1 Dr. Hilde Remøy (REM), prof.dr. Paul Chan (DCM) and prof.dr. Willem Korthals Altes (UDM)

Each section regularly organises meetings on research with all its staff. Theory, impact, and research progress are discussed in these meetings. The output is used as input for the research programme.

The section leaders form the research programme coordination team, chaired by one of them and assisted by a research programme coordinator². The coordination team oversees the progress and development of the research programme. The MBE research programme leader represents the MBE department in the Faculty Research Council and meets the head of department monthly to discuss progress, (funding) opportunities and issues arising.

The section leaders and the section coordinators, together with the chair of the department, master coordinator and education manager, are part of the MBE Daily Board. The Daily Board meets on a three-weekly basis. Research is one of the fixed agenda items. Three to four times a year, the Daily Board organises so-called DB+ meetings with all MBE professors, where research is one of the agenda items.

This organisation, consisting of a Daily Board, a research coordination team and the sections, contributes to synergy in research and education. The governance structure also allows and stimulates integration and collaboration across the sections.

2 Dr. Hilde Remøy as research programme leader and dr. Marjolein Spaans as research programme coordinator

MISSION AND STRATEGIC AIMS OF THE PAST SIX YEARS

MBE STUDIES THE ENTIRE LIFE CYCLE OF THE BUILT ENVIRONMENT, FROM CURRENT USE TO THE INITIATIVE PHASE AND DESIGN OF INTERVENTIONS, AND FROM (RE)DEVELOPMENT TO REALISATION. WE STUDY THE MANAGEMENT IN THE BUILT ENVIRONMENT AT MULTIPLE SCALES AND ADDRESS DIFFERENT FUNCTIONS OF THE BUILT ENVIRONMENT: FROM WORKPLACE TO BUILDING, LOCATIONS, MARKETS, AND FROM HOUSING TO OFFICES, RETAIL AND MIXED-USE.

2.1

MBE RESEARCH DOMAIN

Managing the built environment addresses challenges like climate change, scarcity of resources, and biodiversity loss. In all of these challenges, the built environment plays an important role. It significantly contributes to, amongst others: greenhouse gas emissions, use of resources and production of waste, and biodiversity loss by land take. Because of the continuously rising values of land and buildings, it is also a domain in which social inequality plays a dominant role.

There are many interrelationships between issues like affordability, energy efficiency, material use, and biodiversity loss relating to the built environment. Hence, addressing these challenges requires a broad approach to management in the built environment. One that incorporates the wider impacts of the way we use, (re)develop, maintain, and upgrade our buildings, portfolios, urban areas, and regions. This, in turn, requires innovation in the governance and management of the built environment, which can only be achieved through multidisciplinary and transdisciplinary research.

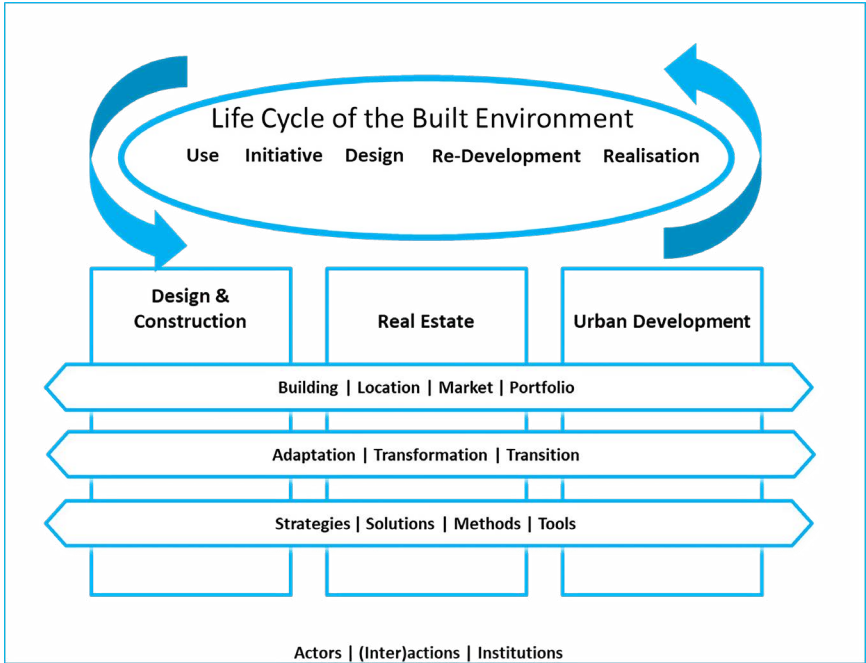


FIG. 2.1
MBE Research domain

FIG. 2.1

The MBE research domain (Figure 2.1) is multidisciplinary in nature. The MBE department comprises scientists from diverse disciplines. Besides design and engineering, it includes public administration, strategic management, economics, law, mathematics, sociology, psychology, geography and planning. Specifically, we study processes of adaptation, transformation, and transition that are needed to achieve a sustainable built environment. In our research, we develop strategies, solutions, methods, and tools for different actors and institutions contributing to improving the governance, organisation, and management of the built environment.

RESEARCH MISSION AND STRATEGIC AIMS

In 2016, the mission and strategic aims of MBE were formulated in three different research programmes: Innovation in Management in the Built Environment (IMBE), Housing in a Changing Society (HCS), and partly in Urban and Regional Studies (URS).

Based on the recommendations of the research assessment 2016 (see Appendix 2), an important change has been the convergence of the three research programmes into one coherent programme. We formulated the following three main strategic aims, which address the recommendations given about the three former research programmes:

- 1 Better integrate research aims of separated research programmes into one larger, department-wide research programme and search for coherence, collaboration and integration, both in content and organisation;
- 2 Improve scholarly rigour to further develop sound, theoretically and methodologically substantiated research;
- 3 Attract more PhD candidates and develop better procedures in supervision and progress monitoring;
- 4 Additionally, in line with the faculty strategy, MBE added a fourth action: Become more aware of and steer on developing our academic culture to foster safety, diversity, inclusiveness and research integrity.

These actions were formulated to increase our research quality and addressed to develop the 2016-2021 mission and strategic aims. The actions implicitly refer to the four specific aspects in SEP 2021-2027: 1) Open Science, 2) PhD Policy and Training, 3) Academic Culture and 4) Human Resources Policy (see also paragraph 6).

In line with our research domain and taking into consideration the recommendation to integrate research aims, we developed the following overall MBE research mission:

To theoretically understand governing, organising and managing in the built environment to design interventions for societal challenges and transitions.

This mission leads to the following objectives:

- Develop novel perspectives and translate these into designing innovative strategies, solutions, methods and tools;
- Improve governing, organising and managing that can impact future designs in the built environment;

- Engage with societal stakeholders and users within and across different functions and scales (buildings, portfolios and urban areas) and different project phases and lifecycle stages (from initiation, design and construction to use, management, maintenance, and redevelopment);
- Develop knowledge for next-generation leaders of management in the built environment.

2.3

CONTEXT OF THE MBE MISSION AND STRATEGIC AIMS AND ALIGNMENT WITH THE UNIVERSITY AND FACULTY RESEARCH THEMES

The MBE research programme contributes to the faculty research themes in many ways. MBE participates in a number of cross-faculty research programmes and initiatives, such as 1 million Homes, Circular Built Environment, Health, Digitalisation, Heritage, as well as in various cross-university programmes like the Delft Energy Initiative, the Urban Energy Institute (hosted at MBE), and TU Delft Artificial Intelligence Labs.

MBE participates in university and faculty programmes to collaborate with universities in Leiden, Rotterdam and Wageningen, for example:

- Leiden-Delft-Erasmus Centre for Sustainability focusing on circular economy;
- Centre for BOLD Cities focusing on Big Open and Linked Data;
- Amsterdam Institute for Advanced Metropolitan Solutions, and;
- Convergence Alliance with Erasmus University and Erasmus Medical Centre in Rotterdam (the Resilient Delta initiative).

The objective of these collaborations is transdisciplinary research that not only develops scientific research but also contributes to education and practice.

As part of our mission to make both scientific and societal impact, MBE partners in various knowledge centres where we collaborate with societal partners and industry. These centres apply and increasingly co-produce scientific knowledge to address societal challenges, supported by empirical data, knowledge and open questions generated by the partners. Based on this knowledge, we develop scientific methods, models and tools.

STRATEGY OF THE PAST PERIOD AND PROCESS

MBE has formulated four main strategic aims (see paragraph 2). These will be addressed in separate paragraphs below. Our indicators will be presented in paragraph 4, the evidence in 5.1-5.6. In 5.7, we present our case study in the form of a narrative based on our research accomplishments.

3.1

INTEGRATE RESEARCH AIMS

As stated in paragraph 2, the current MBE research programme is founded on three former programmes. The integration with parts of the department OTB in mid-2019 aided the process of developing a common mission, research aims and objectives using collaborative sessions. These strategic sessions on ambitions, impact and development resulted in a stronger research collaboration between staff members and more cross-overs between sub-disciplines. This collaboration, in turn, created new and important synergies in multi-, inter- and transdisciplinary research. Joint research themes have emerged and were recognised, and they have also been connected to education through graduation labs.

Three themes have been leading in MBE research over the period 2016-2021: 1) the energy transition as related to the built environment, 2) the organisation of construction and management of real estate in the light of circularity, and 3) the issue of equity and the built environment. Continuation of these themes is a key aim for MBE. In the MBE context, a newly emerging theme has been added: 4) the use of digitalisation in governing, managing and organising the built environment.

IMPROVE SCHOLARLY RIGOUR

The societal challenges MBE research addresses mean that a shift towards transdisciplinary research is necessary to break down the silos of mono-disciplinary research. It asks for research groups, even if they are multidisciplinary, to engage with practitioners to formulate and answer scientific research questions. To address the need to maintain and strengthen rigour in research, we have set an increased focus on methodology and a stronger theoretical basis for our research.

Firstly, we have shifted from acquiring short-term and smaller-scale funding to applying for funds sponsoring larger, medium and longer-term research projects, which includes funding for PhD and PostDoc candidates. Applications were directed to European funding schemes like Horizon 2020, Interreg and Marie Skłodowska-Curie actions, and Dutch NWO³ and RVO⁴ programmes. Several projects were awarded, which helped to build a critical mass of research staff.

To attract funding from industry and societal partners, the emphasis has been on institutional, longer-term collaboration with external parties, allowing larger programmes in which research aims were set by MBE together with the funding parties. Both types of funding schemes have contributed to more scholarly rigour, allowing for more theory-driven research, methodology development and the development and testing of interventions.

This strategy helped us attract young, ambitious researchers as well as high-potential tenured staff. Our staff is now invited to editorial boards of higher-ranked journals, funding programme committees and review panels of prestigious personal grants such as from NWO and ERC.

Secondly, a larger emphasis has been made on publishing, disseminating and communicating research results. We have worked on our visibility and scientific and societal impact by increasing the quality and quantity of research papers to be published in refereed scientific journals. Writing courses and workshops were organised and promoted for all scientific staff and PhD candidates to support this aim. Moreover, we have developed more scholarly rigour at MBE through research methods workshops (named research bootcamps), which, though focusing on PhD candidates, were open for and attended by staff at all stages in their careers.

Finally, we set the aim to organise larger scientific conferences, seminars, symposia and exhibitions – both national and international – as part of research communication and dissemination and also to enhance collaboration and partnership with international scientific practice and national industry.

3 NWO: Nederlandse Organisatie voor Wetenschappelijk Onderzoek or Dutch Research Council

4 RVO: Rijksdienst voor Ondernemend Nederland or Netherlands Enterprise Agency

ATTRACT MORE PHD CANDIDATES, IMPROVE THE PROCESS

In 2016, feedback common to the three research programmes was that we had a low number of PhD candidates. As stated above, the focus on acquiring more long-term research projects resulted in funds to attract PhD candidates. Our improved scholarly reputation increased our international visibility, recognition and reputation, and increased the number of PhD candidates with an international personal research grant or external funding.

Within MBE, we are aware of the issue that some PhD candidates take more than five years to defend their PhD thesis, which was also flagged by the previous research assessment panel. To tackle this, the ABE Graduate School has developed procedures to help PhD candidates structure the research and thesis-writing process. The central and ABE Graduate Schools provide doctoral education to PhD candidates on discipline-related research and transferable skills. Within the department, we contribute to improving the process by taking the following measures:

- When hiring a PhD candidate, we apply the ‘4 eyes principle’, meaning at least two people interview the candidate;
- We follow the procedures with yearly progress meetings and reports, including feedback to the supervisors. This opens up room to discuss and improve the supervision process;
- The go/no-go moment after 9-12 months is useful in assessing the feasibility of the research project: a committee with an external reviewer and independent chair then reviews the research and advises the promoters on the continuation of the PhD research;
- As also addressed under scholarly rigour, we have started organising seminars about research methodology, specifically aimed at PhD candidates. This last measure continues to foster a strong network amongst the PhD candidates, where they learn about methodology, theory and approach from their peers.

DEVELOP A HEALTHY ACADEMIC CULTURE

We consider a healthy⁵ academic culture key for all our staff to thrive in their work and research at MBE. With the help of the TU Delft Employee Monitor, held regularly, actions are defined on issues like work pressure, social safety, and research integrity. With an increasing group of tenure track assistant professors (TTs), PostDocs, and PhD candidates with temporary contracts, openness, inclusiveness, and diversity are important.

Actions to ensure a healthy academic culture, like training programmes for social safety and a working group on research integrity, have been heavily affected by COVID-19. During this more than two-year period, we have given priority to PhD candidates and others with specific needs. We arranged safe workplaces at the faculty if they considered this beneficial for their well-being. For PhD candidates, the help of the PhD mentor was emphasized. Each department has a PhD mentor (tenured staff member) to guide and help them with individual problems that could influence the PhD track negatively. PhD candidates are free to choose one of these mentors.

Work pressure was also amplified by COVID-19. The academic and educational staff had to keep everything running online during the lockdown. A 'work pressure' working group consisting of colleagues at different stages in their careers spoke about this issue with each other and all staff members. As work pressure is the experienced workload, not the workload itself, openness, safety, and inclusiveness are important in discussing these issues. It is a topic always to be aware of and discuss openly. The group developed an agenda with topics to address. With staff returning to campus after COVID-19 lockdowns, this agenda is being picked up more actively.

Diversity and inclusion are topics we continuously have to work on as well. MBE tries to be an open and inclusive group. Our staff has diverse backgrounds in terms of gender, age, discipline and nationality. In the period 2016-2021, we have had surveys about how the staff feels about openness, safety, diversity and inclusiveness and organised workshops to increase awareness about these issues. We have a working group to help us focus on scientific integrity and on developing awareness of this issue.

5 For us, a healthy academic culture is a culture in which the multiplicity of perspectives and identities in the workplace is appreciated; measures are taken to ensure openness, safety and inclusivity; and responsibility is taken by leaders of and within the research unit in order to contribute to such an academic culture (SEP 2021-2027).

INDICATORS

AS DEMONSTRABLE PRODUCTS FOR PEERS, WE USE SCHOLARLY FORMS OF OUTPUT, WHICH ALL INCLUDE SOME SORT OF PEER REVIEW AND THUS GIVE PROOF OF A CERTAIN LEVEL OF SCIENTIFIC QUALITY. TO FOSTER OUR RELEVANCE TO SOCIETY, THE STRATEGY WAS TO DEVELOP AND STRENGTHEN INDUSTRY-FUNDED INSTITUTIONAL COLLABORATION WITH EXTERNAL PARTIES.

TABLE 4.1 Categories of evidence for the quality domains of research quality and relevance to society

	RESEARCH QUALITY	RELEVANCE TO SOCIETY
Demonstrable products	Research products for peers	Research products for societal target groups
	Peer-reviewed articles, books, book chapters, conference papers (Table 5.4)	Projects for policy and practice (highlights: Appendix 3, Table 6)
	PhD theses (Table 5.4)	Networks with policy and practice (Appendix 3, Table 7)
	Degree of open access (Fig. 5.4)	Impact on networks across the knowledge and value chain (Appendix 4);
	Involvement in international (Horizon 2020, etc.) (highlights, (Appendix Table 5) and national (NWO) research projects (highlights, (Appendix 3, Table 2)	Professional publications (Table 5.4)
	Organisation of academic conferences, workshops (highlights, (Appendix 3, Table 3)	Media appearances (see paragraph 5.2)
	Editorships of scientific journals, scientific books, etc. (Appendix 3, Table 5)	
Demonstrable use of products	Use of research products by peers	Use of research products by societal target groups
	Most cited peer-reviewed articles per year in Scopus (Appendix 3, Table 4)	Visitors of website gebiedsontwikkeling.nu (Appendix 3, Fig. 2)
	Impacts of research on policies, methods and practices (Appendix 3, Table 7)	
Demonstrable marks of recognition	Marks of recognition from peers	Marks of recognition by societal target groups
	Impact on science: Prizes and awards (highlights: Appendix 3, Table 8)	

CHOICE OF INDICATORS

The evidence of our research quality is based on a number of indicators that refer to either 'research quality' or 'relevance to society'. They all align with our research mission and our four strategic aims displayed in paragraph 2.

After motivating the selected indicators, we present qualitative evidence in a narrative form based on both research quality and societal impact (see 5.1-5.2). Under 5.3-5.6, we present development in staff, PhD candidates, and funding. Quantitative evidence is provided in 5.8.

Table 4.1 shows the overview of indicators and references to the tables/figures/paragraphs/appendixes in which they are presented in detail in either a quantitative form or as a list with highlights or examples in Appendix 3. Appendix 4 describes the impacts of our research on; 1) policies, methods, and practices; 2) networks across the knowledge and value chain; and 3) science.

INDICATORS IN THE RESEARCH QUALITY DOMAIN

As demonstrable products for peers, we use scholarly forms of output, which all include some sort of peer review and thus give proof of a certain level of scientific quality. These relate to the formulated MBE strategic aims toward a more scholarly rigour and an increasing number (success rate) of PhD candidates (resulting in more PhD theses).

As open access is an important criterion in selecting appropriate outlets for peer-reviewed articles, the number of open-access articles is another indicator. Scholarly rigour is also indicated by facilitating international debate through organising international academic events and taking up editorial activities in academic journals.

Part of our strategy was to strive for a shift from short-term contract research towards more longer-term research funded by national and international programmes. We therefore present some of our projects in such programmes. The number of citations gives an impression of the scientific impact and relates to our pursuit of more scholarly rigour. A side note is that the number of citations tends to favour senior researchers with a long track history over starting researchers. Besides citing our research output, we present scientific impacts in a narrative form. As the last indicator, we present some of the award prizes, which we consider an external appreciation for papers, persons, and project results.

INDICATORS IN THE RELEVANCE TO SOCIETY DOMAIN

To foster our relevance to society, the strategy was to develop and strengthen industry-funded institutional collaboration with external parties. Our starting point for the societal embedding of research and the fostering of societal impact is collaborating with partners in the public and private sectors to jointly formulate and answer research questions. The participation of partners in research projects in which we jointly develop knowledge facilitates and fosters take-up by these partners. If this knowledge is subsequently applied by other public or private parties and finally by a broader group of private or public organisations, we have created a societal impact. We, therefore, develop and participate in networks and projects for and with policy and practice and present these as documentation of our sound impact in this field.

In a narrative form, we present the impacts of our research on (1) policies, methods, and practices and (2) networks across the knowledge and value chain in Appendix 4. Some output is specifically aimed at a professional or even wider audience in the form of professional publications, dedicated websites, such as the gebiedsontwikkeling.nu website and media appearances.



ACCOMPLISHMENTS DURING THE PAST SIX YEARS

5.1

EVIDENCE OF RESEARCH QUALITY

The period 2016-2021 shows an increase in the total number of peer-reviewed articles, from 46 in 2016 to 80 in 2021 (Figure 5.1). The average number of peer-reviewed articles per full-time equivalent (FTE) research capacity increased from 1.8 in 2016 to 3.0 in 2021 (based on Tables 5.1 and 5.4). We consider this a result of our increased focus on more scholarly rigour. In the same period, the shift toward open-access publications was considerable: from 48% in 2016 to 94% in 2021 (Fig. 5.4).

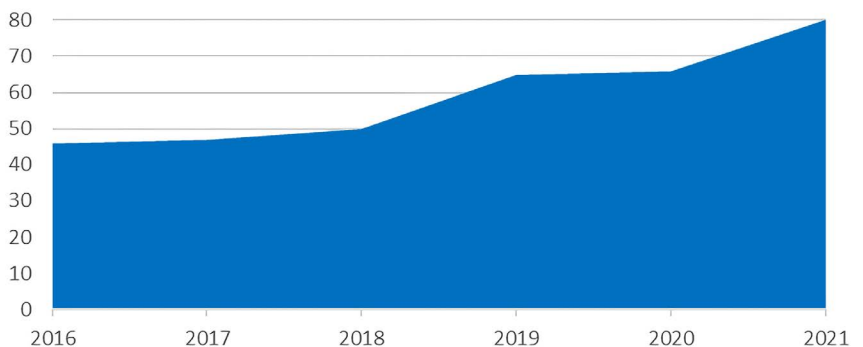


FIG. 5.1

Peer-reviewed articles

(see also paragraph 5.8: Evidence by Number, Table 5.4)

FIG. 5.1

In line with the recommendation from the previous research assessment to focus more on competitive research grants, MBE has been successful – both as a lead partner and as a partner – in EU and NWO funded competitive research grants, mainly on topics at the heart of the MBE research programme. Re-INVEST, RURALIZATION, UPLIFT and RE-DWELL are examples of Horizon 2020 projects in which MBE PhD positions were funded. Other examples of European-funded research programmes in which we participated were Interreg (Triple-A: Energy efficient home renovations and Housing 4.0 Energy) and ESPON (Financial instruments and territorial cohesion). Both as the lead partner and as co-applicant, we were successful in obtaining NWO grants. The NWO Transitions and Behaviour programme allowed us to further strengthen our transdisciplinary research approach and expand the formulated challenges. And in the review period, a successful submission was coordinated in the NWA-NWO programme. Each of these projects includes PhD and PostDoc positions (Appendix 3, Tables 1 and 2).

Although we are happy with these results, there is also a counter side to it. As competition is fierce and the success rate low, research staff needs to invest a lot of their scarce time in preparing research proposals with no guarantee of success. We also consider it a challenge to lead or participate in such projects in a balanced way (no bottlenecks in time and themes) and to adequately prepare for upcoming calls for proposals.

As introduced previously, MBE aims to significantly contribute to and facilitate the scholarly debate in academic journals, academic conferences, and workshops. MBE hosts the secretariat of the European Network for Housing Research (ENHR). Other examples are the European Real Estate Society (ERES) annual conference in 2017 with circa 450 participants, the Corporate Arcadia Exhibition (2017), Congress Research meets practice, towards project management 3.0 (2019) and Together! The future of housing Exhibition (2021) (Appendix 3, Table 3). Throughout the COVID-19 pandemic, we also organised online conferences and symposia, such as the ERES education seminar in 2021. We will continue these efforts in the upcoming years by organising the ENHR 2024 conference.

Participating in managing highly ranked international journals is another way of actively playing a role in the debate. Hereby, choosing editorial activities in academic open-access journals is a key element. Over the whole period, open access in publications covered by Scopus is well over 70%, and this percentage is rising. During this period, MBE staff acted as editors-in-chief of several respected scientific journals, including the Journal of Housing and the Built Environment, Construction Management and Economics, and Housing Studies. (Appendix 3, Table 5). Although these roles are valuable, they must be balanced against the staff input needed for other research activities.

The extent to which scholars utilise MBE research publications (i.e. number of citations) gives an impression of the quantitative impact. The most frequently cited peer-reviewed publication for each year (Appendix 3, Table 4) are primarily published in open-access journals. They show a bandwidth from 31 to 126 citations and a wide diversity of authors and topics across the research programme, reflecting our effort for an academic culture of more diversity and inclusion. As an indicator, we introduced prizes, which are often awarded yearly to journal publications or conference papers. International mobility awards for research staff or awards for student projects (supervised by MBE staff) are examples of such prizes (Appendix 3, Table 8 and Appendix 4).

RELEVANCE TO SOCIETY

MBE's research has a societal impact. Compared to the previous research assessment, there has been a shift from shorter-term occasional research contracts toward more institutionalised collaboration with societal organisations. This allows us to be involved in setting a longer-term research agenda and developing a deeper societal impact. Tables 1 and 2 in Appendix 3 give examples in a national and international setting. They cover the wide range of our programme and include, for example, input to the EU Urban Agenda.

We consider setting up and managing expertise centres as pivotal in achieving societal impact (see also Appendix 4). MBE's position in the Faculty of Architecture and the Built Environment allows for key impacts relating to the design community, covering various scales from buildings to cities. A key societal impact is contributing to the Building and Technology Innovation Centre, a collaboration between the government, the market, and knowledge institutions. It focuses on stimulating innovation to make the built environment future-proof and aims to make the built environment climate-neutral, climate-adaptive and circular. It also addresses the provision of sufficient housing and upkeep of infrastructures and includes innovations in, i.e., digitalisation, to facilitate this. Many MBE research projects aim to embed research results in policy and practice settings, often joining different actors. Publications in professional journals are a way to present our research to actors in practice. We see a decline from 82 (2016) to 54 (2021) professional publications (Table 5.4). This might be the consequence of our increased focus on more peer-reviewed articles but also of a change in the ways professionals interact, in which channels other than professional journals have gained weight.

Another way of sharing knowledge based on MBE research is via media in all forms. Media appearances increased from 124 in 2016 to 251 in 2021, including a few MBE researchers as "top scorers" (see also paragraph 5). Prof. Boelhouwer has registered over 800 press/media appearances in PURE in the research assessment period, mainly on housing markets and housing policy. This is more than 75% of the whole group. Although we consider media exposure as part of our work in conveying news and explaining our work to a wide public, it also makes us scientists vulnerable to negative and threatening social media communications.

As for the impact on policies, methods, and practices, we address three themes in Appendix 4:

- 1 A broader value creation agenda in which these values are made defensible;
- 2 Circularity principles, practices, and product designs, and;
- 3 Addressing emissions reduction and the energy transition.

We elaborate on several examples of our impact on networks across the knowledge and value chain in Appendix 4: Stichting Kennis Gebiedsontwikkeling (SKG, Foundation Knowledge Urban Area Development), Building and Technology Innovation Centre (BTIC) now called the TKI Building and Technology in which we participate together with other 4TU.Built Environment partners) and Opdrachtgeversforum in de Bouw (Forum of Public Commissioners in the Built Environment).

The Department of MBE is also the source of and destination for a number of high-profile researchers of management in the built environment. It has attracted two new professors with strong connections with the Dutch construction industry.

Lastly, one of our research centres with a high societal impact, SKG, has a website gebiedsontwikkeling.nu with professional articles published weekly. It has attracted an increasing number of unique visitors over the past few years showing the increased interest in this platform in providing knowledge and debate on area development within the Netherlands (Appendix 3, Figure 2).

5.3

STAFF

The research capacity (in FTE) of the tenured scientific staff remained relatively stable from 13.8 in 2016 to 15.4 in 2021 (Table 5.1). Traditional science metrics may be used to indicate the use of research works and academic reputation, which according to HR policies, have resulted in promotions of assistant professors to associate professors or associate to full professors. However, traditional metrics do not serve very well to measure the quality of new staff members who have not built up a publications portfolio over a long period of time.

For the viability of the department, it is important to have new staff members. We have successfully attracted some excellent new staff members with two tenure track assistant professors (TT) at the start of 2016 and two who started in 2016 and 2017, all of whom got permanent tenure in the period 2016-2021. Unfortunately, two TTs did not get a permanent contract, one of these left for personal reasons. At the end of 2021, one TT started, and another was hired.

Besides the TTs, we have attracted a full-time professor in Design and Construction Management and part-time professors in Building Law, Construction Cultures, and Practice Interface on Urban Area Development. There were some fluctuations in the temporary staff: the number of PhD candidates increased (see 5.8), and the number of visiting fellows decreased. The decrease was intentional as we assessed the added value of visitors for our research programme more strictly during COVID-19.

PHD CANDIDATES

Our focus on increasing the number of PhD candidates was successful as the number of PhD candidates grew considerably in 2016-2021 compared to the previous period, showing a stable influx and gender balance (Table 5.3).

TUD policy aims at graduation within five years. Although only 53% (21) of MBE PhD candidates graduated in year five or earlier, this rate is higher than that of the faculty (31%) or TU Delft (41%). Compared to the previous assessment period, it shows an improvement from the former IMBE programme: 30% (3). Compared to the HCS programme, it remained stable: at 55% (6).

However, further improvement in completion rates through the continuation of the efforts is needed. For defining actions, we will make use of the outcomes of a recent PhD survey (not published yet).

Additional analyses of all PhD candidates show that 33% (9) of the candidates starting between 2012 and 2015 had a TUD contract, 59% (16) a scholarship and 7% (2) seconded from an external organisation (labelled as industry). In the period 2016-2021, this has reversed to 62% (36) with a TUD contract, 33% (19) scholarship and 5% (3) seconded from an external organisation. The growth in PhD candidates with a TUD contract follows the increase in European and NWO-funded projects.

FUNDING

There are some notes to analysing the MBE funding data as the 2016-2018 data exclude former OTB finances. The 2019-2021 data show an increase in research grants and personnel costs as a consequence of our successful acquisition of European and NWO-funded research projects, including PhD and PostDoc positions (Table 5.2, see also Appendix 3: Tables 1 and 2 for highlights). The integration of part of the former OTB department also partly explains the increase in personnel costs since 2019.

CONCLUSION

MBE is proud of the progress shown in the assessment period with respect to research quality and relevance to society. The numbers on research output and external projects reflect the increased focus on longer-term externally funded research projects. This has led to an increased academic focus on output and an increasing number of PhD candidates working on these projects, enabling a sought-after shift from PhD candidates with a scholarship to PhD candidates with a TUD contract. Moreover, these research projects also enable an agenda-setting position.

CASE STUDY

MBE has contributed to understanding and designing responses to many societal challenges. In this paragraph, we present our case study in the form of a narrative based on our research accomplishments following the three main themes as introduced in paragraph 3. These have been relevant throughout the whole assessment period:

- Energy transition related to the built environment;
- Organisation of construction and management of real estate in the light of circularity;
- Issue of equity and the built environment.

Besides these three main themes, digitalisation is discussed as an emerging theme in MBE research activities. Finally, we will present some accomplishments of the MBE approach toward longer-lasting interactions with communities of design and practice.

ENERGY TRANSITION

A key challenge is the energy transition and the need to make buildings more energy-efficient. The focus of MBE is not primarily on how certain innovations work in laboratory conditions but rather on how they work in a real life-context, i.e., how actual energy savings can be achieved by people living in their homes (Van den Brom et al., 2019).

Studies facilitated by AEDES (the umbrella organisation for housing associations in the Netherlands) created a huge database (SHAERE) with key characteristics of the millions of dwellings held by its members. This database is used for various PhD theses: on energy in dwellings (Van den Brom, 2020), longitudinal analysis of energy performance (Filippidou, 2018), predicting energy consumption and energy savings (Majcen, 2016),

thermal comfort and energy-related behaviour (Ioannou, 2018), quality failures in energy savings projects (Qi, 2021), using transaction cost theory to analyse energy retrofits (Jia, 2021), urban renewal decision making in China (Zhuang, 2020), future-proof renovations (Brinksma, 2017), the complexities of the energy transition (Stutvoet, 2018), sustainable values-based strategic decision-making in a Dutch housing association (Hoomans, 2019) and policy instruments to improve energy performance (Murphy, 2016). The adaptive capacity of the built environment relating to new climatological conditions is the topic of the PhD by Keenan (2016).

Through the TU Delft Urban Energy Institute, hosted by MBE, the knowledge gathered in all research is shared among experts. The contribution toward the societal challenges is based on research, such as papers by Van den Brom et al. (2017) on performance gaps in energy consumption and by Mlecnik et al. (2020) on policy challenges for the development of energy flexibility services. Another field of growing concern is the climate governance strategy for the Dutch delta. A consortium led by MBE has been created for a transdisciplinary research agenda (an Interdisciplinary NWA Research Programme) focusing on developing integrated real estate and infrastructure climate risk strategies. Next to academic partners, practice partners and SKG (Fig 5.3) are involved. A bid submitted in 2021 was funded by NWO.

PRIVATE PARTIES IN REAL ESTATE

AM, AMVEST, BLAUWHOED, BOUWINVEST, BPD, HEIJMANS, HURKS, SYNCHROON, SYNTRUS ACHMEA REAL ESTATE & FINANCE, VANWONEN, VESTEDA, VORM HOLDING

PUBLIC-OWNED REAL ESTATE PARTY

NS STATIONS

HOUSING ASSOCIATIONS

DE ALLIANTIE, HAVENSTEDER

MINISTRIES

BZK (INTERNAL AFFAIRS, INCLUDES HOUSING) AND I&W (INFRASTRUCTURE AND WATER MANAGEMENT)

MUNICIPALITIES

ALKMAAR, AMSTERDAM, BARNEVELD, BREDA, DELFT, DEN HAAG, DORDRECHT, EINDHOVEN, GRONINGEN, LEIDEN, NIJMEGEN, PURMEREND, ROTTERDAM, TILBURG, UTRECHT

PROVINCES

FLEVOLAND, GELDERLAND, NOORD-BRABANT, NOORD-HOLLAND, OVERIJSEL, ZUID-HOLLAND

OTHER PUBLIC ORGANISATIONS

DELTA COMMISSARIS, KADASTER, STAATSBOSBEHEER, WATERSCHAP AMSTEL, GOOI EN VECHT

FIG. 5.2 Participants in Stichting Kennis
Gebiedsontwikkeling (SKG) in 2020
Source: SKG, 2021: 38-39

FIG. 5.2

CIRCULAR BUILT ENVIRONMENT

Making more efficient use of materials resulting in a shift towards a circular built environment is a challenge in which MBE has developed expertise. One example is an Interreg project with the AMS Institute, housing association Ymere, construction company Dura Vermeer and students from the Rotterdam University of Applied Sciences to design a Circular Skin for energy retrofitting. Another example is the circular kitchen (Figure 5.3), designed in an EIT Climate-KIC consortium with research organisations, housing associations, private landlords and the construction sector, with a prototype placed in a selection of rental dwellings.

The transformation towards circularity demands a shift beyond the scale of individual buildings, impacting the whole production, use and reproduction chain of buildings. Our expertise is represented in important industry-wide forums such as Platform CB'23, where our research resulted in the formulation of a framework and lexicon for a circular built environment and guidance on circular procurement and design.

Thus, MBE has been active in many discussions on circular building, circular cities and regions, circular area development, the circular economy, the position of buyer groups in circular housing, and on circular collaboration (theme of the NWO Behaviour and Transitions awarded TransCiBo).

The challenge of circularity relates to insights and research on how construction processes are managed. PhD theses defended include Strang (2018) on supervision and coordination in the building process, Venselaar (2017) on supply chain partnering in the Dutch housing sector, Papadonikolaki (2016) on the alignment of partnering with construction IT and Wu (2021) on the challenges of prefabricated housing. Relationships between public and private agents is an important topic highlighted by the PhD of Leclercq (2018) on the privatisation of the production of public space and the PhD by Kuitert (2021) on how public construction clients safeguard public values in a changing construction industry. These also fit in a wider programme on public values, organisational structures and collaboration with market parties financed by the Forum of Public Commissioners in the Built Environment⁶.

In cooperation with the LDE Centre for Sustainability and Wageningen University & Research, a project on circular area development in The Hague (Binckhorst area) was also financed by the knowledge and innovation programme ACCEZ of the province and industrial partners. The results of the project provide input for the provincial 'accelerators' and have led to a follow-up project with partners from government and industry '*Samen Versnellen*', in which an assessment of frontrunner projects in circular building will result in a joint framework to be used by clients and commissioners. The results of these projects are also shared in the UCL-based Circular Cities Hub and the Circular Built Environment hub at our Faculty.

6 ProRail, Rijkswaterstaat, Rijksvastgoedbedrijf, Schiphol, NS-stations, Nationale Politie, Provincie Noord-Holland, Hoogheemraadschap Hollands Noorderkwartier, Gemeente Rotterdam, Gemeente Den Haag, Erasmus Universiteit (Campus & Offices services), Radboud UMC, De Alliantie, Mitros.

FIG. 5.3
The circular kitchen.
 Source: Climate-KIC

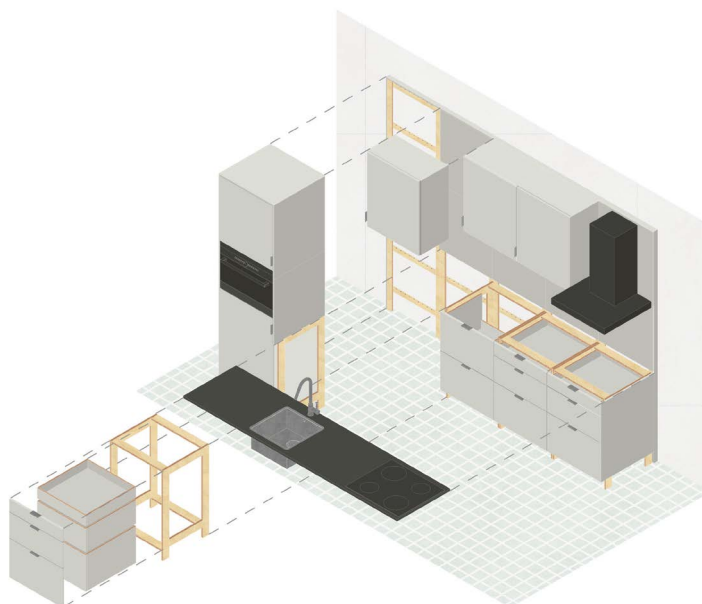


FIG. 5.3

5.7.3

EQUITY IN THE BUILT ENVIRONMENT

Societal inequalities are reproduced through the built environment. Issues of equity and justice play a role in a lot of our activities, including issues on housing affordability, access to adequate housing and the housing systems that cater for this accessibility. Intergenerational inequality and understanding the issues confronting younger people in getting access to the property market are addressed in several Horizon 2020 Research and Innovation actions:

- The UPLIFT project examines vulnerable youth from an educational, housing and employment perspective. In this project, there are interactions between research organisations, institutions from practice (such as the housing association Lieven De Key) and the youth themselves. This is essential as the project aims to put young people's voices at the centre of Youth Policy.
- In RURALIZATION, coordinated by MBE, generational renewal is key. Here the focus is on rural areas and the issue of access to land for new generations. The RURALIZATION consortium (18 partners) is a mix of research organisations and practice partners, such as Terre de Liens, that work together in the Access to Land network.
- RE-DWELL, a European Training Network in which 15 early-stage researchers get the opportunity to develop capacity in design, planning and building, community participation, policy and financing to generate innovative solutions for the housing problem in the EU.

In the course of these projects, many interactions with societal actors take place, such as presentations on the research progress for youth workers, policymakers, neighbourhood groups and governmental institutions.

Issues of inequality may also relate to opportunities for young people in the housing market (as is the topic of the PhD of Deng, 2018), management of social condominiums (the PhD of Vergara d'Alençon, 2018), affordable condominium housing (the PhD of Donoso-Gomez, 2018) and management of self-organisation initiatives (the PhD of Tempels Moreno Pessoa, 2019).

Vergara d'Alençon and Tempels Moreno Pessoa have jointly initiated the MOOC 'Rethink the City' (Tempels Moreno Pessoa et al., 2019), in which PhD candidates and staff from the faculty addressed issues of spatial justice, urban resilience, and housing from a global perspective. For this MOOC, they have been awarded the Excellence in Teaching prize of the Association of European Schools of Planning (AESOP).

Additionally, global housing issues are addressed by a living lab in Addis Ababa financed by an NWO WOTRO grant in which both the department of Architecture and MBE participate. Affordability can also be aligned with economic processes, as is done in the PhD of Bin Mohd Noor (2016), presenting a new business model for affordable housing in Malaysia. Issues of inequality and diversity are also addressed in the PhD of Ahmadi (2017) on living with diversity in Toronto. Understanding the role of housing associations is addressed by the PhD of Van Bortel (2016).

5.7.4

DIGITALISATION

MBE is also growing capability in digitalisation and the built environment, which is an emergent research field. One example is the work on Industry 4.0, which includes a Chinese fellowship, advice (Chan et al., 2021), a briefing note (Chan, 2020), a special issue (Ejohwomu et al., 2021) and talks to industry practitioners.

We also address other topics concerning digitalisation, such as smart city technologies (Ersoy, 2019), the digital dimension of circularity (Çetin et al., 2021), using artificial intelligence to predict building age (Garbasevschi et al., 2021) and, of course, Building Information Management (Papadonikolaki et al., 2016; Koutamanis, 2020).

MBE will also host an AI Lab aimed at activating intelligence in buildings' lasting and liveable environments. There are close links with the work streams of adopting artificial intelligence and stimulating user and citizen acceptance of such technologies in the NL-AI Coalition.

MBE APPROACH: INTERACTION WITH DESIGN AND PRACTICE

In all themes, many interactions take place with professionals. Specifically, our position within the Faculty of Architecture and the Built Environment provides an excellent context to impact the design community. This allows a connection between research insights into societal impact through design. Examples of this connection are a master-class on circularity for the BNA (the professional organisation of architects) and an open-access tutorial, developed in cooperation with the Faculty of Industrial Design, to support creative professionals in treating value conflicts (Lousberg et al., 2019).

Also, the architectural practice itself is studied, such as in a project for the ArchiScienza Foundation on architecture analysed from the sociological theory of professionalisation and by the PhD of Bos-de Vos (2018) on project-specific value capture strategies of architectural firms. In this domain, it is worth mentioning the steps taken to innovate Real Estate Education through the application of Virtual Reality (VR) technologies (also an NWO Behaviour and Transitions grant 'VR-Renovate' led by the department) and a Summer School Sustainable Housing and Environment from an international perspective.

The nexus between research and education is not only based on the educational programmes in the faculty where MBE has its own independent track in the MSc Architecture, Urbanism and Building Sciences. But also in other educational programmes such as the MSc Metropolitan Analysis, Design and Engineering (MADE) (at the Amsterdam Institute for Advanced Metropolitan Solutions with Wageningen University), the MSc Construction Management and Engineering (CME) (with other TU Delft Faculties) and the Master City Developer (MCD) (with Erasmus University; see also below).

COALITIONS WITH PRACTICE

Besides studying spaces for interaction between public and private stakeholders, including citizens, in the forms of living labs and processes of co-production and co-creation, MBE also actively builds and maintains connections with professionals. Based on the policy of long-term coalitions, there are more structural interactions with practice. A very important one is in the field of urban area development. Here, there is a foundation with many participants (Fig.5.2) financing research, including PhD projects. Their website (gebiedsontwikkeling.nu) has about 25 thousand unique visitors per month, publishing regular contributions based on research of the staff.

In cooperation with Erasmus University, the Master City Developer is developed for professionals in the field. With the National Renovation Platform (NRP), we deliver, at the NRP Academy, courses to professionals on property renovation and transformation. How professionals learn and collaborate across disciplinary boundaries in addressing sustainability transitions in urban transformations is the theme of the Behaviour and Transitions Grant 'Stepping Out' led by MBE and in collaboration with the University of Amsterdam. All these efforts make MBE an established player in the professional field.



Professor Marja Elsinga presenting during a Master class at the European Real Estate Society (ERES) annual conference, 2017.



PROFESSIONAL INSTITUTIONS

In related fields of public commissioning, building law, public real estate and housing-market analysis, there are close links with professional institutions. PhD theses include studies on public rental housing governance in China (Yan, 2021), on public housing management in Ghana (Aziabah Akanvose, 2018) and on technology campuses and cities (Curvelo Magdaniel, 2016). University campuses are also the topic of the PhD of Alghamdi (2018) and Valks (2021). The analysis and briefing of school building designs, especially from the perspective of teenagers with autism, is the topic of an NWO grant received by the BOLD Cities consortium (a cooperation of MBE with Leiden University and Interpsy Groningen).

The alignment of an organisation's real estate to its corporate strategy is the topic of the PhD of Arkesteijn (2019). Our expertise in the use of smart tools and the alignment of real estate and organisational strategy has led to a four-year cooperation agreement with the Dutch police force.

HOUSING MARKETS

Housing markets have been analysed in the PhDs by Teye (2018) in collaboration with Statistics Netherlands, by Gong (2017) considering the spatial dimension of house prices and by Dol (2020) studying the West European home ownership sectors and the Global Financial Crisis. External PhD candidates with professional experience can also forge connections. Verburg (2021) has studied the effects of municipal investments on welfare using house prices as a proxy for welfare effects.

Researchers from the department, invited by the regional and national authorities, have reported on the housing market consequences of earthquakes caused by gas exploitation in the province of Groningen. This is a very sensitive issue with many desperate people, political and legal conflicts relating to the allocation of gas exploitation costs and benefits (Boelhouwer and van der Heijden, 2018). Housing market developments in the Netherlands are monitored in quarterly reports based on cooperation with professional real estate organisations and authorities. Insights flow not only in scientific and professional debate (including an often repeated 4-day course on new developments in housing for professionals) but also to the public at large through numerous⁷ interviews and contributions to newspapers, radio and television, for which good relationships with journalists have been built.

So, the MBE approach to achieving the societal impact of our research is based on building long-term relationships with potential users of knowledge so that we know what kind of scientific questions are relevant to society and that we can bring our insights to good societal use.

7 Professor Boelhouwer has registered over 800 press/media outings, mainly over housing markets and housing policy, in PURE between 1/1/2016 and 31/12/2021 (NOTE this over 75% of the whole group).

EVIDENCE BY NUMBERS

This paragraph includes the quantitative data that supports the self-evaluation of the indicators, as explained in paragraph 4, and also supports the discussion about the strategy and the accomplishments during the past period. In particular, it presents information about the numbers of research staff, PhD candidates, funding and research output. Further quantitative data and an overview of key activities can be found in Appendix 3.

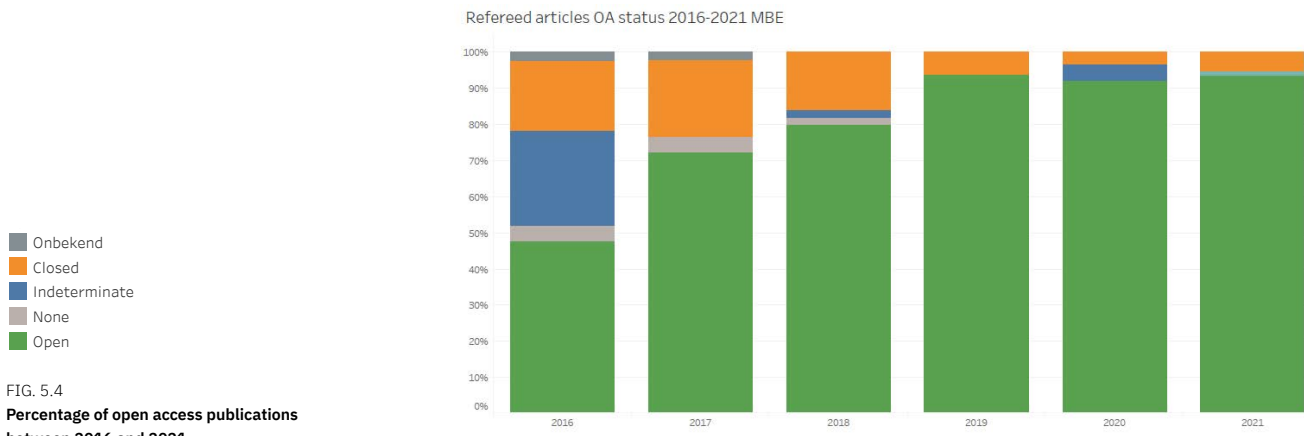


FIG. 5.4

RESEARCH STAFF

TABLE 5.1 Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities.

	2016		2017		2018		2019		2020		2021	
	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE
Scientific Staff	45	13.8	43	13.8	41	14.1	43	14.6	47	16.0	44	15.4
Full professor	13	3.5	11	2.9	10	3.0	13	4.0	14	4.4	13	4.1
Associate professor	11	3.6	10	3.8	10	3.3	9	3.3	10	3.6	10	3.8
Assistant professor	21	6.8	22	7.0	21	7.7	21	7.3	23	8.0	21	7.4
Researchers (incl. Postdocs)	23	11.2	23	10.6	28	9.6	30	11.0	31	11.8	25	11.2
PhD candidates	36	-	38	-	42	-	39	-	53	-	55	-
Total research staff	104	25	104	24.4	111	23.7	112	25.6	131	27.8	124	26.6
Visiting Fellows	27	7.3	31	6.4	17	3.1	18	3.7	20	2.3	14	1.4
TOTAL STAFF	131	32.3	135	30.8	128	26.8	130	29.3	151	30.1	138	28.0

Scientific staff: profiles HL, UD, UHD, permanent and temporary. Researcher: UFO profile OVWOZ (onderzoeker 1, onderzoeker 2, onderzoeker 3, onderzoeker 4, Post-docs), permanent and temporary. PhD studentscandidate: standard PhD (employed) and contract PhDs (externally or internally funded but not employed). Visiting fellows: employee group "Gast en GastWP", profiles HL, UD, UHD, OVWOZ (onderzoeker 1 t/m4). All profiles based on the job classification system UFO. Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities. The indicated number of FTEs takes into account that scientific staff and researchers are considered to spend respectively 40% and 80% of their appointment on research activities.

FUNDING

TABLE 5.2 Overview of funding and expenditure for the period 2016-2021.

	2016		2017		2018		2019		2020		2021	
	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
FUNDING												
Direct funding (1)	1,391	50%	1,491	50%	1,365	50%	1,897	45%	2,263	45%	2,241	43%
Research grants (2)	251	9%	355	13%	281	9%	15	0%	172	3%	504	10%
Contract research (3)	317	11%	349	12%	552	18%	1,275	30%	1,920	38%	1,822	35%
Own contribution	-47	-2%	-129	-5%	-146	-5%	-276	-7%	-547	-11%	-536	-10%
Other (4)	855	31%	820	29%	988	32%	1,299	31%	1,197	24%	1,139	22%
Total funding	2,767	100%	2,817	100%	3,041	100%	4,210	100%	5,005	100%	5,171	100%
EXPENDITURE												
Personnel costs	-2,053	92%	-2,094	88%	-2,205	89%	-3,076	90%	-4,161	89%	-4,256	87%
Other costs	-189	8%	-283	12%	-279	11%	-352	10%	-489	11%	-657	13%
Total expenditure	-2,242	100%	-2,377	100%	-2,485	100%	-3,428	100%	-4,650	100%	-4,913	100%
RESULT	525		440		557		782		354		258	

Note 1: Direct funding (basic funding/lump-sum budget)

Note 2: Research grants obtained in national scientific competition

Note 3: Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, European organisations and charitable organisations

Note 4: Funds that do not fit into the other categories

PHD CANDIDATES

TABLE 5.3 PhD candidates' graduation time related to their year of enrolment.

ENROLEMENT			SUCCES RATE												
STARTING YEAR	MALE	FEMALE	TOTAL M+F	GRADUATED IN YEAR 4 OR EARLIER		GRADUATED IN YEAR 5 OR EARLIER		GRADUATED IN YEAR 6 OR EARLIER		GRADUATED IN YEAR 7 OR EARLIER		NOT YET FINISHED		DISCONTINUED	
2012	4	2	6	1	17%	3	50%	5	83%	5	83%	0	0%	1	17%
2013	2	7	9	1	11%	6	67%		67%	6	67%	1	11%	2	22%
2014	5	1	6	1	17%	5	83%	5	83%	5	83%	0	0%	1	17%
2015	4	2	6	1	17%	2	33%	5	83%	5	83%	0	0%	1	17%
2016	0	6	6	0	0%	3	50%	4	67%	-	-	2	33%	0	0%
2017	3	4	7	1	14%	2	29%	-	-	-	-	3	43%	2	29%
TOTAL	18	22	40	5	13%	21	53%	-	-	-	-	6	15%	7	18%

PhD candidates' graduation time related to their year of enrolment. The table includes PhD candidates enrolled in the period 2012-2017 who are expected to graduate in the review period, by 2021. The expected duration of a PhD is four years.

RESEARCH OUTPUT

TABLE 5.4 Research output for academics and professionals.

	2016	2017	2018	2019	2020	2021
Peer-reviewed articles	46	47	50	65	66	80
Non-refereed articles	1	3	1	1	3	6
Books	2	1	3	2	0	1
Book chapters	21	11	24	13	20	12
PhD theses	7	5	14	4	6	9
Conference papers	49	35	33	21	18	17
Professional publications	82	71	51	39	34	54
TOTAL PUBLICATIONS	208	173	176	145	147	179

DIVERSITY: GENDER AND NATIONALITY

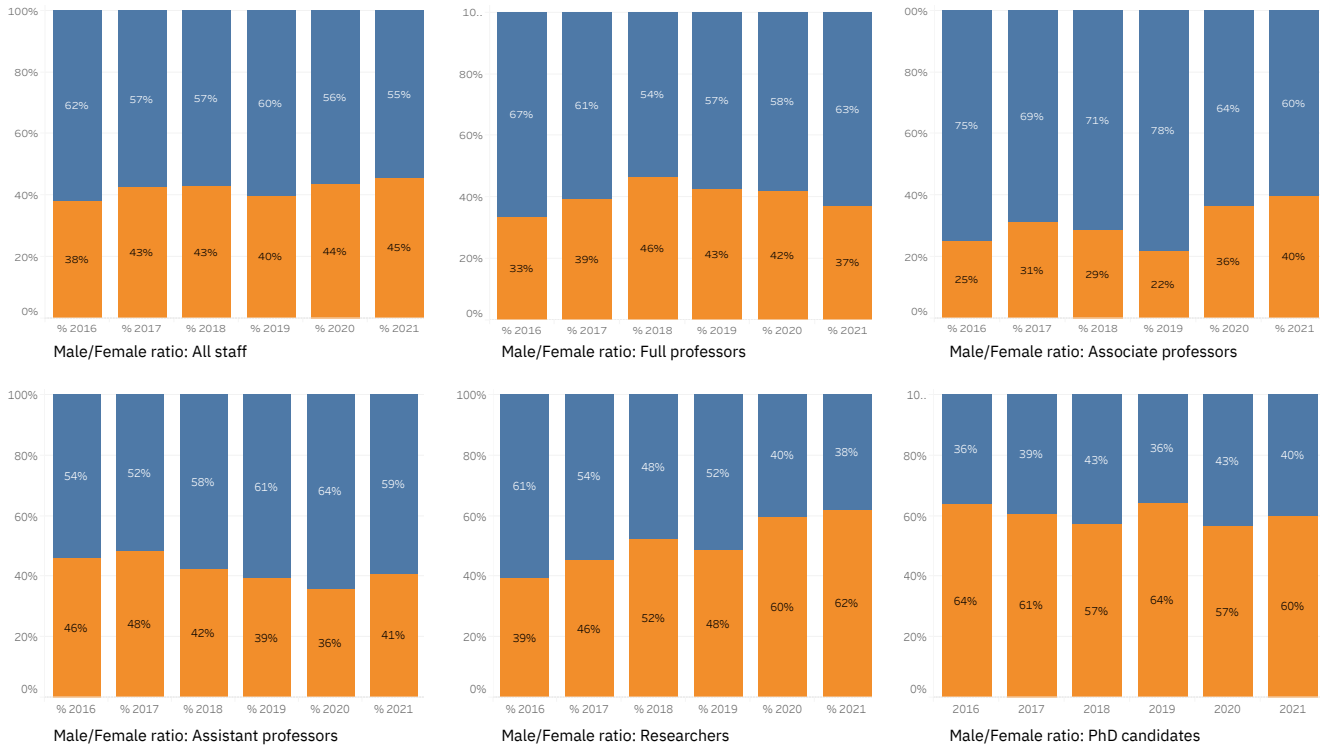


FIGURE 5.1 a-f Gender ratio faculty staff: Male (blue)/Female (orange)

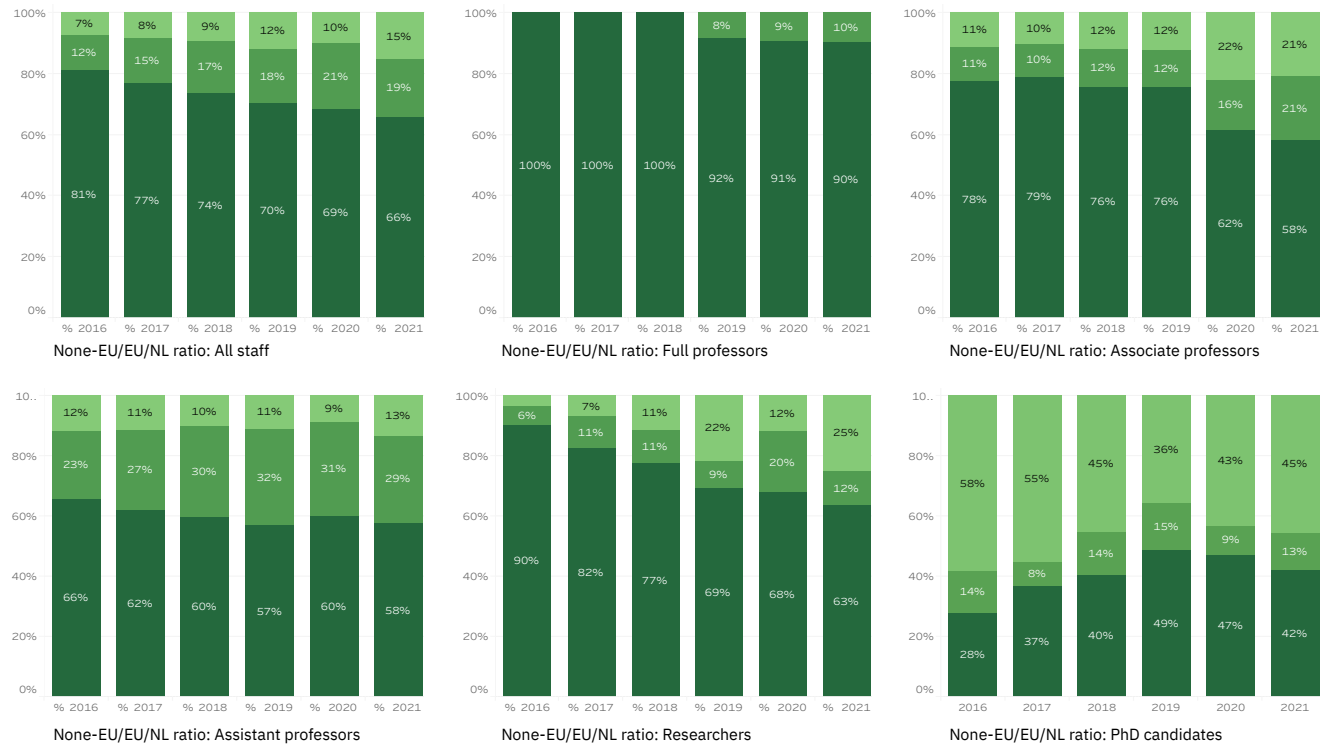


FIGURE 5.2 a-f Nationality ratio faculty staff: None-EU (light green)/EU (green)/NL (dark green)

STRATEGY FOR THE NEXT SIX YEARS

As a start to developing the MBE strategy for the next six years, we analysed our own strengths, weaknesses, opportunities and threats (SWOT). The SWOT is based on our accomplishments over the past six years and our mission and strategic aims for the future. The SWOT was filled in in several rounds of workshops within the department. Then, the SWOT analysis was presented at the qualitative comparison visit at KTH Stockholm (see also Appendix 5) and finally refined.

6.1

SWOT ANALYSIS

STRENGTHS

- Multidisciplinary team to research societal challenges
- Institutionalised relationships with societal and industrial stakeholders
- More long-term research grants (NWO, EU)
- Contribution to the national research agenda in the MBE domain

At MBE, we have a multidisciplinary team to research societal challenges. Our team applies theories from a diversity of scientific fields. The coming together of these fields in an open, inclusive community allows us to collaborate and develop excellent research, as shown in the increase in publications and scientific project funding.

We make a considerable part of our societal impact through networks in national industry and society. We have institutional relationships with societal and industrial stakeholders that enable us to develop a strong impact pathway: disseminating outputs and ensuring that we can transform research output into strong research outcomes. Henceforth, in their practice, our partners apply the knowledge that we develop through research projects for and with them. Our partners are often frontrunners in their fields, and other societal and industrial stakeholders follow their lead.

Acquiring long-term research grants (NWO, EU) has been one of our main aims during the past six years. We are increasingly successful in this type of scientific grant application. These types of projects are important for us to achieve our goals. It allows us to maintain the number of PhD candidates in the department and increases the number of PhD candidates funded through scientific research projects.

Contribution to the national research agenda in the MBE domain: in 2016, we were still seeking to increase our influence and contribution to the national research agenda. Our work to achieve this has been successful over the past six years. We are invited to participate in agenda-setting activities through our academic research centres, for example, on research calls from RVO, development of research initiatives by the Dutch ministries, *Rijksvastgoedbedrijf*, *Rijkswaterstaat*, etc.

WEAKNESSES

- MBE Identity: need for more communication about research products and impact
- Low awareness of personal research grants opportunities
- Insufficient budget to replace retiring staff
- Work pressure

The department has grown in staff due to the convergence of MBE and OTB in 2019. Hence, we needed to rediscover and develop our common identity. We have a relatively small management team compared to the number of FTE and a high necessity to communicate with each other in efficient and open ways. COVID-19 led to working from home for a large part of 2020-2021, meaning that we lost informal communication channels and coffee chats. It took us a lot of time to build up formal communication to fill the gaps of previous informal communication. And still, formal internal communication can be improved. For external communication, we need to improve channels to communicate and disseminate research products. Accordingly, although our work and several individual researchers are well known to external academia, industry and society, the MBE identity is not always clear to our external audience.

Whereas we are successful in larger scientific research grants with consortia, our awareness of personal research grant opportunities provided by NWO and EU is limited. We see achieving personal grants by research staff at all levels as one of the measurements for our aim to foster talent and develop next-generation leaders in management in the built environment.

Funding for tenured staff is threatened by decreasing university funding and a university and faculty policy to finance tenured staff 100% from direct funding. Currently, part of the tenured staff is financed through external research funding (scientific funding and funding by societal and industry partners). This means that we cannot replace all retiring staff and thus need to be selective in which roles to replace.

Especially during the COVID-19 crisis, but also more structurally, tenured staff experiences high work pressure. Tenured staff is expected to spend 40% of their time on research, 40% on educational tasks, 20% on organisation and overhead activities. As educational tasks run in specific educational periods, research time is scarce and dispersed during the peak periods of education. This means that during long periods of the year, tenured staff is working under pressure to deliver funding proposals and research results while also performing educational duties. With the number of tenured staff decreasing, staff will get more education responsibilities and will have less time for research.

OPPORTUNITIES

- Increased funding opportunities for MBE research
- Institutionalised collaboration with academic institutions
- Temporary mobility for tenured staff

We see increasing funding opportunities for MBE research, as both NWO and EU focus on societal issues in their research programmes for scientific funding that can increasingly only be tackled by transdisciplinary research. Here, MBE has a clear advantage being multidisciplinary as a department, and also collaborating with various disciplines in academia and practice.

MBE has several institutional collaborations with academic institutions, like the AMS institute, LDE and directly with the Erasmus University through the TUD-EUR Convergence initiative and 4TU Built Environment Centre. These collaborations are, again, transdisciplinary and contribute to broaden our field of impact.

With many collaborations in international research programmes and with the international reputation of the TU Delft and the Faculty of Architecture and the Built Environment, MBE staff has good opportunities for temporary mobility and are more frequently invited as visiting professors, fellows or lecturers. These opportunities help us to continue building our network internationally.

THREATS

- Labour and housing market (for new staff)
- COVID-19 (pandemics): less opportunity for debate and interaction
- Ethical concerns about staff (data security issues)
- Threats (a.o. in social media) about societally sensitive research

With large numbers of temporary, often international, staff, the Dutch housing market is a possible threat to hiring top talent and being able to execute acquired research.

Dutch talent often chooses to work in industry rather than at the university as a PhD or PostDoc candidate. High work pressure, lower salary and the uncertainty of temporary contracts are issues that reduce the interest of high-potential graduate students in pursuing a career in academia.

COVID-19 has shown to be a threat in 2020-2021, and future pandemics could be a threat. What we have learnt from COVID-19 is that it influenced staff mobility and the mobility of applicants for vacancies. We have learned to communicate better online, organise online conferences and collaborate on international projects in an online setting. However, although online collaboration works well, networks are weakened by a total absence of face-to-face meetings.

A wide recognition has opened our world to broad collaborations internationally and with new countries. Unfortunately, online working also increases (cyber) security risks. As a university, TU Delft is taking measures to restrict collaboration with certain institutes that might bring an increased security risk. This leads to ethical concerns in already ongoing projects and cautiousness in starting new collaborations and projects. Where we aim at increasing our working field, we realise that such threats will limit possibilities in some fields.

Social media and its reach are good for impact but can sadly also increase the number of threats to researchers based on societally sensitive research output. Some MBE staff members have already received threats through social media by 'internet trolls'. We do not have a good overview of the extent to which this happens. Still, as our research mainly focuses on societal challenges, this is a potential threat to openly publishing and sharing research ideas and results.

POINTS OF ATTENTION

Based on the SWOT analysis, we defined some specific points of attention⁸ for the coming six years (see also MBE Strategy 2022-2027):

OPEN SCIENCE

We follow the university and faculty policy on open science. Our opinion is that research integrity and the impact of our output can benefit from an open data policy but still misses data on the extent of open data use. There is also a concern that a large part of the data we use includes personal data protected under the GDPR and, hence, cannot be shared openly. As part of Open Science, open publishing has increased and is generally seen as a good development. The worries that we have is about the quality of the publishers and their review processes. Publications by ‘predatory’ publishers will be blocked as they do not contribute to the quality of publications.

PHD POLICY AND TRAINING

We follow the graduate school in our PhD policy and training. Within MBE, we also pay attention to PhD recruitment and have developed additional policies on recruitment (see also paragraph 3). We encourage supervisors to follow the guidelines from the graduate school, follow courses on supervision and join discussions with PhD candidates regularly. Gender balance and gender bias in the supervision and assessment of PhD candidates are on our agenda. We therefore always have PhD committees with both male and female members, ideally in a mix of max. 70%/min. 30%.

ACADEMIC CULTURE

Fostering a good academic culture that works for MBE is always on our agenda. Diversity, inclusiveness and integrity need attention to be obvious, and we pay attention by organising meetings, workshops and working groups to work on this collectively. Specific attention will have to be paid to vulnerable groups of staff, like tenure trackers and PhD candidates with temporary contracts.

HUMAN RESOURCES POLICY

Diversity and attracting and keeping talent are two specific points for our HR policy for the next six years. Diversity means diversity in gender, cultural and ethnic background, and educational background. Educational diversity is important to us as we strive to (continue) excelling in transdisciplinary research. A good gender balance is accordingly important and is safeguarded through procedures. Diversity in cultural and ethnic backgrounds is counterweighted by the need to have Dutch-speaking tutors and researchers who understand the Dutch context of the real estate industry, as it is often very specific, for example, in laws, regulations, policy etc.

8 Some of these points are interrelated: research integrity is part of Academic Culture but also important in Open Science. The same goes for diversity, which is part of HR Policy but also considered important in Academic Culture.

RESEARCH STRATEGY 2022-2027

6.2.1

RESEARCH PROGRAMME

The current MBE research mission and objectives have been developed over the past three years; they will continue to guide our research in the coming period. In line with these, MBE will further develop the research themes equity in the built environment and the transitions in the fields of circularity, energy, and digitalisation, which all contribute to our ultimate mission: to deliver the scientific knowledge that is needed to develop a sustainable built environment, in which the interests of the end-user and other parties involved are the starting point.

The choice for these themes is based on the challenges and transitions that we recognise in society, combined with scientific challenges to approach this type of complex problem that largely requires a transdisciplinary approach. The themes align well with the aims and mission of the faculty and university (i.e. faculty multi-annual plan) and, finally, the department's knowledge, experience and capacity. There are regular meetings between the daily board and professors in which new challenges are discussed.

6.2.2

HR-POLICY: STRATEGIC PERSONNEL PLAN

- Based on our research strategy, we will develop our strategic personnel plan for the next ten years. To achieve our research mission, we need a team with the knowledge and capacity to develop and deliver excellent, cutting-edge research. As a large number of senior staff will retire in the coming ten years and we cannot replace all (see SWOT analysis), we will define in our strategic personnel plan which scientific fields and knowledge we need to replace and strengthen to achieve our mission. The profile of future vacancies will follow this strategy.
- As a number of senior full professors and associate professors will retire in the coming years, this will give opportunities for new tenured academic staff. As promotions are currently merit-based and not on positions, younger staff does not have to wait until current staff retires to grow and be promoted.

- A newly developed sector plan for the design sciences will provide extra funding at MBE; three new positions will be funded. They will contribute to our strategy of developing the themes of circularity and digitalisation.
- We aim to have an international, diverse, excellent staff. Still, internationally, we realise societal impact through collaboration with local partners. With our research, we mainly have a societal impact in the Netherlands. Therefore, keeping a balance of international staff and staff that speaks Dutch and understands the Dutch context is important to realise our ambitions.

6.2.3

FUNDING STRATEGY

- At MBE, acquiring long-term scientific grants has become one of our strengths. This type of grant directly contributes to our research mission as it allows us to develop theory and novel perspectives, based on which we develop strategies, solutions, methods and tools, with which we continue our mission to improve governing, organising and managing for a sustainable built environment.
- The faculty is developing a plan for ‘rolling grants’ as a direct funding tool for research at the department. We will use these grants to develop research within our four selected research themes equity in housing and the transitions in the fields of circularity, energy, and digitalisation.
- Acquiring personal grants by research staff at all levels is an indicator of individual excellence. So far, we are not successful in achieving personal grants, but we have set the target to acquire at least one in the next six years. To achieve this, we will facilitate eligible candidates. Even so, we want to encourage collaborative research efforts within the department. We are aware that we will need to focus on this contradiction to achieve both aims.
- Although we are successful in acquiring scientific research projects and programmes, we spend much time writing proposals. We aim to develop a strategy for being more selective in which proposals we develop. We will develop a selection procedure to increase the chances of winning proposals and to ensure that we do not develop several proposals for the same call within the department. A way to be ahead of the large research calls and steer on our participation in calls is to strategically scout for new research calls together with the impact and innovation centre. This is a logical next step to take to be strategic about which research programmes and calls we want to participate in. This approach could allow us to develop a pipeline of proposals and encourage staff with knowledge and experience in specific fields to participate in certain calls while spending less effort on calls in which we are less likely to be successful.

SOCIETAL IMPACT, VISIBILITY AND IDENTITY

A challenge that we will further develop is a strong common identity. We will do so by organising research, education and strategic workshops and meetings, bringing together groups of staff in different settings and groups. Moreover, we will organise lunch meetings in which PhD candidates, postdocs and tenured staff present research to each other. Also, more social ‘get-togethers’ will be organised, taking different shapes, like having coffee together, doing sports activities together, and organising our common lunches again. Once this is established, we will work on developing our external communication to also present our common identity. Things that we will do here are to organise research and industry seminars, inviting speakers from industry and societal and government bodies to present and discuss research on societal issues. This is also a way of adding layers to the organisation of societal impact. We already do that well through working with societal and industry partners in scientific research, through our professors with part-time functions in our department and part-time work for industry, and through communication in media, etc. To succeed in our mission, we will need the help of non-academic staff, and hence we will look at the possibility of hiring media and communication staff.

OPEN SCIENCE

- Our PhD candidates, PostDocs and tenured staff are all working in line with the university’s Data Management policy. Researchers are requested to submit a data management plan at the beginning of projects. In the next years, we will prioritise informing and requiring all researchers to work with open-access data where possible.
- We have shifted to publishing our research results in open-access journals, which will remain a focal point. Also, the choice of journals will be put more on the agenda.
- We will ensure to check the quality of the publishers and their review processes.

ACADEMIC CULTURE

- We are working hard to keep an open, inclusive academic culture. This means promoting diversity and including colleagues from all cultural, ethnic and gender backgrounds and from all research fields and educational backgrounds at all career stages in the society of our department. We need to overcome some challenges in the next years, namely ensuring that all PhD candidates feel included. We also need to react to a changing world in which collaboration with colleagues and the hosting of researchers from certain countries and institutes has become complicated.

- We will work on better including our PhD candidates by taking several measures: 1) Requiring tutoring courses for new PhD tutors; 2) Organising mandatory meetings with all supervisors and PhD candidates in the department, in which we discuss how to better work together; and 3) Organising lunch meetings in which PhD candidates present their research to all colleagues, with feedback given by peers from the department who are not part of the supervisory team.
- It is in our nature to seek collaboration and develop partnerships with international researchers and institutes, which also contributes to our diversity aim. This is, however, challenged by the fear of espionage and non-ethical research attitude by researchers, supervisors, institutes and governments of certain (non-European) countries. We already have good routines in place for hiring new staff but are now also installing careful review procedures for collaborations, staff exchange and visiting researchers. We aim to keep an open research society, and to do that we need to ensure that all MBE staff and partners are working ethically and openly.

6.2.7

PHD POLICY

- We have seen a small increase in PhD candidates completing their thesis and graduating within five years, but further increasing this number will remain on the agenda as we consider it important to enable PhD candidates to complete their thesis in time.
- From PhD surveys, we know that self-funded PhD candidates and PhD candidates with a grant encounter more difficulties during their PhD training than their colleagues. They often have tight personal finances and rely on department funding for conferences, travels, etc. Also, self-funded PhD candidates seem to feel more excluded by colleagues and supervisors. This could be because they are not part of a larger research project where more researchers work together. As PhD candidates with private funding or external scholarships will remain welcome, we want to make sure that we can include them well in our department and that we can improve and shorten their journey towards a PhD. We aim to increase the number of PhD candidates funded through research projects and with an employee contract. As we increase the number of TU-employed PhD candidates, we want to stabilise the number of grant-PhD candidates. Over the next years, we aim to develop our personnel strategy on this point by developing aims for how many PhD candidates we will take up every year and by developing strategies to improve the success rate of graduation within five years. We want to encourage PhD candidates from different research groups and backgrounds to interact with each other even more. To this end, we have already developed an office environment specifically for the PhD candidates and want to encourage further interaction through developing more collaborative activities.

Based on the SWOT, we believe that MBE research is in a better situation than six years ago and that following our strategy will allow for further development.





URBANISM

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SUMMARY

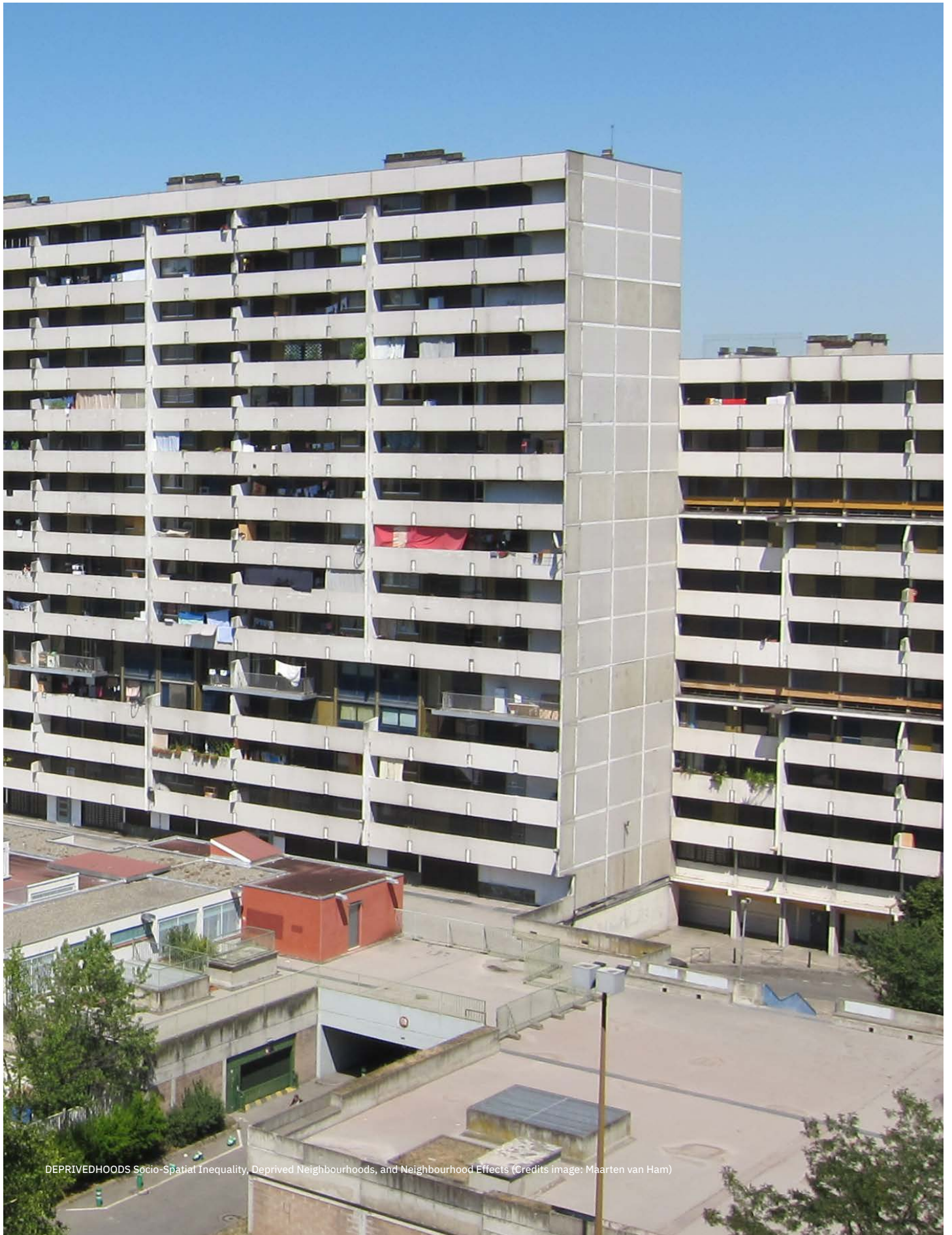
SUSTAINABLE URBANISATION, CLIMATE ADAPTATION, CIRCULARITY AND DIGITISATION ARE AMONG THE CORE THEMES THE FACULTY EMBRACED AS RELEVANT SOCIETAL THEMES FOR RESEARCH AND EDUCATION. THE DEPARTMENT OF URBANISM ADOPTS THEM AS THE FOUNDATION FOR DEVELOPING EXCELLENT SCHOLARSHIP AND RESEARCH. WE SEE URBANISM AS AN INTERDISCIPLINARY PLANNING AND DESIGN ACTIVITY THAT FOCUSES ON THE (RE) CREATION OF SUSTAINABLE URBAN LANDSCAPES AIMED TOWARD CLIMATE ADAPTABILITY, CIRCULARITY, SOCIAL EQUITY, AND ECOLOGICALLY INCLUSIVE URBANISATION AT ALL SCALES.

This is reflected by our mission: to advance, share and apply knowledge on how to adapt the built environment to societal and environmental changes; and to apply contextual design, planning and engineering strategies and interventions with impact for a better society. The Urbanism research programme is shaped by our understanding that the quality of the urban environment is crucial for societies' social, economic and environmental performance and for a more sustainable and fairer urban environment.

The Department of Urbanism received the highest score for excellence in the 2016 research assessment. Urbanism has an international reputation for academic research, scholarship and education built on the Delft Approach to Urbanism. This approach is knowledge-based, design-oriented, and multiscale, in which landscape architecture, urban design and planning closely collaborate with engineers, data scientists, sociologists, geographers, and ecologists. Urbanism is committed to socially relevant research, exemplified by our involvement in design projects and policy development, the development and implementation of practical tools and methods and our leadership and participation in (inter)national networks. A high level of scientific output in the form of journal articles, books and datasets and their use, but also the high number of prestigious ERC grants and awarded NWO and Horizon2020 funding testify to our premium research.

Our research is organised around four cross-cutting themes, which involve staff from across Urbanism: Delta Urbanism, Inclusive Urbanism, Green Urbanism and Data-supported Urbanism. These four themes are closely aligned with the research themes of the faculty. We are dedicated to open science, disseminating research through publications and datasets in open formats. Strengthening a safe and productive academic culture, in which research integrity and inclusivity are key elements, is part of our ongoing effort to enhance the conditions for a thriving urbanism community and a strong PhD culture. Through our HR policy, we are continuously working on the talent management of existing staff, developing leadership, increasing cultural diversity, and improving female representation among senior staff.

In the future, the department will consolidate the research programme to remain world-leading in design-related scholarship and socially relevant and impactful research for the understanding, planning and developing of sustainable urban landscapes. We will strengthen the Delft Approach to Urbanism, which is socially and ecologically inclusive, with a strong link between spatial research and design across all scales, based on inter- and transdisciplinary working, and employing state-of-the-art digital technology. To foster disciplinary breadth, depth and innovation, we nourish a fair, diverse and inclusive academic culture where everyone can excel and talent is rewarded, with a strong connection between research and education. We will strengthen our PhD culture to stimulate a more efficient Urbanism PhD programme. We will actively participate and lead academic and societal networks and engage with NGOs and governmental and other societal partners. We will continue stimulating open and collaborative research practices to make publications, data, software and other types of academic output available to the world.



INTRODUCTION

URBANISM IS AN INTERDISCIPLINARY DESIGN-ORIENTED PLANNING ACTIVITY FOCUSED ON (RE)MAKING SUSTAINABLE URBAN LANDSCAPES GEARED TOWARDS CLIMATE ADAPTATION, CIRCULARITY, SOCIAL EQUITY AND ECOLOGICALLY INCLUSIVE URBANISATION ACROSS ALL SCALES.

We strongly believe that the complexity of the societal challenges requires a **cross-disciplinary approach that is context-driven, solution-focused, internationally oriented and employs design thinking in addition to academic rigour**. By cultivating this integrative Delft approach to urbanism, the Department of Urbanism gained an excellent global reputation in societally relevant academic research, as expressed in the highest score for excellence in the previous research assessment in 2016.

A high level of scientific output in the form of journal articles, books and datasets and their use, but also the high rate of prestigious European Research Council (ERC) grants and awarded NWO and Horizon2020 funding testifies to our premium research. As detailed in this document, **we are committed to societally relevant research** regarding impact, public engagement and uptake. This is exemplified by the department's involvement in design projects, the development and implementation of practical tools and methods, and our involvement in policy development. Leading and participating in national and international networks with renowned academic partners, governments, NGOs and other societal stakeholders ensures that we are at the forefront of emerging research questions, spatial innovation and societal development.

The breadth of disciplines represented in the department and the fruits of their interdisciplinary collaboration become apparent through our four research themes focused on **Delta Urbanism, Inclusive Urbanism, Green Urbanism** and **Data-supported Urbanism**. These themes enable us to align our ambitions and research initiatives while bolstering innovation and collaboration. A key feature of our department is our dedication to **open science**, disseminating research results successfully through publications and datasets in open formats. Strengthening a safe and productive **academic culture**, in which research integrity and inclusivity are key elements, is part of our ongoing effort to enhance the conditions for a thriving urbanism community.

Through our **HR policy**, we continuously work on increasing female representation among our senior staff, as well as improving cultural diversity. Our efforts in **talent management** focus on rewarding excellence through internal promotions and developing leadership and communication skills through dedicated programmes. At the same time, we teach and generate a steady number of planning and design professionals through our MSc-graduate programmes. And we **invest in our PhD student community**, advancing future generations of internationally and design-oriented PhD researchers who benefit from a strong connection with our research.

Though the COVID-19 pandemic severely impacted social and academic life and sometimes caused personal tragedy in our department, the entire Urbanism research community showed a tremendous capacity for adaptation and true resilience in maintaining high levels of societally relevant research output. Jointly preparing this document was a meaningful learning process in which we shifted from a more quantitative to a more qualitative description of our research. A process in which we experimented with the narrative format to express the viability of our work and its academic and societal impact. It was a rewarding exercise to strengthen the exchange within Urbanism, making us more aware of our strengths, weaknesses, opportunities and threats. We are looking forward to your observations and constructive feedback that will enable us to strengthen further the Urbanism research community, the research programme and its societal impact.

MISSION AND STRATEGIC AIMS OF THE PAST SIX YEARS

URBANISM'S MISSION IS TO ADVANCE, SHARE AND APPLY KNOWLEDGE ON HOW TO ADAPT THE BUILT ENVIRONMENT TO SOCIETAL AND ENVIRONMENTAL CHANGES, AND TO APPLY CONTEXTUAL DESIGN, PLANNING AND ENGINEERING STRATEGIES AND INTERVENTIONS FOR A BETTER SOCIETY.

2.1

SCOPE

Sustainable urbanisation, climate adaptation, circularity and digitisation are among the core themes the faculty embraced as relevant societal themes for research and education. The Department of Urbanism adopts them as the foundation for developing excellent scholarship and societally relevant research.

The Urbanism research programme is shaped by our understanding that the quality of the urban environment is crucial for societies' social, economic and environmental performance and a more sustainable and fairer urban environment. Urbanism has a world-class international reputation for its academic research, scholarship and education for space and society, built on the **Delft Approach to Urbanism**.

This approach is knowledge-based, design-oriented and multiscale, with disciplines such as landscape architecture, urban design and planning closely collaborating with engineers, data scientists, sociologists, geographers and ecologists. Urbanism is a practice which finds solutions for contemporary challenges by connecting design, technology and science. We take this approach to the international arena in partnership with some of the world's leading universities.

The core of the Department of Urbanism in Delft is formed by the Sections of Urban Design, Landscape Architecture, Spatial Planning & Strategy, Urban Studies, Urban Data Sciences, and Environmental Technology & Design. **Urban Design** is concerned with the design of the physical form of existing urban areas and their future adaptations due to urban transformation processes. **Landscape Architecture** focuses on knowledge acquisition, strategy development and design exploration of landscape compositions and systems in the built environment. **Spatial Planning & Strategy** is concerned with formulating, implementing and evaluating policies, visions, strategies, plans and programmes for urban regions. **Urban Studies** investigates people-place relationships at different spatial scales, from neighbourhoods to cities and regions. The research is focused on a better understanding of how neighbourhoods, cities and regions develop, how different spatial configurations and structures emerge (within and between cities) and how these configurations affect socio-economic outcomes for people across spatial scales. The Urban Studies section became part of Urbanism as a result of the reorganisation of the former OTB department in 2019 (see introduction Faculty). **Urban Data Science** focuses on the technologies and governance models underpinning geographical information systems (GIS) and spatial data infrastructures. It aims at designing, developing, and implementing better systems to model (3D) cities, buildings and landscapes, as well as the governance mechanisms employed in concepts such as the 'open city' and 'the city as a service'. **Environmental Technology & Design** focuses its research on the sustainable development of neighbourhoods, cities and regions, addressing the environmental challenges in the interaction of people, technology and design.

The six sections form the basis for **inter- and transdisciplinary¹, context-driven, problem/solution-focused research and education**. Together they cultivate and substantiate the Delft approach to Urbanism (Fig. 2.1). Urbanism involves engineering-, social-, and environmental-based methods and techniques as operative instruments, as well as the development and application of advanced social and urban data science and geospatial information technologies. Besides the development of the disciplines themselves, there is a strong emphasis on the interaction of these fields in terms of theories, methods and techniques, as well as their application via concepts, strategies and spatial interventions exemplified by four research themes: **Delta Urbanism, Inclusive Urbanism, Green Urbanism** and **Data-supported Urbanism** as elaborated through four case studies in paragraph 5.

1 **Multidisciplinarity** draws on knowledge from different disciplines while remaining within their respective disciplinary limits. **Interdisciplinarity** analyses, synthesizes and harmonizes links between disciplines to create a coordinated and coherent whole. **Transdisciplinarity** is a type of interdisciplinary working but actively engages societal stakeholders (apart from the scientific community) in co-creating knowledge and solutions.



FIG. 2.1
The Department of Urbanism and its constituent sections

FIG. 2.1

The department has 228 staff members (124 Full-Time Equivalent, FTE) in total, of which 66 with tenure (51.2 FTE), 59 with a temporary appointment (39.54 FTE) and 103 guests (33.37 FTE) involved in research, education and organisation. This group represents **28.5 FTE of research capacity** (excl. PhDs and visiting fellows). The breakdown in positions, staff development, gender balance and cultural diversity of research staff is discussed in paragraph 5.

Urbanism is led by a Management Team (MT) that consists of the department chair, department manager, section leaders, research leader and education leader. The MT meets every two weeks. Next to the MT, there is a Daily Board for Urbanism Research (DB Research), in which research coordinators from all sections discuss research affairs on a monthly basis. DB Research provides advice and input for the decisions of the MT. The research leader is the link between DB Research and the MT but is also part of the Research Council of the faculty, a collective of research leaders representing the departments.

SUMMARY RECOMMENDATIONS OF THE 2016/2019 RESEARCH REVIEW

Following the self-assessment protocol, in 2016, an external assessment committee scored Urbanism research on a four-point scale ranging from 1 to 4. Urbanism was given the score 1 ('world leading') on 'research quality' as well as 'relevance to society' and 2 ('very good') on viability. The review panel issued the following strategy recommendations in 2016 and 2019 (in summary):

- Reconsider the research themes, and try to streamline/consolidate them. This would help to prioritise efforts to get more grants and communicate priorities and interests to the outside world of sponsors and students. It would also help identify gaps and new areas of research that could be filled by the new individual faculty to be hired,
- Continue to explore ways to engage the university in hiring women for chair positions,
- Continue training and redirecting middle-level staff in new and existing areas of research, along with developing new mechanisms and structures to guide doctoral student work,
- Continue to be proactive. The committee fully supports the stated goal to strengthen research management because a sustainable research programme requires both forward-thinking leadership in grant capture and consistent monitoring and tutoring in existing research development. The programme should consider adding the goal of fostering creative thinking with regard to directions for future research. This should be achievable because it appears that, despite the programme size and the complexity of the research areas, the programme governance can take place in an apparently seamless way (it uses regularly scheduled research programme meetings and, among other things, coordinates research within the Faculty Research Council).

The 2016 evaluation of our research and the recommendations of the assessment committee and the midterm assessment committee 2019 led us to formulate a departmental research strategy for the period 2016-2022 that will be elaborated on in paragraph 3.

STRATEGY OF THE PAST PERIOD AND PROCESS

3.1

STRATEGIC AIMS 2016-2021

Based on the evaluation and recommendations by the review committees in 2016 and 2019, the Department of Urbanism has continuously worked on developing its mission and strategy, entailing strategic objectives and a working programme for implementation. A process was organised in which staff was involved through regular general and dedicated meetings to jointly develop the mission, identify four common research themes, further develop the Delft Approach to Urbanism, and bring in new ideas and suggest improvements in oral and written form.

With regard to **research quality**, **societal relevance** and **viability**, our discussions have led to the following strategic aims for the period 2016-2021:

- 1 Consolidate the Urbanism research programme in clear cross-cutting themes, and focus on high-quality, societally relevant and impactful research;
- 2 Move from multidisciplinary working to an interdisciplinary approach and to further develop the foundations of the Delft approach to Urbanism;
- 3 Foster disciplinary breadth, depth and innovation of the constituent disciplines of Urbanism;
- 4 Build more robust interconnections between the research programme and education, making effective use of the high-quality student body;
- 5 Increase societal impact - making a difference in the real world.

To achieve the above strategic aims regarding quality, relevance and viability, it is important to create an academic environment in which research outcomes are shared widely and freely, make our PhD programme more efficient to free up staff time and invest in the academic culture of the department. Therefore, **Open science, PhD policy and training, academic culture, and human resources** are regarded as preconditions for achieving aims 1 to 5, which has led to three additional strategic aims:

- 6 Introduce the principles of open science more clearly in our research routines;
- 7 Further develop an efficient and impactful Urbanism PhD programme;
- 8 Provide a cohesive, diverse and inclusive academic culture and a community for all members of Urbanism to thrive.

Good academic research is not done in isolation but in collaboration with other national and international academic and non-academic partners, stakeholders and networks. **Strategic collaborations** improve the quality and societal relevance of our work but also strengthen our PhD programme through external funding. At the same time, strategic collaborations benefit from open science. This has led to a final strategic aim:

- 9 Build strong national and international strategic collaborations with academic and non-academic partners.

3.2

WORKING PROGRAMME

The strategic aims were operationalised through the following actions in the period 2016-2021:

CONSOLIDATING THE URBANISM RESEARCH PROGRAMME WITH A FOCUS ON QUALITY, RELEVANCE AND IMPACT (AIM 1)

Where in the past, our research performance was largely evaluated quantitatively, we now put much more emphasis on the quality of our research, both as a department and in the evaluation of research staff. The aim was to focus more on curiosity-driven research and on high-quality and highly esteemed partners and funding sources for more fundamental research. It was a strategic choice to move from many small projects to fewer but larger and longer-term projects. Therefore, we developed and adhered to a funding strategy containing the following elements: 1) focus on long-term funding (which for us means that it offers the possibility of hiring PhDs and Postdocs, 2) a preference for funding from well-established funding bodies (among which the ERC, NWO, H2020), 3) preparing applications with relevant partners and dedicating time to strengthen our network, and 4) focus on grants that target innovation and impact. At

the same time, 5) we reduced our dependence on external funding, which implies that we can focus more on curiosity-driven research, which will likely boost our innovation levels. We experienced a substantial increase in research funding with 6) a balance between national and international projects. 7) We also focussed more on winning prestigious individual grants (we recently secured our third personal European Research Council grant) and major collaborative grant projects through NWO and Horizon2020 funding with strategic partners in the Netherlands, Europe and China. The large number of external grants meant that we had to focus senior staff time on successfully managing and completing externally funded projects, which sometimes was a challenge. To increase the impact of our research, we put more emphasis on publishing in high-quality, open, and peer-refereed outlets. We stimulated research staff to publish at least one academic peer-reviewed journal paper (Web of Science or Scopus-indexed) per FTE researcher each year, including PhD candidates from year two. Stimulating a culture of academic publishing benefits the department as well as the careers of individual researchers. A culture of collaboration was stimulated within the department to avoid putting too much stress on staff. This resulted in a high level of scientific output in the form of peer-reviewed open-access journal articles, books and datasets. At the same time we maintained the visibility of urbanism research through valorisation across the full range of media, high-profile events and online learning, exemplified by the case studies in paragraph 5. We strengthened research management by holding monthly meetings of research leaders and organising broader research meetings and seminars.

FROM MULTIDISCIPLINARY WORKING TO AN INTERDISCIPLINARY APPROACH (AIM 2)

Societal challenges require inter- and transdisciplinary ways of working and design thinking to deal with complexity and to connect long-term perspectives with short-term actions. Therefore, we aimed to strengthen the Delft approach to Urbanism, which is by tradition a knowledge-based, design-oriented, multiscale and interdisciplinary approach in which a multitude of disciplines advance, share and apply knowledge on how to adapt the built environment to societal and environmental changes. However, as research tends to specialise and focus on the development of disciplinary knowledge, it is also important to reflect on what brings the disciplines together and what the added value of their collaboration is. Therefore, we focussed on identifying a limited number of overarching research themes in which the department excels, making room for emerging themes that build on existing competencies and outcomes. This enabled us to move from multidisciplinary working to an interdisciplinary approach while working on our department's theoretical and methodical foundations. As the Delft approach to urbanism is not fixed but represents a living discourse, we organised regular meetings with the entire department to discuss and reflect on the foundations of the approach, resulting in a written description of the Delft Approach. Through developing a shared mission, Urbanism has enhanced the definition of the department's research, which has resulted in the definition of four overarching research themes: Delta Urbanism, Inclusive Urbanism, Green Urbanism and Data-supported Urbanism. These themes are elaborated through case studies in paragraph 5 and appendix 2. The case studies display the breadth and depth of our research as well as the societal impacts exemplified by several quantitative and qualitative indicators (paragraph 4). This streamlining

also enabled a clearer relation to the faculty's and university's research themes. Within these four themes, people from different disciplines find each other easily as a result of the cohesive community that we are for joint bidding on externally funded research projects.

FOSTERING DISCIPLINARY BREADTH, DEPTH AND INNOVATION (AIM 3)

Urbanism as an interdisciplinary approach can only exist by the grace of each constituting discipline playing a key role in theoretical and conceptual debates within their disciplines and being at the forefront of methodological innovation in their own specific field. Therefore, we also leave much room for the individual, constituting disciplines to develop strategies that enhance the disciplinary breadth and depth of their discipline and concentrate their resources in a way that advances disciplinary innovation and allows getting the best out of their staff. This includes giving individual researchers the autonomy they need to develop into independent, innovative research leaders (Principal Investigators) and pursue their own ambitions. Through the appraisal process, we will continuously ensure that relevant staff are competent in research supervision, publication and writing of funding proposals. All our disciplines are active in setting the right conditions for innovation: organising workshops and events on novel themes, engaging in collaborations that provide novel perspectives and insights, bringing in key researchers as guests to the department or as speakers, and developing research networks with partner institutes, giving room to explore their staff's innovative ideas, etc. The possibility to do more curiosity-driven research is another important element – albeit it is a freedom that comes with responsibilities.

BETTER CONNECTING URBANISM RESEARCH AND EDUCATION (AIM 4)

For many practices in society, there is a strong need for academically trained professionals and evidence-informed ways of working. The academic profile of our Urbanism alumni is shaped during the masters' phase of the department's four study programmes: MSc track Urbanism, MSc track Landscape Architecture, MSc Geomatics, and MSc Metropolitan Analysis, Design & Engineering (MADE). The added value of intertwining research and education for students is clear: they get the most up-to-date knowledge in their field of study, develop their research skills, and develop a critical academic attitude. But our research staff also learns from teaching young critical minds. We aim for a strong link between research and education and have several ways of achieving this. Some best practices include 1) several (graduation) studios are embedded in research projects of staff, 2) the MSc Honours Program Master (HPM) Architecture and the Built Environment allows selected honours students to set up and carry out their own research linked to one of the current research projects in Urbanism, and 3) we stimulate graduation students to write scientific journal articles during and after

graduation. Since 2018, the faculty has embedded academic research into its educational innovations focusing on 'Teaching design', 'Academic skills', 'Multi-, inter- and transdisciplinary education', 'Online/blended education' and 'Curriculum revision and educational leadership'. The Urbanism department contributes to all themes of this research programme.

INCREASE SOCIETAL IMPACT – MAKING A DIFFERENCE IN THE REAL WORLD (AIM 5)

We are committed to socially relevant research in terms of applications, public engagement and uptake in an economic, socio-cultural and educational context. This is exemplified by the department's involvement in design projects, development and implementation of practical tools and methods, and involvement in policy development. As exemplified by aim 9 and the case studies in paragraph 5, we also strengthened collaboration with societal partners by bolstering outreach, capacity building and stakeholder engagement. This by leading and participating in national and international networks of renowned academic partners, governments, NGOs and other societal stakeholders to ensure that we are at the forefront of emerging research questions, spatial innovation and societal development. To increase the societal impact, the focus is on knowledge utilisation. We try to change the levels of understanding, knowledge and attitudes of all relevant stakeholders, including citizens, to empower them, and many outreach activities are aimed at exactly that, as exemplified by the case studies in paragraph 5. We contributed to professional magazines, news and other media targeted at larger audiences. We also actively contributed to policy debates, for instance, through organising or participating in workshops, conferences and other events where relevant stakeholders meet. Also particularly relevant is online learning: we have developed several MOOCs (massive open online courses). Some of them are part of the case studies described in paragraph 5. Urbanism addresses many relevant scales – from redesigning streets and public spaces to neighbourhood development, debates on urban and metropolitan development, involvement in provincial or national policy debates in many countries across the globe, and even regional development and planning issues at the European scale. We also actively participated in the discussion on the UN Global Development Goals. Communication, capacity building and stakeholder engagement are keywords in our work. The recent appointment of part-time design professors, leading professionals in the field, also strengthens our relationship with society by bringing in real-time cases and representing the department in societal networks and public debates.

MOVING TOWARDS OPEN SCIENCE (AIM 6)

Open science is a relatively new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. Moving towards open science had strong implications for how we conduct and organise our research in the department, particularly regarding data

management and open-access publication. We stimulate the shift from the standard practices of publishing research results and data in scientific publications or restricted databases towards sharing and using all available knowledge and data at an earlier stage in the research process. We do this by raising awareness, showing possibilities, and by making use of the facilities offered by the university, such as repositories (e.g. Pure) in which all research output needs to be uploaded and becomes available to the broader public. But also more proactively by setting up and hosting our own data repositories and refereed open-access publication series. As exemplified in paragraph 5, we became frontrunners in open science, especially through our high rate of open-access publications, software and datasets (e.g. 3DBAG) that found their way to scholars and societal end-users. In our perspective, open science also means that others can collaborate and contribute, where research data, software scripts, and descriptions of research processes are freely available under the terms of FAIR (Findable, Accessible, Interoperable and Reusable) that enable reuse, redistribution and reproduction of the research and its underlying data and methods. This aspect needs to be developed further through, for example, data management plans and setting up exchange platforms, as in practice, it turns out to be difficult to document and register all data and knowledge of all relevant stages of the research, as well as finding a balance in what to share when.

DEVELOPING AN EFFICIENT AND IMPACTFUL URBANISM PHD PROGRAMME (AIM 7)

The introduction of the faculty-wide A+BE Graduate school (see introduction Faculty) has strongly contributed to streamlining the PhD process, better organising doctoral education, closer supervision and mentoring of PhD students, and a more structured selection of PhD candidates. Next to the PhD policy and training offered by the faculty, we focus on developing an Urbanism PhD community and its performance. Therefore we organise regular sessions among the PhDs and their supervisors to discuss content, time management, supervision styles, etcetera. We are also working on ways to establish a healthy mix of different funding sources and diversity of scholarships, next to funded projects to safeguard a steady influx of PhD researchers and provide tenure trackers and other staff to gain experience in PhD supervision. Over the years, we have seen a steady inflow of new PhD students at Urbanism, while the number of PhD defences is picking up. Yet, there still is a concern about the time it takes to complete the PhD trajectory, as many PhD students take more time than the expected four years; reasons for this vary from person to person. Therefore, we aim to strengthen the PhD monitoring process through presentations to external peers to create a ‘flagship event’ to which all PhD candidates contribute (in addition to ‘go, no-go’ in year one). We also are working on training programs for supervisors to increase their effectiveness in coaching and mentoring PhD candidates.

PROVIDE A COHESIVE, DIVERSE AND INCLUSIVE ACADEMIC CULTURE AND URBANISM COMMUNITY (AIM 8)

In the ongoing effort to create a healthy and productive academic culture, we focussed on inclusivity and research integrity by raising awareness through departmental meetings and developing policy that stimulates good practices. We strongly adhere to the core values of TU Delft: Diversity, Integrity, Respect, Engagement, Courage and Trust (DIRECT). We have a zero-tolerance approach regarding academic misconduct (a senior staff is a member of the university academic integrity committee). For instance, there was an alleged plagiarism case surrounding a book of some very senior staff members of the department, in which the contributions of other staff were not sufficiently acknowledged. This caused a lot of unrest and feelings of unsafety among staff. We responded to it very quickly by discussing the case with the affected staff and those responsible for the book, something that did not happen in the past. This resulted in rectifications by the publisher and apologies by the book editors. Together with the university's integrity officer and the faculty's diversity officer (hosted by our department), we have also been working on programmes to raise awareness, showcase good practices and offer practical guidelines on research integrity, ethics, fairness, a safe working environment, etc. This required us to work on a respectful and diverse academic culture that reflects societal, cultural and economic trends such as women's empowerment, globalisation, the rise of countries in the Global South, acknowledgement of the LGBT+ community, and the increasing diversity in Dutch society. We aim to embrace diversity as an asset and value our staff for all their individual talents and qualities but also for what makes them unique and different. Diversity comes with challenges, and, therefore, we organised several workshops to raise awareness and stimulate dialogue. During these workshops, we were encouraged to be open about the challenges and opportunities of diversity while dialoguing on issues such as gender, micro-aggressions, stereotypes (negative and positive), language, feelings of isolation or lack of respect. Despite these and other initiatives, diversity and inclusivity require ongoing dialogue. Notably, we were the first department in which the leadership followed a specific course developed by TU Delft on 'Managing Undesirable Behaviour' and how to deal with it effectively. We also targeted diversity and talent management through our HR policy. Together with the HR department of the faculty, we develop ways to attract and bind excellent senior staff, particularly female professors. We are aware that we need to improve the proportion of female senior staff members (especially at the full professor level) and the cultural diversity in leadership. We work on this via targeted advertisements and personal invitations for job applications. To achieve our ambitions in talent management, we develop leadership and communication skills through dedicated programmes but also reward excellence through internal promotions to keep talented people.

BUILD STRONG NATIONAL AND INTERNATIONAL STRATEGIC COLLABORATIONS WITH ACADEMIC AND NON-ACADEMIC PARTNERS (AIM 9)

We continuously strengthen relationships with key local and international strategic research partners and networks and within the university through the Delft Research

Initiatives (DRIs). Urbanism participated in various knowledge centres and strategic collaborations like the Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute, a joint initiative of TU Delft, MIT Boston and Wageningen UR), the strategic Leiden-Delft-Erasmus Alliance (LDE), the Convergence Resilient Delta and Convergence Artificial Intelligence (AI) & data science. These are core initiatives where Urbanism professors take the lead (e.g. as scientific director). The Redesigning Deltas initiative is a recent example where Urbanism took the lead in a multiyear research programme (and one of the faculty's flagship projects). The department also plays a crucial role in 4TU.Federation being part of the board and taking a leading position in research projects where Dutch technical universities collaborate and produce outstanding and socially relevant research of an international standard and promote cooperation between research institutes and businesses. We also play a significant role in the GIMA programme, a collaboration between the University of Twente/ITC Enschede, TU Delft, Utrecht University and Wageningen University. GIMA is a blended learning master's programme offering more than advanced use of GIS (Geographic Information Systems) for a variety of applications, which has become one of the most popular and well-evaluated master's programs on geo-information applications and management in the Netherlands.

FIG. 3.1

The need for short- and long-term mitigation of, adaptation to and coping with urgencies and uncertainties

(Credits image: Guangyuan Xie)



FIG. 3.1

Internationally, the department took the lead in collaborating with leading global academic institutions by chairing the International Forum on Urbanism (IFOU) and actively participating in the IDEA League and BauHOW5, both strategic alliances among leading European universities of technology, science and engineering, committed to bringing science to society. At the institutional level, Urbanism also has strong partnerships with renowned knowledge centres in the UK, Asia and the Americas that stand

for excellence in research and societal impact. Examples include the Urban Systems and Environment Joint Research Centre (USE) with the South China University of Technology, in which we work on adaptive strategies for sustainable urban development in fast urbanising areas (Fig. 3.1), and the European Policies Research Centre (EPRC-Delft) with the University of Strathclyde, a centre for comparative policy research and knowledge exchange relating to EU Cohesion policy and other EU policies. We also actively participated in professional and academic networks such as Aesop, IFLA, ECLAS and ISOCARP, and we want to explore how we can better use these networks to contribute to the earlier-mentioned strategic aims.

Sponsorship of and collaborations with NGOs like the Van Eesteren-Fluck & Van Lohuizen Foundation (EFL), WWF Netherlands, UN-Habitat, Birdlife Association Netherlands, National Association for Greenspace Professionals in the Netherlands (VHG), Delta Alliance, Deltametropolis Association and National, Provincial and Local authorities ensure the societal relevance of our work. We are strongly connected to the TU Delft-wide Deltas, Infrastructures & Mobility Initiative (DIMI), which is developing integral solutions for urgent societal problems related to vital infrastructure for water safety and smart mobility, which are intrinsic to the natural and built environment. Urbanism's contribution focuses on the theme Resilient and adaptive urban deltas with the earlier mentioned Redesigning Deltas programme, but also with the Delta Futures Lab and the refereed open-access Journal of Delta Urbanism hosted by the department. Urbanism hosts the Academic Lead Climate Change Adaptation of the TU Delft Climate Action Programme and two of its flagship projects: Future Deltaic Systems and Sponge Cities. The Climate Action features plans for research, education, action on climate on the TU Delft campus and cooperation with the worlds of politics and industry. Urbanism also participates in a number of other cross-faculty research programmes and initiatives introduced in the Faculty chapter: 1 million Homes, Circular Built Environment, Health, Digitisation and Heritage.

INDICATORS

NEXT TO INDICATORS THAT REFER TO ACADEMIC OUTPUT, SUCH AS THE NUMBER OF REFEREED JOURNAL ARTICLES AND BOOKS, WE WANT TO SHOWCASE THAT WE ‘GET THINGS DONE’ THROUGH INDICATORS THAT EXPRESS KNOWLEDGE UTILISATION, SUCH AS THE USE AND DOWNLOADS OF PUBLICATIONS AND DATA SETS, REFERENCES IN PUBLIC DOMAINS (E.G. MEDIA) AND IMPLEMENTATION THROUGH DESIGN AND POLICY.

Table 4.1 shows an overview of indicators that we selected to evaluate the quality, impact and societal relevance of our research, in line with our own strategy and aims. The quantitative and qualitative indicators, such as demonstrable products, use of products and marks of recognition, express our performance as a result of our research strategy in the period 2016-2021.

In paragraph 5, the research context is laid out, and four research themes are elaborated by means of four case studies to exemplify the excellence and impact of our research programme based on these indicators and their relationships. Next to indicators that refer to academic output, such as the number of refereed journal articles and books, we want to showcase that we ‘get things done’ through indicators that express knowledge utilisation, such as the use and downloads of publications and data sets, references in public domains (e.g. media) and implementation through design and policy. Major awarded individual and collaborative research grants, as well as financial support from and contract research with societal partners, demonstrate that we as a department successfully implement our research strategy. The emphasis is on the qualitative aspects while using the themes and their case studies to highlight and exemplify evidence via examples. Some of the indicators can be summarised quantitatively in tables (indicated below), but most can only be shown through examples. This means that the overview in this format is highly selective but indicative of the quality and impact of our research.

TABLE 4.1 Categories of evidence for the quality domains of research quality and relevance to society

	RESEARCH QUALITY	RELEVANCE TO SOCIETY
Demonstrable products	Research products for peers	Research products for societal target groups
	(Open) Journal articles (Fig. 5.12)	(Open) Books (Table 5.4)
	Conference papers (Table 5.4)	Book chapters (Table 5.4)
	PhD-Dissertations (Table 5.4)	Professional publications (Table 5.4)
	Editorships	Lectures, masterclasses, conferences for a general audience
	(Open) Data sets and software	Invitations for public lectures
	Designs, plans and policy advices	MOOC's
	Exhibitions	
Demonstrable use of products	Use of research products by peers	Use of research products by societal target groups
	Use of data sets and software	Projects in cooperation with societal parties
	Citations of articles, books and other products	Contract research
	Downloads/reads of articles, books and other products	Use of academic results in contexts of practice
		Use in and relation to education
		References in professional and public domains (e.g. media)
		Use of academic results in contexts of practice
Demonstrable marks of recognition	Marks of recognition from peers	Marks of recognition by societal target groups
	Research grants awarded to individuals (Table 5.2 and Appendix 1)	Financial and material support by society (Table 5.2 and Appendix 1)
	Research grants awarded to individual and major collaborative research projects (Table 5.2 and Appendix 1)	Public prizes awarded to individuals
	Prizes awarded to individuals	

ACCOMPLISHMENTS DURING THE PAST SIX YEARS

5.1

RESEARCH CONTEXT

In 2021, the department consisted of **80 scientific staff members and researchers** (excl. PhD) representing **28.5 FTE research capacity** (Table 5.1). Regarding **HR policy**, the number of full professors has been declining over the years due to retirements, and it has been difficult to recruit new senior staff. This did not immediately affect the quality and impact of our research. However, it did affect the department's visibility since there were fewer full professors acting as figureheads to connect the department with societal stakeholders and contribute to societal debates. Although this role was partly and successfully taken over by leading associate professors, there are examples where, for instance, stakeholders or media reached out to professors from other departments since they could not find a full professor in our department addressing their needs. We believe that in the longer term, this might affect the societal impact and viability of our research. To address the issue, we have moved to a more proactive mode of talent management in which we stimulate the internal growth and promotion of talented and well-performing staff members through dedicated coaching trajectories. Although the **gender balance** and **cultural diversity** have improved in the past years, female leadership in the department lags behind, despite serious efforts to attract female full professors through targeted advertisements and personal invitations. Given the global focus of our work, the department acknowledges that we need more non-European representation in leadership without neglecting the importance of Dutch-speaking senior staff, which is important for a strong link to Dutch society (Figs. 5.13 and 5.14).

Regarding PhD policy and training, we have a steady population of **52 PhD students** on average, but the completion rate within four years in the past period was low despite the efforts of the Faculty Graduate School to professionalise the process and monitoring (Table 5.3). This does not affect the quality of the research but is a concern regarding the viability of the research in terms of financial coverage of hours and other resources. Part of the delays can be explained due to personal circumstances or because students only work part-time on their PhD. It is generally acknowledged that we need to increase efficiency, and, in this respect, training and professionalisation of supervision will become increasingly important. To increase the PhD population's cultural diversity, we aim for more Dutch PhD students to benefit Dutch society.

The Department has acquired more than **€ 26 million in research funding** in total for the period 2016-2021 (Table 5.2., Appendix 1). There was an increase of 40% in funding income when comparing 2021 with 2016. We successfully acquired several prestigious individual grants, such as 3 ERC grants, 3 NWO VENI/VIDI grants and 9 Marie Curie grants. Furthermore, we acquired more than 150 major collaborative research projects (Horizon2020, etc.) and projects which are financially supported by societal partners in the period 2016-2021 (for a full list, see Appendix 1). A limited selection will be highlighted in section 5.2.

The 2016-2021 period has been very productive, with a total output of **1336 publications**, of which **571 peer-refereed journal articles, 211 book chapters, 22 books and 46 PhD theses** (Table 5.4.). The full list can be found here: <https://research.tudelft.nl/en/organisations/urbanism/publications/>. Through repositories, such as Pure and the TU Delft repository, all our publications can be accessed, and most are open-access. This is due to negotiations by all Dutch universities with publishing houses, which have led to agreements that allow researchers at Dutch universities to publish open-access in most journals. The publication ratio per research staff member has remained high over the years, with an average of **3.1 peer-refereed journal papers per FTE** over the past six years and 3.4 in 2021, the highest of the faculty. This demonstrates a high level of awareness that knowledge dissemination is important in our research community. **Regarding open science, 87% of our refereed publications are open-access** (2021), representing a steep increase compared to 64% in 2016 (Fig. 5.12. Many of these publications are in high demand, given the number of downloads, as exemplified later.

Through **hosting and editorship of refereed, open-access and Scopus-indexed journals**, we take the lead in high-end open science. Examples include Bulletin KNOB (Dutch/English), Research in Urbanism Series, SPOOL and Planning Practice & Research. We are also very active in publishing open data and software, as demonstrated in section 6.2. Open datasets are published at repositories like <https://3d.bk.tudelft.nl/opendata/> 4TU repository or DANS-Easy, and software is made available on <https://3d.bk.tudelft.nl/code/> and Github. Several papers describing the creation of new datasets have been published in addition to storing the data. The department also provides the Programme Manager Open Science for TU Delft as a whole, benefiting from our knowledge and experience in this respect.

At the individual level, there were important marks of recognition; for instance, Dirk Sijmons, Professor of Landscape Architecture, received the IFLA Sir Geoffrey Jellicoe Award 2017, which is the highest recognition for unique and lasting impact on the welfare of society and the environment in the field of Landscape Architecture

(Fig. 5.1). Also, staff members received the ICE Reed and Mallik Medal 2018 for work recognised by their peers for exceptional quality and benefits for the science & engineering community. More examples can be found here: <https://research.tudelft.nl/en/organisations/urbanism/prizes/>.



FIG. 5.1
Professor Dirk Sijmons (centre) receiving
the prestigious IFLA Sir Geoffrey Jellicoe
Award 2017
(Credits image: IFLA)

FIG. 5.1

5.2

FOUR URBANISM RESEARCH THEMES ILLUSTRATED THROUGH CASE STUDIES

The research programme of the Department of Urbanism is organised in four themes: **Delta Urbanism**, **Data-supported Urbanism**, **Green Urbanism** and **Inclusive Urbanism**. We illustrate the quality and impact of the research themes through **four case studies** of the research and projects conducted by the department. The cases also show proof of the viability of our research as the four themes represent the ways how we address societal challenges such as sustainable urbanisation, climate adaptation, circularity and equity. The case studies stretch across the sections and are not strictly connected to one section or research group (Fig. 5.2). In each of the case studies, we could only highlight a selection of our research outputs, use and recognition, as mentioned in paragraph 4. See Appendix 2 for more detailed narratives of the four case studies and an overview of the research and projects involved.



FIG. 5.2

Four themes to explain the research results of the department as a whole
(distribution of the research is only illustrative)

FIG. 5.2

5.3

DELTA URBANISM

Sustainable urbanisation, loss of biodiversity and climate change are key challenges for **deltas around the world**. These highly dynamic geographies are characterised by fragility, criticality and risk: transitional landscapes between land and water, altered by the effects of urbanisation, industrialisation and extractivism. The department's research on Delta Urbanism covers the most important scales of the **relationship between land and water, focussing specifically on the development and application of design-oriented, systemic, and inter- and transdisciplinary approaches sensitive to social-cultural and ecological conditions on-site**. Adaptive multiscale design strategies, nature-based solutions for coastal and riverine flood protection, water-sensitive urban design and vernacular water practices are some of the themes that are elaborated on in research and teaching.

Several **major international collaborations** exemplify the quality of our research and societal impact with partners from academia, the private sector, governmental bodies and local NGOs, building a transdisciplinary framework at the intersection of spatial design and planning, governance, social sciences, water science and engineering. One example is the DST-NWO Water4Change project, a collaboration of the Dutch and Indian governments in which the department takes the lead. This project started in 2020 with a research grant of **€ 3.5 million**, enabling **13 PhDs** (4 NL, 9 India) and **3 Postdocs** (1 NL, 2 India). It addresses the complex challenges to urban water systems faced by fast-growing secondary cities in India and the sustainability transitions needed for short- and long-term mitigation of, adaptation to, and coping with urgencies and uncertainties (Fig. 5.3). By co-creating a Water Sensitive City Framework and a Fit-for-Purpose Guideline, this research enables water-sensitive development, accounting for site specificities, knowledge and practices, presenting innovative interventions, practices and design, and policy guidelines.

Another example is the NSFC-NWO- EPSRC Adaptive Urban Transformation project, a collaboration of the Chinese, Dutch and British governments in the Sustainable Deltas Programme. The project started in 2018 with a research grant of **€ 1.1 million**, focusing on urban landscape dynamics, regional design and territorial governance in the Pearl River Delta in China, the fastest urbanising delta in the world. This joint research project with academic and societal partners addresses sustainable urban transformation and, in particular, adaptive socio-ecological inclusive design strategies and principles that employ natural and urban dynamics to address increasing flood risk and loss of biodiversity in fast urbanising deltas. This has led to **17 refereed journal articles, 3 PhD theses and 5 invited keynote addresses** at major conferences such as the prestigious Annual National Planning Conference China with **10.000+ visitors and 15.000+ streamings**. Also, online/offline media coverage displays the societal interest in the research, exemplified by an article in Les Echos Week-End, a weekly magazine by France's largest business newspaper and a Television interview at the 5:00 pm Wink News in South Florida. Next to policy guidelines and adaptive design principles, the project also led to practical applications and implementation through design projects in which we led the design team responsible for urban development plans in, for example, Guangzhou and Shantou (Fig. 5.4).

Transdisciplinary working with scholars, designers, students, and societal partners is fundamental to Delta Urbanism. Collaborations with the Departments of Architecture and Management of the Built Environment and the Faculties of Technology, Policy and Management, and Civil engineering ensures its interdisciplinary focus. Besides research, there are also **strong links with education** through research-by-design graduation labs dedicated to Delta Urbanism. Especially the Delta Interventions Lab and Transitional Territories Lab, related to Urbanism and Architecture MSc tracks, and the Circular Water Stories Lab and Resilient Coastal Landscapes Lab from the Landscape Architecture MSc track are examples of teaching related to Delta Urbanism across the departments and sections. We play a leading role in the cross-faculty Delta Futures Lab, uniting master students, researchers and professionals in multidisciplinary projects in the framework of DIMI Delft Deltas, Infrastructure and Mobility Initiative. The organisation of several international symposia, conferences, PhD seminars, workshops, and exhibitions, such as the constructed pavilion 'The Port and the Fall of Icarus' at the Venice 16th International Architecture Exhibition 2018, further connected and expanded our network in academia and practice and helped to disseminate our work to the public nationally and internationally (Fig. 5.5).

FIG. 5.3

Water4Change

The Water4Change project regards India as a perfect 'testing ground' to reflect on the inter-plays and co-dependencies between society and nature; three case-study cities (Credits image: Water4Change)

FIG. 5.4

Landscape-based design for a new urban extension for the Municipality of Shantou

Employing water-sensitive and socio-ecological principles (Credits image: OKRA Landscape Architects with Steffen Nijhuis, TU Delft)

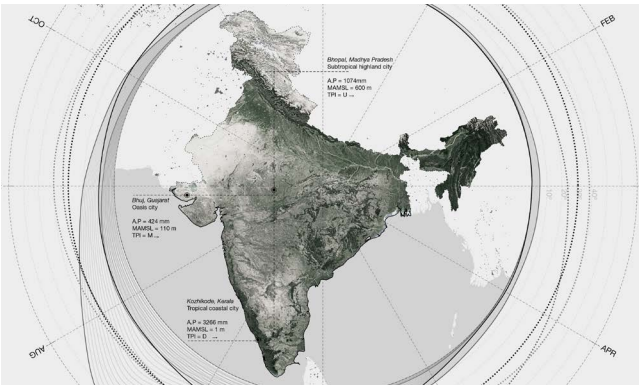


FIG. 5.3



FIG. 5.4



FIG. 5.5

FIG. 5.5
Constructed pavilion 'The Port and the Fall of Icarus'
 Venice 16th International Architecture
 Exhibition 2018 (Image credit: Taneha
 Bacchin, TU Delft)

5.3.1

INCLUSIVE URBANISM

Growing urban **inequality** is an **increasingly urgent concern** for citizens, urban practitioners and policymakers around the world. Inequality is not only unacceptable from an ethical and normative standpoint; it also generates high costs for society, hampering the performance of cities, with impacts on the health, social cohesion and living standards of cities, where people and economy can flourish. The department's research on Inclusive urbanism addresses those urgent challenges from an **integrated and cross-disciplinary perspective**, emphasising **the spatial dimension of inequality** and how spatial planning and urban design can be mobilised to make cities more just and inclusive. What makes our approach to researching those topics unique is how we combine insights and methods from the disciplines of urban design, spatial planning, urban geography and urban sociology. At the same time, in our research on and for inclusive urbanism, we seek to **engage a diversity of stakeholders** and, in particular, representatives of vulnerable and marginalised groups in the co-design of and co-decision on sustainable urban futures.

Next to major international collaborations, the research quality and impacts are illustrated by several **research grants awarded to individuals**, such as three prestigious ERC grants and a NWO-VIDI. An example is the 5-year DEPRIVEDHOODS research project funded by the European Research Council with a **€ 2 million ERC Consolidator Grant** awarded to a researcher from Urbanism. The project started in 2014 with ten researchers from Sweden, the United Kingdom, Estonia and The Netherlands. The objective was to better understand the relationship between socio-economic inequality, poverty and neighbourhoods (Fig. 5.6). The project resulted in **55 refereed journal articles, 4 books, 3 PhD theses** and more. The output is widely used, as exemplified by **378 citations** of a refereed article (2016) and **232.000 downloads** in the period 2021- 2022 of a refereed open-access book. The research also had wide media coverage in international newspapers such as the Financial Times, Washington Post and The Guardian, and on radio and television. The research fundamentally advanced understandings of the ways in which individual outcomes interact with the neighbourhood, which will ultimately lead to more targeted and effective policy measures.

FIG. 5.6
Better understanding of the relationship between socio-economic inequality, poverty and neighbourhoods
(Image credit: Maarten van Ham, TU Delft)

FIG. 5.7
How European identity and perceptions of the EU and Cohesion policy vary at national, regional and local levels
(Image credit: Cohesify)

An example of a **major international collaboration** is COHESIFY. Against stiff competition from 28 other consortia across Europe, this winning EPRC-led consortium comprised eight universities and two SMEs from ten EU Member States with complementary disciplinary backgrounds and applied creative expertise in communication, branding and citizen engagement. This two-year research started in 2016 with a total budget of **€ 2.4 million** in the framework of the **EU Horizon 2020: Inclusive, Innovative and Reflective Societies**. The project focussed on citizen engagement in spatial policies and the ways in which policy decisions affect citizens' lives. We explored the ways in which European policies to improve territorial, economic and social cohesion in cities and regions affect the identities and attitudes of the citizens, providing policy recommendations and **14 research papers** with insights for **bringing the European Union's Cohesion Policy closer to citizens** (Fig. 5.7).



FIG. 5.6

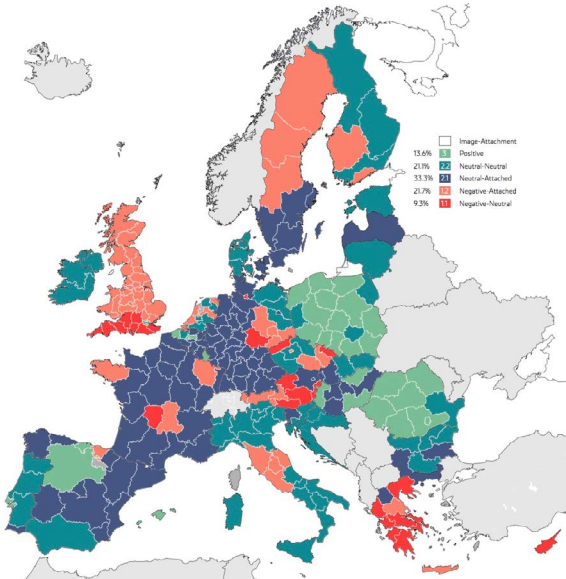


FIG. 5.7

The department is a **centre for responsible urbanists' research and education**, relying on inclusion, diversity and social justice. Next to our research, this is also reflected by our **outreach** activities involving partners in the **Global South**, for instance, through partnerships via the Delft Global platform, promoting the adoption of **co-creation** and **participation of vulnerable stakeholders** in social inclusive planning and design of public spaces and facilities. For example, via WHO Téchne, we participated in a World Health Organization network of architects, engineers, designers and public health practitioners that responds to acute public health events with urgent and customised support. In the context of the COVID-19 pandemic, we produced advice and design guidance for health authorities and other local organisations, helping to rapidly redesign and adapt existing facilities to accommodate the demands created by the pandemic. In Inclusive Urbanism, we also **integrate our research work with educational activities**, for instance, by co-creating a Manifesto for the just city with scholars and students or offering courses geared towards broad international audiences, including **MOOCs** on spatial justice and inequality as well as physical and online summer schools and workshops.

5.3.2

GREEN URBANISM

This theme aggregates, on the one hand, the department's research that deals with the urgent and intertwined societal challenges of climate change, energy transition, environmental degradation, biodiversity loss and food and material security, and, on the other hand, the more explorative and conceptual research that reframes the contemporary urban territory as landscape metropolis. The focus is on **advancing human and ecological well-being** through understanding and employing **nature, space** and **place conditions** for **socio-ecologically inclusive design** from the building to the regional scale. But also the development of **design-oriented landscape approaches** that base spatial development on the natural system along with exploring and employing the cultural, spatial and perceptive characteristics of landscapes in planning and design. Research on **urban climate and energy, regional landscape approaches, urban biodiversity** and **regenerative and circular urban landscapes** are connected to systemic design, adaptive design principles and regenerative strategies that lead to **healthy and inclusive green-blue cities**. The development of metropolitan landscape and nature networks, heat stress mitigation concerning urban morphology and increasing the sponge capacity and biodiversity in the urban context through greening cities are important topics for research and applications, along with circular approaches to address improvement or restoration, renewal or revitalisation of energy and materials sources in the built environment.

One example is the involvement of the department in the design and construction of the Van Leeuwenhoekpark in Delft, an example of the **use of academic results in contexts of practice in collaboration with societal partners**. Here, researchers were involved in formulating the project brief, the tendering process, advising the Municipality of Delft and the design team on microclimate design measures, and numerically simulating and (forthcoming) monitoring the microclimate in and around the park with

custom-developed weather stations. The park is currently under construction, and our involvement in the project led to significant alterations in the park's design. In another practice context, we collaborated with the **Municipalities of Rotterdam, The Hague and Amsterdam** to better understand the relationship between urban heat, urban morphology and its effect on health. The research was funded by the municipalities, the **Climate Proof Cities programme** by the Dutch Government and **4TU,BOUW**. The results were published in open-access publications *Amsterwarm* (2020), *Haagse hitte* (2018) and *Hotterdam* (2017). They indicated that urban heat islands pose serious health issues and that short-term social and behavioural measures must be accompanied by long-term action to regenerate the urban tissue. The research also resulted in policy advice that proposes a mix of solutions where residents, homeowners and the municipality each have a role to play in adapting to an environment that will be hotter more often and for longer periods in the future. The recently awarded, **prestigious personal NWO VENI grant** for research entitled 'The Garden Complex' is a significant acknowledgement from peers and showcases our excellence in research on metropolitan landscapes. Generous financial support by societal partners such as Birdlife Netherlands and the National Association for Greenspace Professionals in the Netherlands (VHG) enables research fellows to work towards the establishment of a centre of excellence in urban ecology and urban forestry, respectively. The Urban Climate Arboreta in Delft, Almere, Barendrecht and Dordrecht are examples of innovative experimental sites that generate knowledge on the cooling effects of trees in the urban environment.

FIG. 5.8
**Urban Climate Arboretum at the Floriade
in Almere**
(Image credit: Fotolinie)



FIG. 5.8

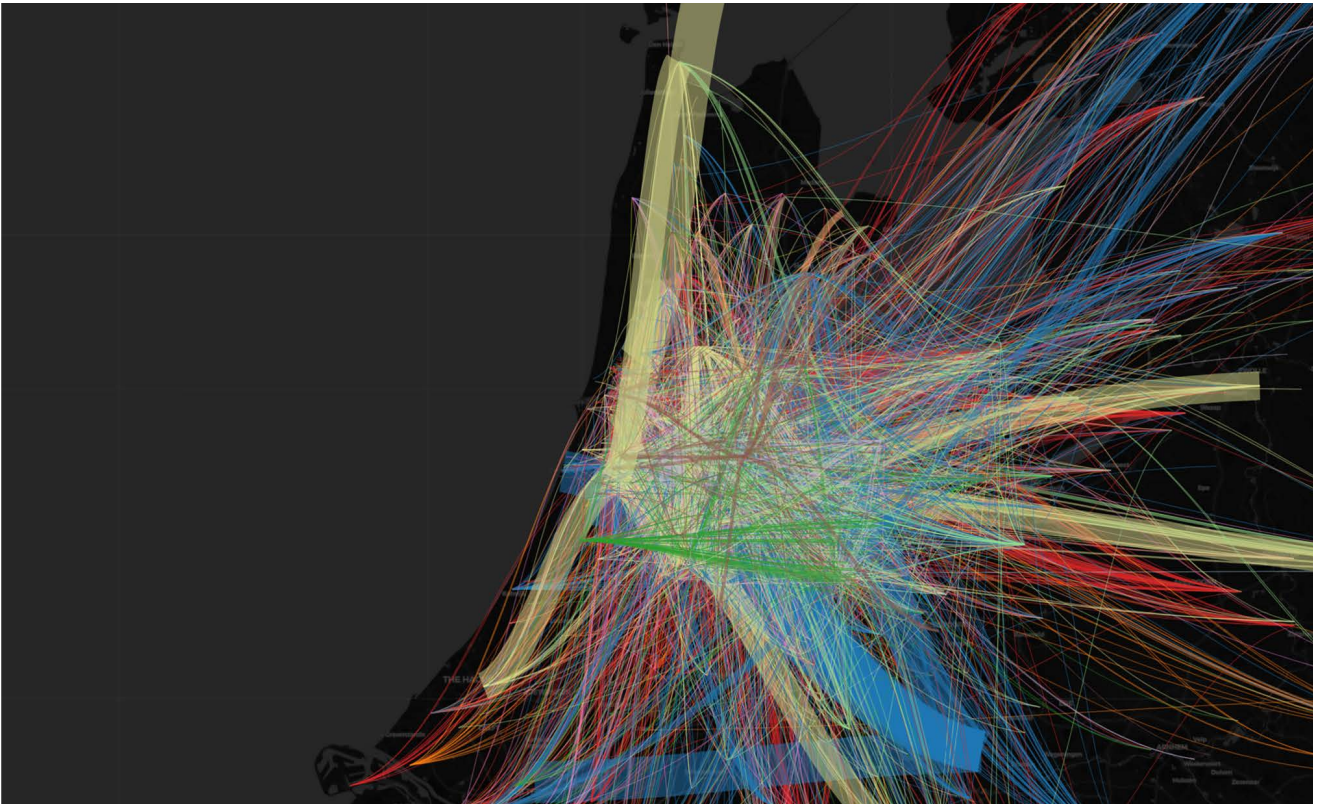


FIG. 5.9

FIG. 5.9
Analysis of material flows in the western
part of the Netherlands
(Image credit: REPAiR)

The **EU H2020 Project** REsource Management in Peri-urban Areas (REPAiR) is an example of a **major international collaboration** with a total funding of **€ 5 million** in which we take the lead in a 4-year project started in 2016. The core objective was to provide local and regional authorities with an **innovative transdisciplinary open-source geodesign decision support environment (GDSE)** developed and implemented in **living labs in six European metropolitan areas**. The GDSE allows creating integrated, place-based, eco-innovative spatial development strategies aiming at a quantitative reduction of waste flows in the strategic interface of peri-urban areas (Fig. 5.9). These strategies will promote the use of waste as a resource, thus supporting the ongoing societal initiatives to establish a strong circular economy. The research resulted in more than **40 refereed open-access papers, project reports, virtual exhibitions, an online knowledge transfer handbook** and an Online geodesign decision support environment (GDSE)-tool.

As exemplified by the research outreach, capacity building and stakeholder engagement are fundamental to the way we work. This also becomes clear in major conferences that we hosted and organised, such as the 14th Ecocity World Summit Rotterdam 2021, with more than **500 participants, 400 abstracts and 200 research papers**. But also **MOOCs** such as Sustainable Urban Development, Nature Based Metropolitan Solutions and Spatial Circularity Strategies for Sustainable Regional Development display our efforts in making a difference in society. Four theme issues in the refereed open-access journal Spool helped to increase our visibility around the theme of Landscape Metropolis.

DATA-SUPPORTED URBANISM

In the field of data-supported urbanism, the department's impacts are manifold, covering the whole lifespan of data (i.e. generation and reconstruction, standardisation, management, usage) as well as the different possibilities that modern open/big-data approaches offer to urban landscape planning and design in the context of Digital Twinning. The department is strongly committed to generating and using **innovative, sustainable and open data ecosystems** where researchers and practitioners can interact in different ways: by retrieving and using the data, adding new data, and delivering improved data and new insights back into the ecosystem. The impact encompasses both theory development as well as implementation. It focuses on how **buildings, cities and landscapes** can be **automatically** and **semantically modelled in 3D/4D** to be used for urban planning and design, which new legal, economic, societal and ethical **challenges and opportunities that new big/open urban data** brings to urbanism and how data-supported approaches foster the development of **new methodologies** and products that support all stages of **co-creative urban planning and design** with a particular focus on sustainability, circularity and inclusiveness challenges.

The prestigious project Urban Modelling in Higher Dimensions serves as an example of the research quality and societal impact of our work in this theme. This **€ 1.7 million** project funded by the **European Research Council** and **Amsterdam Institute for Advanced Metropolitan Solutions (AMS)** started in 2016. It enabled a team of **7 researchers (incl. 2 PhDs and 2 Postdocs)** to design, develop, and implement user-driven solutions to model cities, buildings and landscapes in 3D for environmental modelling, urban planning and design. The project contributed to generating a countrywide open 3D dataset called 3D BAG, a register of addresses and buildings of the Netherlands, including building height information and related quality metrics. The open dataset is very popular with **~900 downloads a day** and **~168.000 downloads in the period Jan-Mar 2022**. It is used on **municipal platforms** such as 3D.Amsterdam.nl and 3D.Utrecht.nl (Fig. 5.10). Next to this (and other) open data, open software is also developed for applications in urban planning such as noise simulation, computational fluid dynamics (e.g. for wind and air pollutants), characterisation of the energy performance of the building stock, etc. Given the growing role of Digital Twins in the immediate future, particular attention has been paid to the issues related to **interoperability between different data formats and standards**, with a specific focus on integrating BIM and GIS data in the project EuroSDR GeoBIM. At the same time, the definition and release of the CityJSON as an OGC community standard have contributed to the standardisation effort regarding data for 3D city models.

FIG. 5.10

The Municipality of Amsterdam is building a digital copy of the city: 3D Amsterdam.

It consists of a 3D model of the city, various functionalities and an interactive web viewer (Credits image: 3D.Amsterdam.nl)

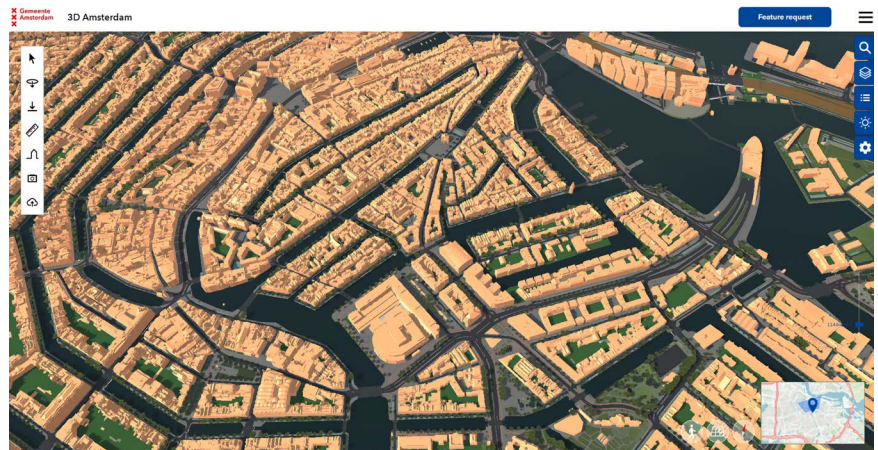


FIG. 5.10

Another aspect of Data-supported Urbanism is the governance of open data, its societal, economic and ethical impact, and the legal conditions for implementing and utilising open data policies. In that regard, the department also takes the lead in open science via programmes like ODECO: towards a sustainable Open Data ECOSystem, a 4-year **Horizon 2020 Marie Skłodowska-Curie Innovative Training Network initiative**. The central aim is to train the next generation of creative and innovative early-stage open-data researchers to unlock their creative and innovative potential to address current and future challenges in creating a user-driven, circular, inclusive open-data ecosystem. The programme runs between October 2021 and September 2025 and will deliver 15 PhD degrees in joint supervision and training between the public and private sectors.

The department also extends its role as a knowledge hub for Data-supported Urbanism with the recently launched 3D Urban Understanding Laboratory (3DUU) within the TU Delft AI Labs programme (Fig. 5.11). Combining data from different sources and using AI will allow computers to learn and work with them so that large amounts of urban data can be automatically processed and interpreted. The department will continue to be proactively sought and further developed, both with other academic/research institutions and with public/private companies, to maximise the dissemination of knowledge, best practices and applications.

FIG. 5.11

The 3DUU Lab

Developing new methods and techniques that automatically recognise and model objects in real-world scenes in 3D by combining data from various sources, such as aerial photos and laser scanners on vehicles (iCredits mage: 3DUU).

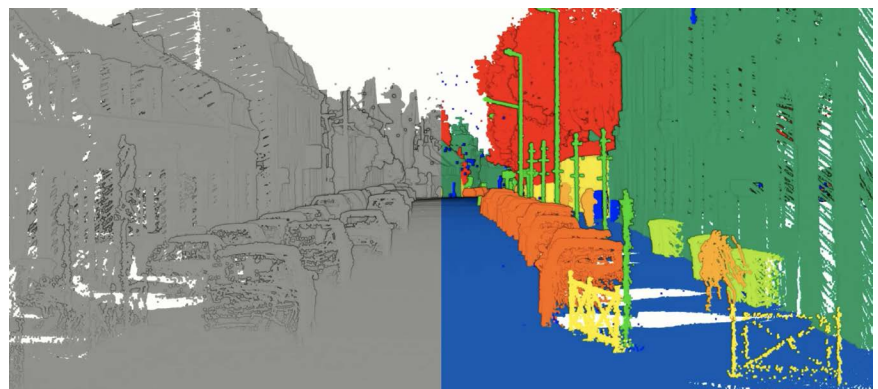
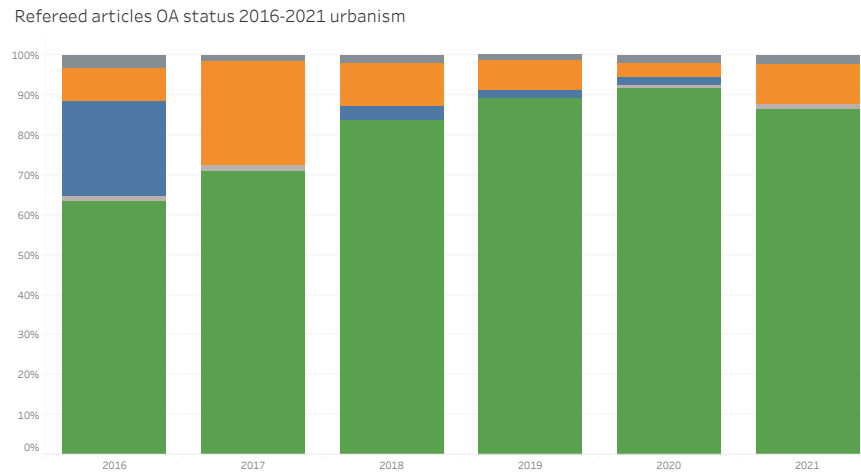


FIG. 5.11

EVIDENCE BY NUMBERS

This section includes the quantitative data that supports the self-evaluation of the indicators and also supports the discussion about the strategy and the accomplishments during the past period. In particular, it presents information about the numbers of research staff, PhD candidates, funding and research output.

PERCENTAGE OF OPEN ACCESS PUBLICATIONS BETWEEN 2016 AND 2021



Open Access Status

- Onbekend
- Closed
- Indeterminate
- None
- Open

FIG. 5.12
Percentage of open access publications
between 2016 and 2021

FIG. 5.12

RESEARCH STAFF

TABLE 5.1 Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities.

	2016		2017		2018		2019		2020		2021	
	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE	NR	FTE
Scientific Staff	39	11.8	41	12.6	41	12.4	49	15.0	51	15.5	52	16.5
Full professor	9	2.6	9	2.4	9	2.3	9	2.1	8	1.8	7	2
Associate professor	16	5.2	17	5.7	15	5.0	19	6.0	18	6.2	19	5.8
Assistant professor	14	4	15	4.5	17	5.1	21	6.9	25	7.5	26	8.7
Researchers (incl. Postdocs)	40	15.8	39	18.6	42	20.3	38	15.4	37	15.2	28	12.0
PhD candidates	57	-	54	-	54	-	43	-	49	-	55	-
Total research staff	136	27.6	134	31.2	137	32.7	130	30.4	137	30.7	135	28.5
Visiting Fellows	40	0.8	34	1.7	35	1.6	52	4.0	41	6.6	33	3.0
TOTAL STAFF	176	28.4	168	32.9	172	34.3	182	34.4	178	37.3	168	31.5

Scientific staff: profiles HL, UD, UHD, permanent and temporary. Researcher: UFO profile OVWOZ (onderzoeker 1, onderzoeker 2, onderzoeker 3, onderzoeker 4, Post-docs), permanent and temporary. PhD candidate: standard PhD (employed) and contract PhDs (externally or internally funded but not employed). Visiting fellows: employee group "Gast en GastWP", profiles HL, UD, UHD, OVWOZ (onderzoeker 1 t/m4).

Overview of research staff headcount (NR) and corresponding, allocated full-time equivalent (FTE) for research activities. The indicated number of FTEs takes into account that scientific staff and researchers are considered to spend respectively 40% and 80% of their appointment on research activities.

FUNDING

TABLE 5.2 Overview of funding and expenditure for the period 2016-2021.

	2016		2017		2018		2019		2020		2021	
	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
FUNDING												
Direct funding (1)	1,597	46%	1,719	41%	1,559	35%	2,033	49%	2,331	47%	2,601	53%
Research grants (2)	908	26%	1,223	29%	1,014	23%	991	24%	1,029	21%	536	11%
Contract research (3)	975	28%	1,563	37%	2,111	47%	1,328	32%	2,319	47%	2,012	41%
Own contribution	-508	-15%	-657	-16%	-686	-15%	-776	-19%	-1,058	-21%	-549	-11%
Other (4)	466	14%	359	9%	494	11%	565	14%	312	6%	285	6%
Total funding	3,439	100%	4,207	100%	4,491	100%	4,141	100%	4,932	100%	4,885	100%
EXPENDITURE												
Personnel costs	-3,026	83%	-3,447	79%	-3,702	79%	-3,449	79%	-4,672	84%	-4,438	88%
Other costs	-635	17%	-905	21%	-1,002	21%	-898	21%	-893	16%	-597	12%
TOTAL EXPENDITURE	-3,661	100%	-4,352	100%	-4,705	100%	-4,347	100%	-5,565	100%	-5,034	100%
RESULT	-223		-145		-214		-206		-632		-150	

Note 1: Direct funding (basic funding/lump-sum budget)

Note 2: Research grants obtained in national scientific competition

Note 3: Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, European organisations and charitable organisations

Note 4: Funds that do not fit into the other categories

PHD CANDIDATES

TABLE 5.3 PhD candidates' graduation time related to their year of enrolment.

ENROLEMENT			SUCCES RATE											
STARTING YEAR	MALE	FEMALE	TOTAL M+F	GRADUATED IN YEAR 4 OR EARLIER		GRADUATED IN YEAR 5 OR EARLIER		GRADUATED IN YEAR 6 OR EARLIER		GRADUATED IN YEAR 7 OR EARLIER		NOT YET FINISHED		DISCONTINUED
2012	3	4	7	0	0%	1	14%	3	43%	4	57%	0	0%	3 43%
2013	4	2	6	0	0%	3	50%	4	67%	4	67%	0	0%	2 33%
2014	0	2	2	0	0%	0	0%	1	50%	1	50%	0	0%	1 50%
2015	3	3	6	0	0%	0	0%	3	50%	3	50%	2	33%	1 17%
2016	8	5	13	1	0%	4	31%	4	31%	4	31%	6	46%	3 23%
2017	3	3	6	0	0%	0	0%	0	0%	0	0%	4	67%	2 33%
TOTAL	21	19	40											

PhD candidates' graduation time related to their year of enrolment. The table includes PhD candidates enrolled in the period 2012-2017 who are expected to graduate in the review period, by 2021. The expected duration of a PhD is four years.

RESEARCH OUTPUT

TABLE 5.4 Research output for academics and professionals.

	2016	2017	2018	2019	2020	2021
Peer-reviewed articles	96	69	111	92	107	96
Non-refereed articles	-	5	4	10	4	5
Books	3	3	4	2	8	2
Book chapters	45	33	35	25	31	42
PhD theses	6	7	13	8	8	4
Conference papers	77	56	44	30	25	30
Professional publications	55	42	28	20	21	30
TOTAL PUBLICATIONS	282	215	239	187	204	209

DIVERSITY: GENDER AND NATIONALITY

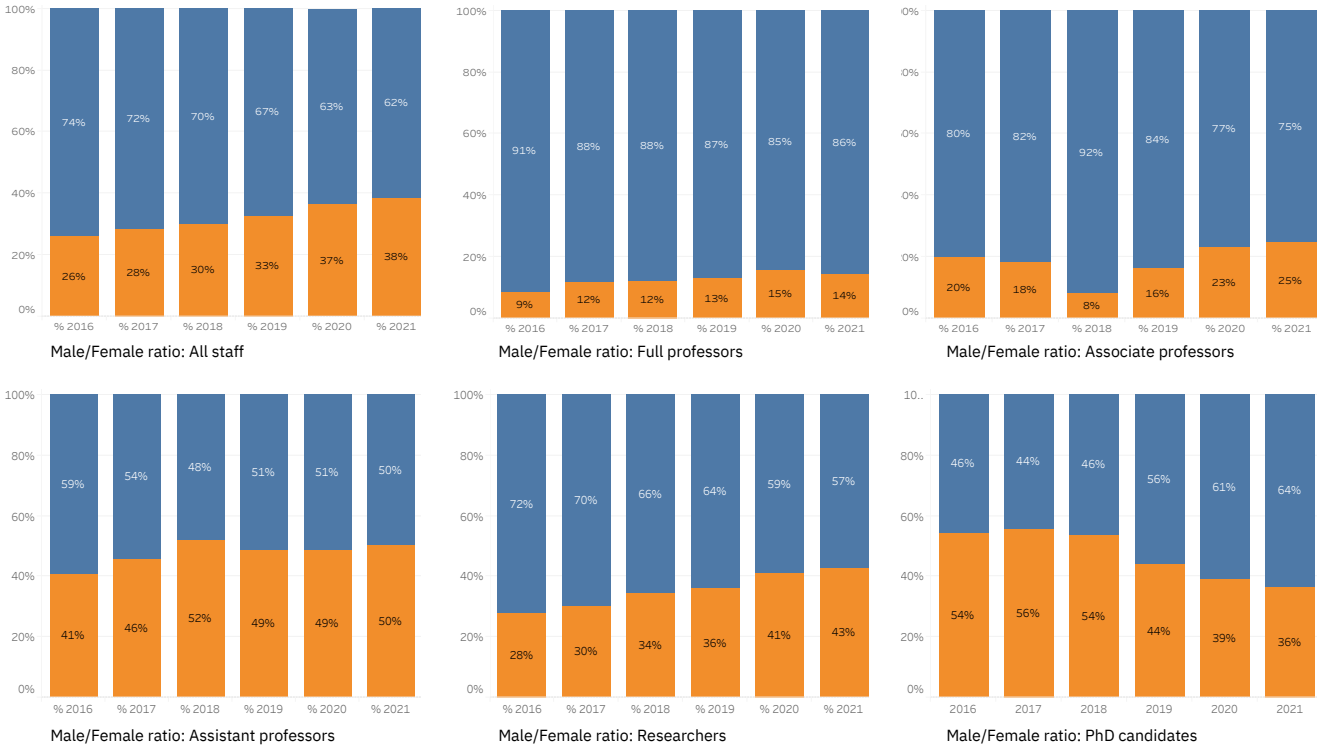


FIG 5.13 a-f Gender ratio faculty staff: Male (blue)/Female (orange)



FIG 5.14 a-f Nationality ratio faculty staff: None-EU (light green)/EU (green)/NL (dark green)

STRATEGY FOR THE NEXT SIX YEARS

6.1

SWOT ANALYSIS

A SWOT analysis was conducted as part of defining the strategy for Urbanism for the period 2022-2027. The analysis is the result of discussions and brainstorming within different groups, including faculty members and research staff. Also, a site visit to ETH Zurich (LUS) (Appendix 3) and online inter-collegial conversations with people from peer institutes such as UCL Bartlett and GSD Harvard provided useful input.

STRENGTHS

- A distinct Delft approach to Urbanism;
- Strong record in inter- and transdisciplinary, context-driven and solution focused research and applications;
- Critical mass of research staff willing and able to collaborate across disciplines;
- Deep experience and capability in international research collaboration;
- Well-established collaboration between academics and practitioners;
- Successful transition towards more academic publication, while maintaining a prominent position in professional and popular publication;
- Well connected to the structured and organised PhD training and development (eg. Go/No Go process, yearly review), supported by the Graduate School
- Diverse research project portfolio, from various funding streams;
- Strong links between Research and Education;
- Stable portfolio of major externally funded research projects;
- Strong record in Open Science.

WEAKNESSES

- Efficiency in research and education leads to less space for experimentation and creativity;
- Gender balance and cultural diversity in senior positions (esp. Assoc./Full. Professors);
- Lack of full professors;
- Low efficiency PhD dissertations (most need > 4 years to complete);
- Limited staff progression and possible loss of younger capable researchers;
- Lack of personnel capacity and support for acquisition (e.g. leading a big EU proposal);
- High work pressure;
- Difficulty in keeping a balance between continuity in research (lifelong contracts) and flexibility in contracts;
- Lack of support in communication and outreach;
- No physical laboratory with space for experimentation and instruments (e.g. Design+Make Lab, Multimedia Lab).

OPPORTUNITIES

- Global trends in urbanisation demand knowledge and expertise in urbanism;
- Influx of many new staff members due to successful major research bids and strategic funds;
- Potential for developing underpinning Delft Approach to Urbanism
- Continuing research calls at national, EU and global levels on urbanisation;
- Wide network of national and international partners that bring opportunities to urbanism;
- Strong strategic alliances in the Netherlands and internationally;
- Growth and leverage academic culture, inclusiveness and diversity;
- More time for curiosity-driven research;
- Continuing demand from high-quality applicants for master's and doctoral studies (+ some capacity to supervise them).

THREATS

- Fragmentation of the research portfolio due to the steep increase of funding and people in short amount of time and dedicated to specific topics;
- Potential for fragmentation of overall programme and direction if disciplinary research strands are not sufficiently complemented with transdisciplinary research;
- Highly competitive national and international research funds. As a result, lower success rate and much time spent on writing research proposals
- Possible fragmentation of effort as researchers pursue limited funding sources;
- Difficulty of recruiting and bind senior staff in urbanism.

URBANISM RESEARCH STRATEGY 2022-2027

The Urbanism research strategy indicates how we will utilise the opportunities and strengths mentioned above and how we will face the identified weaknesses and threats. We defined the following strategic aims for the further development of the research of our department in the period 2022-2027. The strategic aims were built on the previous ones, but we adapted and sharpened them according to our needs.

6.2.1

RESEARCH QUALITY AND SOCIETAL RELEVANCE

- Remain world-leading in design-related scholarship and socially relevant and impactful research for the understanding, planning and development of sustainable urban landscapes;
- Cultivate the Delft Approach of Urbanism as a socially and ecologically inclusive approach with a strong link between spatial research and design across scales, based on inter- and transdisciplinary working and employing state-of-the-art digital technology;
- Foster disciplinary breadth, depth and innovation;
- Actively participate and lead academic and societal networks and engage in strategic collaborations with governmental partners, NGOs and other societal partners;
- Cultivate the relationship between the research programme and PhD/MSc education.

Urbanism is a research-led department, and our programme will continue to focus on curiosity-driven research with relevance to society with extensive and effective inter-relations with many stakeholders. We will maintain high levels of research quality and societal impact through our research outputs and their use and recognition. New national strategic funds to strengthen research staff (e.g. Sectorplan) and teaching staff (e.g. Van Rijn), next to the steep increase in external research funding, will lead to significant growth in staff (40+) over the next 12 months. This will lead to great opportunities to expand and deepen our research, but this expansion might also threaten the coherence of our research programme. We will further cultivate the Delft Approach to Urbanism by creating a true inter- and transdisciplinary working environment through ongoing dialogue and collaboration.

We will consolidate our current success in knowledge utilisation and valorisation by continued work with non-academic partners. Strengthening outreach, capacity building, stakeholder engagement and curiosity-driven research remain constituent elements of our strategy to bolster the social impact. We will also further grow and leverage our strong relationship between research and education.

6.2.2

OPEN SCIENCE

- Stimulate more open and collaborative research practices in which publications, data, software and other types of academic output (when possible) are shared and made available for (re)use.

We strive to further increase the proportion of open-access publications and other research outputs to ensure that our work is available to all potential users anywhere in the world. In collaboration with the Programme Manager Open Science we will explore approaches (e.g. development of methods, platforms and workflows) that strengthen the possibility to exchange throughout the research process in the context of Urbanism in accordance with the principles of open science.

6.2.3

PHD POLICY AND TRAINING

- Nurture an Urbanism PhD culture and develop a more efficient Urbanism PhD programme;
- Develop complementary Urbanism PhD policy and Urbanism-oriented PhD courses.

We will work on further improving our PhD programme's efficiency by monitoring progress at the department level (next to the Graduate School) and by training supervisors. We will also strengthen the Urbanism PhD culture by organising regular meetings with PhDs and their supervisors at the department and section level for social interaction and knowledge exchange. The development of Urbanism-related courses for the graduate school is a priority.

6.2.4

ACADEMIC CULTURE

- Bolster a fair and inclusive academic culture where all members of Urbanism can excel.

Strengthening our academic culture, especially inclusivity and research integrity, requires ongoing dialogue and leadership. Together with the university's integrity officer and the faculty's diversity officer, we will continue to elaborate and organise (training) programmes and workshops at the department level to raise awareness, showcase good practices, and offer practical guidelines on research integrity, ethics, fairness, a safe working environment, etc.

HR POLICY

- Elaborate ways to recruit and retain excellent top talent;
- Continuously build on a diverse urbanism community as a precondition for excellence and innovation.

In the coming years, we will continue our efforts to recruit and retain top talent from the Netherlands and around the world and to encourage their development. Together with the Faculty HR department, we will explore ways to attract (senior) staff that contributes to diversification in terms of gender balance (e.g. more female senior staff) and cultural representation. We strive for a diverse team in which the specific strengths of all team members can be combined. To retain well-performing academic staff, we will work on personal career paths through personal mentorship and roadmaps, but also dedicated training programmes on leadership and communication.

The strategy as presented here serves as a compass for the further development of the excellent scholarship and research that characterises the Urbanism research community. The strategy process is an ongoing undertaking. In the upcoming period, the strategic aims and working programme as outlined here will be translated into more tangible, concrete actions that will enable us to maintain our outstanding reputation in contributing to the understanding and creation of future-proof, liveable and socio-ecological inclusive urban landscapes as a prerequisite for a better world.

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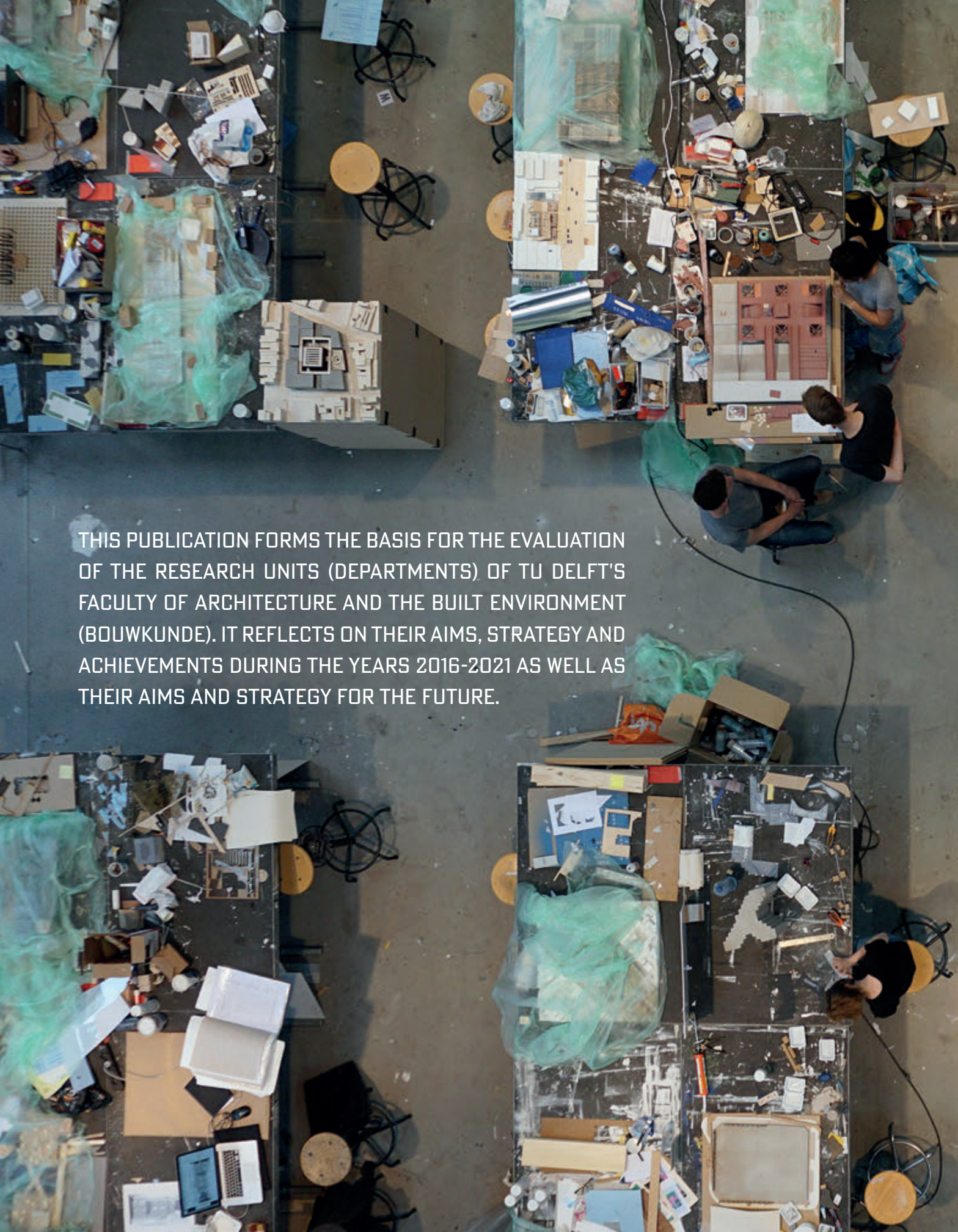
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THIS PUBLICATION FORMS THE BASIS FOR THE EVALUATION
OF THE RESEARCH UNITS (DEPARTMENTS) OF TU DELFT'S
FACULTY OF ARCHITECTURE AND THE BUILT ENVIRONMENT
(BOUWKUNDE). IT REFLECTS ON THEIR AIMS, STRATEGY AND
ACHIEVEMENTS DURING THE YEARS 2016-2021 AS WELL AS
THEIR AIMS AND STRATEGY FOR THE FUTURE.