Assessment Committee Report on Research in Industrial Design Engineering 2013-2018 Delft University of Technology

January, 2021

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"Collaborate and Lead"

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Colophon

Title
Assessment Committee Report on Research in Industrial Design Engineering 2013-2018, Delft University of Technology

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PREFACE

The Assessment Committee was assigned the task of evaluating the research carried out at the Faculty of Industrial Design Engineering at Delft University of Technology (TUD) over the period 2013-2018.

After a long preparation time, over four days, we undertook an in-depth exchange and discussion with staff and management of IDE. This enabled us to understand, validate, and refine the initial impressions that we formed through the faculty self-assessment report.

The Committee appreciated the way in which the faculty staff responded to the Committee's many additional information requests and the openness and flexibility to change the programme many times before and during the online site visit. The site visit, which was online because of the COVID-19 crisis, was a design process itself, since an online assessment was new to the faculty as well as to the Committee. We faced severe time limitations – which made it hard for the Committee to dig deep – and the online setting was not ideal. Nevertheless, we managed to get a clear picture of IDE, with all supportive efforts of our Committee secretary.

I especially would like to thank the Committee members who were willing to do more than the usual preparations and who made the online meetings a truly inspirational venue. And although we never met in person as a Committee, I really felt we acted like a team. I hope that soon we can meet in person again.

Prof. Dr. ir. Jan Dul
Chairman of the Committee

1. Assessment Committee and Assessment Procedures

1.1 Assessment Scope

The Assessment Committee was asked to assess the research of the three Departments that comprise the Faculty of Industrial Design Engineering at Delft University of Technology. This assessment covers research in the period 2013-2018. In accordance with the Standard Evaluation Protocol 2015-2021 for Research Assessments in the Netherlands (SEP), the Committee's tasks were to assess the quality, relevance to society, and viability of the research programmes on the basis of the information provided by the faculty and interviews with faculty management and research department personnel. Following this, the Committee was to make recommendations for the future.

The site visit was originally planned for April 2020. But then COVID-19 also reached IDE and the site visit was postponed until October 2020. Although COVID-19 was not resolved in October, it was decided not to further delay the review and to make the site visit an online format. This made the research review an extremely challenging activity for the Committee. Firstly, an online research assessment was entirely new to the Committee and faculty alike. The rhythm of online meetings is different from actual face-to-face meetings, and also has consequences for Committee preparations and ways of working during the visit. In Appendix A the Committee shares some of the lessons learned. Secondly, the educational burden for the IDE staff turned out to be very high (due to the switch to online education), making the staff's priorities less on the assessment of research. Third, IDE moved on from the point where the self-evaluation report stopped, making the self-evaluation report partly outdated. The Committee requested additional documents about the current situation.

The above developments resulted in a request from IDE to change the focus of the Committee task. The Committee was expected to assess the faculty's departments along the aspects of the SEP: Research quality; Relevance to society & Viability with a shift of attention from assessing the output over 2013-2018 to

more critical discussion on the faculty's strategy and its implementation on these topics.

1.2 Committee Composition

The members of the Committee were:

Prof. Dr. ir. Jan Dul, Committee Chair, Professor of Technology and Human Factors, Rotterdam School of Management, Erasmus University Rotterdam, the Netherlands.
Prof. Dr. Hua Dong, Professor in Design, Brunel Design School, United Kingdom.
Ir. Willem Haanstra, PhD candidate at the Design, Production & Management department of the University of Twente, the Netherlands.
Prof. Dr. MariAnne Karlsson, Professor and Head of Division for Design & Human Factors, Chalmers University of Technology, Sweden.
Prof. Dr. Tek-Jin Nam, Professor and Head of Industrial Design Department, Korea Advanced Institute of Science and Technology, South Korea.
Ir. Gu van Rhijn, Senior Project leader at TNO Work and Productivity, the Netherlands.
Prof. Dr. Anna Valtonen, Professor in Strategic Design, Aalto University, Finland.

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

Ir. Sven Laudy of Quicken Management Consultants was appointed a process consultant to the Committee.

1.3 Impartiality

All Committee members signed a statement of impartiality and confidentiality to ensure they would assess the quality of the research programmes in an impartial and independent way. Committee members reported any existing personal or working relationships between them and IDE members of the programmes under review before the interviews took place. The Committee discussed these relationships before its first meeting. The Committee concluded that there

existed no unacceptable relations or dependencies that could lead to bias in the assessment.

1.4 Data provided to the Committee

The Committee received the following detailed documentation:

- Self-evaluation report of the unit under review, including all the information required by the Standard Evaluation Protocol (SEP), with appendices,
- Previous assessment report 2007-2012,
- Additional document “Strategy IDE & follow up review 2007-2012”,
- 'Publication and the Landscape of Design Research', including a selection of key academic papers,
- Answers to the Committee’s ‘questions for clarification’,
- Outcomes of the survey,
- List of publications.

These documents together with the interviews and additional information (e.g. data, slides) requested during the site visit were the Committee’s key bases for assessment.

1.5 Committee Procedures

The Committee followed the Standard Evaluation Protocol, 2015-2021 (SEP). Prior to the online site visit, on the basis of their specific expertise two Committee members were appointed main assessors for each programme and were asked to lead the evaluation of that particular programme. These assessors independently formed a preliminary assessment for each programme. Before the site visit took place, the Committee had an online meeting in which the initial remarks were discussed as well as the interview strategy. Also, before the site visit an online survey was sent out to the faculty staff to collect input for the interviews.

Final assessments were based on the preliminary assessments, combined with documentation provided by the faculty, the survey and the interviews. The Committee interviewed the Rector Magnificus of Delft University of Technology, the Faculty Management Team, departments, and teaching, supporting and administrative staff of the Graduate School and research programmes. Interviews took place online between October 5 and 8, 2020. The chair and secretary were present at the Faculty of Industrial Design Engineering in Delft. The interview schedule is attached in Appendix C.

Before the interviews, the secretary of the Committee briefed the Committee on the Standard Evaluation Protocol for research assessments. This briefing also covered the rating system (Appendix D). It was explained that the criteria Quality and Relevance to society are directed towards assessing past activities, while Viability is assessed in a more forward-looking manner. On the same day, the Committee discussed the preliminary assessments. For each programme interview, the Committee prepared a number of comments and questions. The Committee also agreed on procedural issues and aspects of the assessment. All Committee members were actively involved in the interviews. After each interview session, the Committee discussed the findings and comments, and sometimes scores when needed. This could only be done briefly, as the online set up of the programme gave the Committee only limited time for reflection. Lastly, it is not possible to compare the score of the departments, given the broad nature of the research programmes.

The Committee also offered a separate advice session to the IDE faculty and Executive Board of TUD regarding the follow-up steps that are required to increase the academic quality of the departments and to create a more academic profile, in order to have 'design' recognised as an academic discipline. The Committee presented their preliminary general impressions of the faculty to the Management Team on the last day of the online visit. A second concluding meeting with the Management Team and a presentation of the preliminary findings took place two weeks after the site visit.

Following the online site visit, the Committee finalised the report through email. Following approval by all Committee members, the faculty received a copy of the

first version with the invitation to correct factual errors. In response, the Committee discussed these comments, made several modifications to the text and then presented the final report to the Board of the University. The report was printed after formal acceptance.

2. Assessment of the Industrial Design Engineering Faculty

2.1 The Faculty of Industrial Design Engineering

Research and education in Industrial Design Engineering (IDE) at Delft University of Technology (TUD) is carried out within three Departments: Design, Organisation and Strategy (DOS, old research programme Strategic Design), Human-Centered Design (HCD, old research programme User Experience) and Sustainable Design Engineering (SDE, old research programme Technology Transfer).

Research at the faculty of Industrial Design Engineering (IDE) aims to provide support to societal challenges by developing scientific knowledge, design methods and tools to improve the way design is done. IDE focuses at three societal challenges: health, sustainability, and mobility. The research is carried out from three perspectives:

1. (the desirability for) people,
2. (the feasibility of the) technology and
3. (the viability for the) organisation.

As mentioned in the faculty's strategy document, IDE sees its mission as *"Matching the evolution of people with the revolution of technology".* In order to meet the ambition and embrace opportunities of the future, IDE wants to make the following strategic choices:

- *Creating Future Design.* IDE wants to take its position as a global player in design and give more visibility to its research in defining how design will be done in the next 10 years. In order to achieve this, the faculty will concentrate and strengthen its research on three strategic themes: Systemic Change, Embedding Artificial Intelligence and Designing Design.
- *Distinguishing and profiling as an academic design research institute.* IDE wants to realise a clearer position within research in the field of design.

Design research helps to strengthen internal cohesion on the one hand, and to raise the external profile both within TUD and beyond on the other hand. This is done by: a) making the IDE core body of knowledge more explicit, b) clarifying the structure and focus of the IDE research organisation, c) strengthening the PhD process & culture, and d) profiling and making the IDE strategy more explicit.

- *Generating more societal impact.* IDE wants to position and bundle its research even more strongly along the current application areas Health, Sustainability, and Mobility. This is expected to help researchers to align research ambitions towards funding possibilities and increase impact by showing its research quality and contributions to society.

Remarks and Recommendations

All three departments are future-oriented and actively working on the IDE strategy. The Committee recognises the movement and energy to go to a new future state: the process of formulating a shared strategy plan seems to work well. It is also stimulated by the definitions of the core application areas mobility, health and sustainability (MHS) and by the creation of new positions.

IDE can be stronger together by using the combined expertise to drive and generate new knowledge and new fields. IDE should be **driving** the application areas, rather than just serving. The Committee thinks that IDE could be more confident about your unique qualities.

The departments are mainly organised according to People, Technology and Organisation; for successful driving of current and future application areas and for making the shift towards systemic design, selective development and combining of expertise through collaboration is essential. Collaboration allows for better addressing current and future application areas and also helps to identify and deepen relevant knowledge in the specific expertise fields.

Currently, individual freedom exists regarding expertise development and collaboration - as long as it is design-oriented and MHS focused. The Committee recommends to balance the broadness and focus. Using the energy, freedom and the enthusiasm of the staff to give directions seems a good guiding principle, but critical mass in specific fields is a prerequisite to excel, and may need some

steering mechanisms. Focus is particularly necessary now that new diverse technologies are emerging. Also, the integration of fields of expertise for addressing areas of (future applications) could help to make the research more coherent. There are great opportunities for the faculty to take the lead in the People & Organisation side of emerging technologies with regard to prototyping[1] the future. This requires focus (on topics and/or technologies), collaboration between departments and visibility, collaboration and leadership within the TUD. The TUD can be proud to have IDE as a potential driving force to combine People, Technology and Organisation for tackling societal challenges.

The Committee challenges IDE to define the **unity** within diversity. The self-evaluation report states: "want to behave as one". Define and map this "one", not in terms of application areas – those are market-driven and subject to change - but in terms of IDE's foundations/ expertise, which is much more sustainable.

The Committee recommends having a discussion about name giving in relation to the faculty's strategy and potential - the time might be ready for this. *Industrial* is too restrictive. Is it necessary to have the *Industrial*, moving towards *Systemic*? IDE does neither want to be an engineering school, nor an art school. The "E" drives it to *Engineering*. The Committee learned that it is important to include *Engineering* because it gives better access to funds and better embedding within TUD and to distinguish IDE from a design art school.

[1] Prototyping refers not only to prototyping of physical products but also includes prototyping of services (for service design) and systems (for systemic design), which could be presented via video, software, "interactive virtual simulation", etc.

2.2 Research Quality

Table 1 shows the demonstrable research output of the Faculty of Industrial Design Engineering for the period 2013-2018.

	2013	2014	2015	2016	2017	2018
Refereed articles	85	80	94	128	113	129
Books	3	2		2	1	2
Book chapters	34	23	11	10	31	25
PhD theses	10	16	12	21	13	21
Conference papers	157	141	101	92	111	100
Professional publications	40	33	38	26	16	15
Editorial work	22	16	5	7	13	13
TOTAL	**351**	**311**	**261**	**286**	**298**	**305**

Table 1: Total output Faculty IDE

Remarks and Recommendations

The Committee likes the pluri-formity of research methods and the multidisciplinary backgrounds of the design researchers from the technical, social and other sciences as well as from design practice and design research. In the end, it is about doing quality research, not about what method is used and what background one has. The diverse faculty backgrounds are believed to have contributed to the IDE's success.

The Committee believes that goal setting regarding research output could bring IDE further. In the field of design research, it is important to distinguish, recognise and stimulate two types of valuable outcomes: on the one hand traditional publications in academic journals and other publication outlets, and on the other hand design-specific contributions such as demonstrations, exhibitions, commercial societal impact, and design awards. For assessing research quality, the Committee therefore looked at the assessment of

1) Publications
2) Other design research output

Regarding 1) Publications: IDE has a system for classifying journals that define the academic design field: 2/3 of the journal articles seem not to fall into the core categories as defined by the faculty. Given the available research capacity (on average 40 FTE per year of research capacity of scientific staff, and 85 PhD candidates per year) the productivity seems not very high (on average about 100 journal articles per year) in comparison to other academic fields, such as specific social science fields to which IDE contributes (listed in IDE's classification of core journals). Yet, the productivity is not uncommon in an engineering environment and relatively high in comparison to other design schools. The committee further noticed that the output was not focused on the core journals (on average about 35 journal articles per year). Regarding 2) Other design output: this is not rigorously documented and classified. It seems there was no formal system of tracking these outcomes or ranking the quality of the outputs.

The Committee thinks there are ways to create more research impact and research visibility[2]:

- Set up a holistic system for guiding researchers towards quality (goal setting). This system includes the above two indicators and many others;
- A reflection on whether IDE's research productivity of about 100 journal articles per year fits IDE's academic ambitions;
- Focus on desired/core research outlets and the desired core categories at the highest possible quality level (publications and design-specific outlets);
- Further develop and expand the existing system of 'key journals in design' towards a quality system of peer reviewed journals (and other) publications to represent the current IDE strategy regarding design approaches and application areas;
- Formulate formal indicators for other design research output (other than publications) where IDE wants to show its work – preferably peer reviewed. For example, define the 5 most valued outlets (that are

[2] Other design outputs, i.e exhibitions, are signs of research quality but can also have societal impact. We discuss it under Research Quality.

competitive), and define the criteria based on which to value them. Typically, entrance requirements through a field-specific jury is more valued than just participating in an event on an invitation etc.;
- Publications and other indicators can be used as input for a more holistic view on research quality. Numbers (e.g. publication statistics) are a valuable base of information. Do not be allergic to it. Use it as it gives insight in research performance. The key is being holistic and flexible but at the same time looking at the numbers;
- Do not 'waste' efforts by selecting outlets that are not core.

It is recommended to use these systems as guidance for researchers and leaders, rather than as 'ticking the box' instrument, for example as input to holistic evaluations such as narratives for describing research performance.

2.3 Relevance to Society

Remarks and recommendations

The research of IDE is highly relevant. It is impressive to see how there is a link with society on a variety of levels: policy, business, user, product, etc. The choice of the three societal areas sustainability, health and mobility is clear and well-implemented.

There is a clear focus on developing design methods, but not on evaluating these methods in practice, e.g. by industry, former students etc. and although evaluation is always part of a design method developed, design methods seems not to be evaluated in practice and the issue seem~~s~~ not to be on the agenda.

The process in which research projects and outcomes are selected for external communication appears to happen 'naturally' and bottom-up, without a clear visible process or system in place. The Committee recommends thinking about how this process can be made more transparent, to allow all researchers to access external communication channels and to disseminate their knowledge to non-academic audiences. This is especially relevant to staff members who are working on more theoretical, conceptual or complex pieces of research that may

be harder to explain to the general public or are less visually striking or attention grabbing compared to other research outcomes. The Communication department indicated that it can be difficult to select which narratives are to be shared, and which ones are not shared with 'the world'. A prominent selection criterion is the impact that the research may have on society.

Consider integrating 'the creative and inventive aspect of design' in design research. For this, explore other achievement outlets, e.g. demo sessions in premiere conferences, design shows, design and research awards etc, in addition to academic journals. Consider introducing new measures so that other outlets can be recognised in the personnel evaluation. Also, look into the criteria of different design school rankings and consider what IDE could do to increase its visibility in them.

2.4 VIABILITY

The composition of the research staff at faculty level is found in Table 2.

	2013		**2014**		**2015**		**2016**		**2017**		**2018**	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	89	28.2	86	27.7	84	26.4	85	28.0	86	28.0	87	27.8
Post-docs	28	11.8	31	11.5	26	7.2	30	12.1	30	14.5	46	17.7
PhD-students	90		91		82		87		83		86	
Total research staff	**207**	**40.0**	**208**	**39.1**	**192**	**33.6**	**202**	**40.0**	**199**	**42.5**	**219**	**45.5**

Table 2: Staff embedded in the Faculty IDE

TOTAL	2013		2014		2015		2016		2017		2018	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	19400	77%	19922	73%	19689	74%	19850	73%	19759	71%	20180	72%
Research funding[2]	876	3%	1.009	4%	1321	5%	1413	5%	1668	6%	1923	7%
Contract research[3]	3717	15%	8912	33%	6267	24%	5900	22%	4481	16%	4649	17%
Other[4]	1212	5%	-2646	-10%	-634	-2%	60	0%	1976	7%	1088	4%
Total funding	**k€ 25205**		**k€ 27198**		**k€ 26643**		**k€ 27222**		**k€ 27884**		**k€ 27840**	

Table 3: Total funding at level of the Faculty IDE. All amounts in k€.

1. Direct funding by the University, obtained directly from the University, and financial compensation for educational efforts.
2. Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, EU/ERC, ESF).
3. Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, the European Commission, and charity organisations.
4. Funds that do not fit the other categories.

Total funding rose over the years from €25.21 million in 2013 to €27.84 million in 2018 (Table 3). The percentage of direct funding decreased from 77% in 2013 to 72% in 2018. The percentage of funding from research grants increased from 3% in 2013 to 7% in 2018, and the percentage of contract funding decreased from 5% in 2013 to 4% in 2018.

Remarks and Recommendations

Leadership/ management

The Committee considers collaboration inside IDE and outside IDE as key for the successful implementation of the IDE's strategy. However, it is unclear who is organising the collaboration and who supports the collaboration, faculty-wise and university-wise? The present bottom-up approach, where researchers take collaboration initiatives themselves based on personal interests (content, wish for teamwork) or on funding opportunities is good, but should not be the only way. The current leadership focuses on supporting the bottom-up approach, i.e.

bottom-up initiatives are encouraged and rewarded by management but this is not enough. In particular when the faculty is growing and new staff is taken onboard, more systematic strategic planning of collaboration is needed. Implementation of a new strategy takes place partly by hiring new people but strategy renewal needs also to come from within existing staff.

There also seems to be a difference in how cooperation and expertise development is organised for the application areas. Flexibility is needed here but also direction. Application areas may also be able to exchange experiences and learn from each other when it comes to organisation, working methods, internal communication and employee involvement, as well as identifying areas of specific expertise that needs to be developed.

For implementing the strategic plan, it may be needed to develop the expertise and abilities of staff (not only tenure trackers but also tenured staff) and to encourage staff mobility (career policy).

The Committee learned that for researchers the organisational structure is not always clear and that they lack overviews of expertise within IDE. What is the role of the department and what is the role of the application area in developing the research at IDE and stimulate collaboration? The main organisational structure is clear (three departments) but sub-structures and underlying formal and informal coordination mechanisms are not.

The Committee recommends to start the discussion within IDE on how collaboration is stimulated, steered, and managed. The Committee learned that more structure on collaboration is coming, i.e. a programme manager for one of the areas is now in place and another one is soon coming.

People

Excellent research requires excellent people and excellent support systems. Therefore, it is needed to 1) balance workload, 2) develop staff, and 3) to develop support systems:

1) The Committee noticed that balancing research, teaching and administration activities is a challenge for many researchers: The

Committee remarks that to fit personal qualities, ambitions and needs, more individualisation of tasks and setting personal development goals are needed. The Committee found that acquisition of PhD projects is a burden for tenure track staff and tenured staff (TS); having an acquired project from the start is a luxury for PhD candidates.

2) Development of staff. The (research) performance of staff is evaluated based on four pillars (academic, societal impact, teaching, organisational) requiring minimum levels of each and excellence in some. It is sometimes a challenge for the tenure track staff, as well as for the tenured staff to understand what is expected and what needs to be developed. Staff wants to be assessed and to develop on personally fitting criteria. The Committee learned there is some room for improvement regarding the goal and interpretation of the four pillars, as it is not a ticking box exercise only.
   The mobility is low, in general. Once people are tenured, they stay. How could one motivate these members and make them more mobile, e.g. through sabbaticals? Could the staying faculty's capabilities be developed in a more systematic way such that expertise and skills fit future needs? The Committee recommends to put a system in place for the development of tenured staff, and to guide and develop the careers of the tenured staff, also in terms of mobility (internally and externally).
   At IDE group assessment is not considered. For stressing collaboration this might be necessary.
3) Development of support systems. Several research support systems are available at IDE, for example on valorisation, communication, ICT. There is a potential to maximise their value towards individual researchers, and to make the supportive value more explicit. For example, researchers are supported on valorisation by seven full time staff members. This amount of support allows for supporting researchers to develop and drive complex collaborative projects at systemic level. The committee suggests considering how access to IDE's support systems and collaboration between support staff and researchers can be ensured when physical interactions are reduced, not only in the current COVID-19 situation but also in future on-line work.

Collaboration

Collaboration at IDE seems to happen a lot (mainly naturally) but it seems not much organised. The motivation for IDE staff to collaborate can be different:

- Researchers look for interesting possibilities for cooperation based on expertise. An overview of who has which expertise is lacking;
- Researchers like to work with others (teamwork);
- Researchers collaborate to increase the chances for (financed) projects;
- Researchers collaborate for profiling (working in the same application areas: sustainability, mobility, health).

The Committee thinks that natural collaboration is not enough. In addition to leadership and management of collaboration (see above) for accelerating collaboration it is advised to make an overview of the existing expertise at IDE to be able to move to the systemic level. Also, it is important to make sure there is a good motivational source for collaborating and stimulate people from different departments to meet each other. With the increase of online-working (during and after the COVID-19 crisis) natural collaboration is hampered and collaboration needs to be addressed explicitly.

The Committee would like to see the whole TUD on board for improving collaboration of IDE within TUD, rather than just the IDE trying to make themselves heard. The TUD can be proud of having a strong Design faculty with international reputation and with experience in multidisciplinary collaboration. IDE can add design, people and organisational expertise to technology faculties and can take the lead in collaboration within TUD and with partners for tackling societal challenges. The TUD can also be in the lead of changing the Dutch research landscape in a way that acknowledges the true impact of design, and the methods and research specificities thereof.

There are many ways to integrate design into the entire TUD and to increase the usage of design in all faculties. For example, one could have designers embedded in other parts of the TUD, e.g. as is done with computer scientists to stimulate collaboration on artificial intelligence.

TUD can also be the leader in pushing design as an academic field, for example towards national and international funding organisations. Beyond the boundaries of the TUD, IDE is also not on its own in this challenge (recognition of design). TUD/ IDE should seek to build 'alliances' with likeminded institutions, both nationally and internationally. IDE may pursue a leading role, but should not need to do this on its own.

Improving collaboration can also be supported by the Communication department. In the last couple of years, the department has shifted from a focus on internal communication towards more external communication. The team seems to prefer a story driven approach to external communication. Their messages to the outside world use narrative devices to catch the attention of the public. Often individuals are used in these stories, making them the 'heroes' of the narrative, providing a human face to the outside world and offering a point of contact on specific research topics. Even though there is some focus on using teams of people as heroes, these examples are mostly from student teams and sometimes a group of PhD students. Given the multidisciplinary nature of design, using teams as heroes could be a promising device to show the collaborative nature of the TUD/IDE.

Leading design

IDE seems to be the ideal partner for taking a leading role in developing design towards a broadly recognised academic discipline. Firstly, IDE has much experience in multidisciplinary approaches – easy connecting to technical and social sciences – which is inherent to the design profession. Secondly, IDE has a clear position as 'the people-people' in the technical/ engineering environment of TUD. Thirdly, IDE focuses on producing generalisable design knowledge, principles and methods. Lastly, IDE is well-equipped for leading collaboration within engineering and beyond. The recommendation is to use these capabilities and be the linking pin to help to shape the convergence strategy of TUD. The development of the medical technology initiative is an enlightening example here.

Recruitment of staff

The faculty has a long tradition of hiring faculty from a broad set of backgrounds (with an interest in design). This is an asset and makes collaboration easy, as trans-disciplinarity is the norm. However, the viability-question for the future is if there is a strong enough focus on the core itself, i.e. on design. This is also reflected in the "standing" of the design research. Historically, design was informed by other disciplines. It is now in a more balanced situation where design learns from its collaborators and vice versa.

2.5 PhD Programmes and IDE Graduate School

It is the ambition of the Graduate School (GS) to train and deliver highly skilled doctoral graduates. Consistent with the agreements of the Bologna Process regarding the doctoral training as a third cycle of tertiary education, the GS has developed its educational programmes into a distinct part of the academic training leading to a doctoral degree. The mission of the TUD Graduate School is to prepare and train doctoral candidates to become highly qualified, autonomous and leading researchers and skilled professionals and to ensure that the doctoral process is transparent, systematic and effective. Furthermore, the GS recognises scientific supervision as a pivotal and defining element of the research environment and doctoral training.

The success rates of the PhD candidates at faculty level are found in Table 4.

Enrolment				Success rates						
Starting year	**Male**	**Female**	**Total (female + male)**	**4 years**	**5 years**	**6 years**	**7 years**	**Total**	**Not yet finished**	**Dis continued**
2008	42%	58%	12	8,3%	33,3%	66,7%	75,0%	83,3%		16,7%
2009	33%	67%	18	5,5%	27,8%	38,9%	50,0%	72,2%	5,6%	22,2%
2010	47%	53%	15	6,7%	20,0%	53,3%	66,7%	73,3%	13,3%	13,3%
2011	44%	56%	16	6,3%	25,0%	50,0%	62,5%	62,5%	18,8%	18,8%
2012	39%	61%	18		22,2%	38,9%	55,6%	61,1%	27,8%	11,1%
2013	50%	50%	14	7,1%	28,6%	64,3%		71,4%	14,3%	14,3%
2014	40%	60%	10		30,0%			30,0%	70,0%	
Total	**43%**	**57%**	**103**	**3,1%**	**26,2%**			**66,0%**	**19,4%**	**14,6%**

Table 4: Success rates of the PhD candidates at faculty level

REMARKS AND RECOMMENDATIONS

Across the TUD, PhD projects frequently take 5-6 years, instead of the intended duration of 4 years. Various efforts are made to bring the completion duration towards 4 years, including go/no decisions, a 9-month progress evaluation, mandatory meetings, annual staff evaluations, a central administration system, and international collaboration on best practices. The PhD processes appear to work fairly well. Many PhD candidates do not have to worry about finances etc, that has been taken care for them (at the cost of more worries for others, see above). Despite this, there is still room to adjust research questions to the interests and needs of the PhD candidates.

The size of the cohort is big, which the PhD candidates also see as a benefit. Career development of PhD candidates is given proper attention. PhDs are also expected to reach out and find the expertise that they require for their research themselves, in line with the 'bottom-up' and 'natural' collaboration style indicated at the IDE faculty level.

The Committee noticed that there are also hindrances that PhD candidates may encounter. Some PhD candidates feel too dependent on the expertise of the supervisors or the time that the supervisors can make available for supervision. There are minima in place for supervision (50 hour/year for 1st promotor and 150 for the daily supervisor).

Some PhD candidates experience a lack of discussion, coaching and positioning of the PhD projects with respect the type of research (human centered, design centered, research centered).

The system for **monitoring** PhD process is described in the Meeting Manual and has been in use since 2015. It is seen as mostly successful in monitoring the progress of PhD students and intervening whenever necessary – something that did not always happen in the past. This process is not just there to check the progress of the PhD candidates, but is also used to ensure that the supervisors are aware of their role and responsibility, and that expectations of all parties are managed. As such, it also serves as a quality control for supervision and it makes the GS partly responsible for the quality of the research. Some PhD candidates consider the system to be rather rigid and bureaucratic. The requirements of the GS can sometimes conflict with the research planning made with the supervisor.

The Doctoral Monitoring Application (DMA) is used to **document** the progress of PhD candidates, but is generally seen as user-unfriendly. Though PhD candidates enter their information into the DMA, the department uses its own parallel system 'Vlootschouw', which contains the consolidated data extracted from the DMA. As such, the DMA can be a major source of frustration for PhD candidates and their supervisors.

The Graduate School has indicated areas where they can improve:

- Continuous improvement of the current graduate school courses;
- The further development of online forms of education in collaboration and exchange of practices with other institutions;
- The further development of supervisory skills in the supervision of PhD candidates;
- The development of a cohort system;
- Improving the online documentation system (now supported by DMA).

The Committee agrees with these improvement areas, but also recommends to look into ways to make the alignment between GS requirements and PhD training plans more flexible.

2.6 Research Integrity

TUD has articulated its ideals, values, principles and responsibilities in the TUD Code of Ethics. The Code provides guidelines for everyone who is part of the TUD community: the academic staff, support staff, guests and students. The Code of Ethics has been designed as a 'living document' that can be continually updated in response to new insights or topical issues.

Remarks and recommendations

The Committees sees a very good will but also a very young practice (only 4-5 years). A fairly well-structured system has been set up and a lot of documents, a website etc. have been created. A policy or mechanism to detect scientific misconduct is not (yet) in place. This is to be left to the heads of the departments. Also, the Committee observed that IDE uses a rather narrow definition of integrity.

It is not clear to what extent integrity is discussed and embedded within the faculty or departments. It would be good to discuss integrity on the basis of concrete examples in which integrity plays a role for instance:

- Dealing with inaccuracies in your supervisor's research;
- What to do in case of harassment;
- Research with human test subjects;
- Subjects of research that IDE as a faculty does not permit.

The Committee concludes that on integrity IDE has a more system-oriented than culture-oriented approach. Awareness is important and the Committee recommends to start the conversation of embedding integrity in the IDE culture at management level.

2.7 Diversity

Remarks and recommendations

The focus of diversity is mainly on gender and international staff members and disciplines. The gender balance in IDE faculty is doing very well in achieving an

almost balanced female/male composition of the faculty (47% female, 53% male) and about 1/3 of full professors are female. 38% IDE faculty is international/EU, and 62% national. It seems that 50% of the faculty members are under 40 years of age, suggesting a growth of recruitment in junior positions? Quite a few IDE faculty members seem to have been educated at TUD. During the site visit the Committee learned that IDE encourages staff members to have experiences at places outside TUD.

The Committee noticed that IDE has no faculty specific policy on diversity. It recommends to discuss whether it is needed to consider other aspects of diversity (e.g. also regarding cultural backgrounds and the balance between permanent/temporary positions) and to make a diversity plan (strategic and operational) to:

- Identify opportunities to increase diversity and achieve awareness of diversity and inclusion among staff and students;
- Stimulate and build good practice and innovation in diversity and inclusion and use it to support decision-making.

2.8 Faculty's Extra Question

QUESTION: "WHICH FOLLOW-UP STEPS ARE REQUIRED TO INCREASE THE ACADEMIC QUALITY OF THE DEPARTMENTS AND TO CREATE A MORE ACADEMIC PROFILE, IN ORDER TO HAVE 'DESIGN' RECOGNISED AS AN ACADEMIC DISCIPLINE".

For increasing the academic quality of the departments, the Committee refers to the general remarks and recommendations made above under Research Quality that apply to the three departments as well.

IDE is striving for recognition of design as an academic discipline. The Committee thinks design at IDE is already mature and well-recognized academically, within TUD but also worldwide, e.g. large group, long tradition, good visibility, and a large number of PhD candidates. Its design research is characterised by well-

developed design research methodologies and a variety of design researchers with background in design or other relevant disciplines. Also, there is very good visibility in a variety of outlets for research results: publications and other outlets. The Committee thinks that IDE could lead academic design rather than participate only. See remarks under Viability.

The Committee recommends to not be defensive but rather be offensive in positioning design as an academic discipline. Defence only distracts from utilising these capabilities with full confidence. The Committee recommends to use IDE's position to push the frontiers, within and outside the Netherlands.

For increasing the critical mass liaising with other international leaders in design is desirable – more players are needed. Especially to team up with other institutions when promoting the design discipline.

Given the role of the Communication department to help form clear narratives for the outside world, perhaps this team can also help in developing the narrative about the recognition of design as an academic discipline, especially towards non-academic (inter)national stakeholders.

3. Assessments of Individual Research Departments

The Committee assessed the three research Departments of the Faculty of Industrial Design Engineering of Delft University of Technology. These are the department level assessments:

Research Department	***Research quality***	***Relevance to society***	***Viability***
Design, Organisation and Strategy	2	2	1-2
Human-Centered Design	1	2	1-2
Sustainable Design Engineering	2-3	2	2-3

The categories are defined in the SEP and have the following meaning[3]:

Category	***Meaning***
1	World leading/ excellent
2	Very good
3	Good
4	Unsatisfactory

The detailed assessment of each department follows[4].

[3] See also Appendix D

[4] The assessments of the departments are in the order in which they appear in the self-evaluation report

3.1 Research Department Design, Organisation and Strategy (DOS)

Head of Department	Prof. dr. ir. Ruth Mugge	
Research staff 2018	9.1 Research FTE (excluding PhD)	
Assessments	Research quality	2
	Relevance to society	2
	Viability	1-2

As mentioned in the self-assessment report, the role and impact of design within organisations has changed considerably in recent years and Design, Organisation and Strategy (DOS) investigates these changes, recognising the increased importance and influence that design can have in organisational contexts. The DOS programme has established a unique set of interests guiding the co-formulation and co-implementation of organisational strategy by insightful analysis, working with stakeholders, and applying design tools and techniques.

DOS aims to advance theoretical and practical knowledge in the following research topics:

a) Strategic design in organisations and networks
b) Strategies for sustainable innovation
c) Design theories, methods and practice

DOS researches these three directions mostly within the application areas that are central to the IDE faculty: Health, Sustainability, and Mobility.

In terms of content, related to strategic design in organisations and networks, DOS addressed topics such as design practices of envisioning, organisation, effectuation (i.e., how design can make things happen), and entrepreneurship. In relation to strategies for sustainable innovation, DOS has looked at individual needs and behaviours of consumers towards societally relevant (and sustainable) innovations, as well as to the responsibilities of consumers and market intermediaries to make these innovations more acceptable and accessible.

The research staff is composed of 6.8 FTE scientific staff, 2.4 FTE post-docs and 13 PhD candidates (2018).

Table 5 shows the demonstrable research output of the Department of DOS.

	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Refereed articles	20	14	19	24	27	31
Books	2					
Book chapters	5	4	1	4	2	10
PhD theses	3	3	1	4	2	5
Conference papers	43	27	27	21	32	18
Professional publications	12	7	11	4	2	2
Editorial work	3	2				1
TOTAL	**85**	**55**	**59**	**57**	**65**	**66**

Table 5: Total output of the Department of DOS

The composition of the research staff at level of DOS is found in Table 6.

	2013		**2014**		**2015**		**2016**		**2017**		**2018**	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	19	6.3	19	6.6	21	6.4	21	7.3	22	7.1	22	6.8
Post-docs	1	0.7	7	2.0	9	1.6	5	2.4	4	2.0	6	2.4
PhD students	12		11		10		9		8		13	
Total research staff	32	7.0	37	8.6	40	8.0	35	9.6	34	9.1	41	9.1

Table 6: Staff embedded in the Department of DOS

The total funding of DOS is found in Table 7.

TOTAL	2013		2014		2015		2016		2017		2018	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	2089	69%	2607	79%	2549	77%	2554	70%	2842	77%	3017	69%
Research funding[2]	60	2%	13	0%	9	0%	150	4%	47	1%	61	1%
Contract research[3]	645	21%	871	26%	784	24%	1071	30%	904	25%	1616	37%
Other[4]	236	8%	-203	-6%	-21	-1%	-144	-4%	-120	-3%	-315	-7%
Total funding	k€ 3030		k€ 3288		k€ 3321		k€ 3632		k€ 3674		k€ 4380	

Table 7: Total funding at level of the Department of DOS. All amounts in k€.

1. Direct funding by the University, obtained directly from the University, and financial compensation for educational efforts.
2. Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, EU/ERC, ESF).
3. Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, the European Commission, and charity organisations.
4. Funds that do not fit the other categories.

Research quality

In the self-assessment the approach of DOS is described as diversified. The diversification makes it difficult to initially get a holistic view of the department, even with the formulation of the three research directions. In addition, diversity can be a strength but also a weakness and hence raises a number of questions. Is it possible for such a diverse approach to lead to cutting edge results? Is this indeed a too broad approach? However, the interview with the department provided a more coherent (and positive) image.

“Designing design” was mentioned in the interview and is one of three strategic themes but seems to be a recent concept. If this is indeed a strategic theme it is evident that this needs to be discussed more in order to be accepted widely within DOS.

The output in terms of publications shows overall very good quality – based on the available information. The output in terms of refereed articles shows a steady increase over the period 2014-2018 whilst the number of conference papers decreases, a result that is assumed to be based on strategic decisions. Nevertheless, only half of the publications are journal articles, and only half of these appeared in the journals that IDE has identified as key.

Not altogether evident from the self-assessment but more so based on the impressions from the interview, other design-specific research output will probably become more important in the future - also for DOS. It appears that DOS does not have a strong tradition in acknowledging these and other alternative outputs. However, in the interview the Committee learned that DOS recognizes the importance of the matter and that staff is increasingly involved in other activities to disseminate results, share knowledge and create impact. This is considered a positive development.

Relevance to society

The research at DOS is itself highly relevant to society but it can also provide an important link between the research carried out at HCD and SDE and implementation. The Committee sees the collaboration with businesses/ companies/ organisations as one of the stronger channels in which relevance to society can be sought.

The Committee learned from the interviews that DOS is seeking for more and new ways of evaluating its output/ results considering DOS relevance to society, as well as working on finding relevant measures for this evaluation. This is highly encouraged. Getting the current department strategy into effect will also further boost societal relevance.

VIABILITY

DOS is a smaller department with competent researchers and potential for growth. In the interview, some abstract concepts were explained really well with concrete examples.

Over time DOS appears to be applying new research methodology and has for example included also more action-oriented research, hereby broadening the scope. The Committee encourages DOS to continue this development towards diversification of research methodologies.

Regarding funding DOS describes an increase over the reported period, both in terms of direct funding and research funding. The overall development is positive from economic and dissemination perspectives but based on the self-assessment report, the Committee's interpretation is that a substantial part of the growth comes from contract funding. If this is so, the Committee wants to stress that contract funding most often means closer collaboration with stakeholders, but also can result in more short-term output and less academic freedom. It is important that DOS takes these challenges into consideration.

As a relatively smaller department, DOS seems to be good at finding collaboration within the faculty. At the same time, design theories, methods and practice seem to be general rather than specific to DOS; hence the question is if and how DOS can increase collaboration across departments on these topics? The long-term partnerships with organisations offer an opportunity not only for DOS but also for HCD and SDE for more long-term research projects as well as more longitudinal studies of impacts, for example, to study the long-term effect of organisational changes and the efficacy of design methods.

DOS has been successful in recruiting staff that fit the department's research areas and (new) young and ambitious people are on board which is an important lever for the future. In addition, new tenure track staff has been/ or about to be employed with what was interpreted as an ambition to integrate new topics (e.g. AI). Even though this development is considered positive, the Committee feels that it is important to ensure that the core of DOS, i.e. the organisational and strategic perspective of design and the theoretical basis for addressing related topics, is not hampered in the recruitment of these new staff/competencies.

Even after hiring new staff, DOS is still a fairly small group which means that they have to do their share of management tasks. This seems to ask a lot from the staff.

In the interview the department made much clearer than in the self-assessment report what was its role in IDE and its ambition to develop expertise, for example, new ways of researching organisational aspects of design. Overall, the Committee got the impression that the DOS knows what they are doing and that they have outlined a clear future direction.

Recommendations

The Committee recommends the following for the DOS department:

- The number of publications show a positive increase but it is recommended that DOS formulates a clear strategy to focus on publishing in core publication outlets;
- The developed research methodology is generic and beyond DOS and should be developed in concert with other departments. Introducing new research methodologies in studies of the core topics of DOS is considered positive and is encouraged;
- From a relevance to society perspective criteria for impact assessment are and will become more important in the future. DOS is recommended to seek for ways of evaluating impact as well as finding relevant measures for this evaluation;
- DOS should seek closer collaboration with other departments of IDE: with the SDE department in terms of prototyping the future with emerging technologies as well as with HCD, especially since the goal is to move to a systemic level.

3.2 Research Department Human-Centered Design (HCD)

Head of Department	Prof. dr. ir. Pieter Desmet	
Research staff 2018	22.9 Research FTE (excluding PhD)	
Assessments	Research quality	1
	Relevance to society	2
	Viability	1-2

As mentioned in the self-assessment report, research at the Department of Human-Centered Design (HCD) aims to extend its knowledge within and beyond human-centered design. The basis from which HCD ventures is human experience, but they expand the foundations of their knowledge base with two research themes that transcend the traditional sub-disciplines of user experience (aesthetics, emotion, usage, comfort, perception, etc). The three research themes for HCD's knowledge base are:

1) Foundations of Interaction. This research theme focusses on what fundamentally drives the human product interaction, and whether the frameworks uphold to novel trends;
2) Design for Change. This research theme entails the understanding of interactions between multiple actors (from people to intelligent devices, or 'things'), their interrelations, and the values at play in an increasingly connected and complex world;
3) The Human Touch. In this theme HCD extends its knowledge on design strategies for uniting and connecting, seducing, motivating, giving insight, and building trust in people.

HCD connects these research themes to societal challenges in a variety of application domains, e.g. Health Care, Energy and Mobility.

Within the broad, international landscape of design research, HCD's research program is traditionally theory/model-driven, empirically sound, and often of an experimental nature. Next to this, HCD also develops more design driven ways of doing research.

The research staff is composed of 13.9 FTE scientific staff, 9.0 FTE post-docs and 38 PhD candidates (2018).

Table 8 shows the demonstrable research output of the Department of HCD.

	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Refereed articles	38	42	37	67	61	63
Books	1	2		2		1
Book chapters	16	16	9	4	26	8
PhD theses	5	8	5	9	5	10
Conference papers	78	66	55	54	44	54
Professional publications	22	16	19	15	11	13
Editorial work	6	10	3	4	10	8
TOTAL	**166**	**160**	**128**	**155**	**157**	**157**

Table 8: Total output of the Department of HCD

The composition of the research staff of HCD is found in Table 9.

	2013		**2014**		**2015**		**2016**		**2017**		**2018**	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	41	12.4	39	12.7	39	12.7	40	12.8	41	13.1	43	13.9
Post-docs	14	4.4	10	5.1	11	4.0	15	6.0	14	6.1	25	9.0
PhD students	42		44		39		40		40		38	
Total research staff	97	16.8	93	17.8	89	16.8	95	18.8	95	19.2	106	22.9

Table 9: Staff embedded in the Department of HCD

The total funding of HCD is found in Table 10.

TOTAL	2013		2014		2015		2016		2017		2018	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	4627	64%	5076	58%	4920	66%	4903	64%	5787	62%	5799	65%
Research funding[2]	594	8%	874	10%	1211	16%	1068	14%	1388	15%	1668	19%
Contract research[3]	1305	18%	4228	48%	2650	35%	2290	30%	1295	14%	1354	15%
Other[4]	660	9%	-1380	-16%	-1287	-17%	-658	-9%	933	10%	79	1%
Total funding	k€ 7186		k€ 8798		k€ 7495		k€ 7602		k€ 9402		k€ 8900	

Table 10: Total funding at level of the Department of HCD. All amounts in k€.

1. Direct funding by the University, obtained directly from the University, and financial compensation for educational efforts.
2. Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, EU/ERC, ESF).
3. Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, the European Commission, and charity organisations.
4. Funds that do not fit the other categories.

RESEARCH QUALITY

HCD is globally known for its excellent research. The research quality presented is very high, and is very much in relation to the strategy of IDE. There are very good publication records of journal articles. HCD has a leading role on six areas. In particular, achievements on Design & Emotion, Ergonomics, Transformation design and Sustainability seem excellent. The showcases are impressive.

As the department has been shown to be one of the few most influential research groups in the world in its particular field, it clearly deserves an excellent rating. This also has a risk: the department is aware that they are doing well in design research. The gaze can sometimes be inward. Will they be able to develop and change, in collaboration with others and responding to external changes, if this means changing something that works well?

Relevance to Society

The department aims to seek societally relevant research topics and 'rich' contexts in which to do design. "Focusing on the human in societal change" is a good and societally relevant way to define the departments aims. The example projects to show societal relevance are excellent. However, the contexts are centered within the Netherlands, or the EU. It is rather difficult to measure the significance of the impacts at an international level.

Relevance to society is largely understood – at least in the interview – as commercialisation, PhD candidates, and as the number of external people contacting the department, etc. There might be room to lift also the societal relevance of the core itself, i.e. to emphasize how important it is to develop new fundamental thinking in design, strong human-centered research, and to link this design-driven theoretical thinking to other societally relevant approaches.

Viability

It appears that the department manages to cover a broad range of contexts, while also having the capability to focus on specific research topics, such as in healthcare.

The Committee likes the idea of their hiring strategy ("We want people with good ideas"). The HCD has a long tradition of hiring faculty from a broad set of backgrounds (with an interest in design). This makes collaboration easy, but the question is if there is strong enough focus on design itself. See also the comment under Viability in the faculty part of the report.

There appears to be little mobility in tenured staff. (See also the comment under Viability in the faculty part).

RECOMMENDATIONS

The Committee recommends the following for the HCD department:

- HCD has a long history and an excellent research track record, but we recommend a courageous approach to think about new approaches, partners and areas.
- The focus on fundamental research and generalities (rather than cases) is good, but we recommend HCD to think about how these could be transferrable and widely disseminated. The basics of design could be more widely used in society, how can HCD as a strong department promote this?
- In the interview it became apparent that the HCD has large collaborations with other fields, such as psychology and sociology (largely through the background of the faculty). The transdiciplinarity of the department is not well understood (especially by university leadership), so we recommend that HCD formulates it more explicitly and maybe initiates a formal collaboration with some other (Dutch?) university which is strong in these areas.
- Seek closer collaboration with the faculty, especially with the SDE department in terms of prototyping the future with emerging technologies. The committee further recommends to team up with DOS as well, especially since the goal is to move to a systemic level. The DOS research focus of "Designing design" comes close to the HCD foci, and collaboration might be better than duplication.

3.3 Research Department Sustainable Design Engineering (SDE)

Head of Department	Prof. dr. Peter Vink	
Research staff 2018	12.8 Research FTE (excluding PhD)	
Assessments	Research quality	2-3
	Relevance to society	2
	Viability	2-3

During the assessment period the department had been restructured. Currently, half of the department consists of personnel that was recruited between 2015 and 2020. In this period the approach to research has been significantly altered and is still under development.

As mentioned in the self-assessment report, research at the Department of Sustainable Design Engineering (SDE) responds to and drives developments with the aim of developing scientific and practical knowledge on the intersection of technology, design, engineering and sustainability.

SDE concentrates its research in three selected promising areas:

a) Materials and Manufacturing. This area focusses on developing product/service level design tools and methods, in particular, tools and methods that enable the use of emerging materials and advanced manufacturing processes for achieving designs;
b) Knowledge and Intelligence design. This area aims to empower designers and stakeholders in the design, development and evaluation of knowledge- and intelligence-centric products/services/systems;
c) Design for Sustainability. This research area focusses on developing design tools and methods for sustainable products/services/systems.

The mission of SDE is to empower designers through breakthrough technology innovations in these three areas via three fundamental tasks:

1) Explore and identify emerging technologies to create new frontiers in the design;

2) Develop new design tools and methods to adapt and integrate the identified technologies for enabling innovative yet sustainable designs;
3) Demonstrate the design opportunities with future-oriented, sustainable and innovative demonstrators using those tools and methods.

Scientific outcomes of SDE are design methodologies, method and tools that empower designers to combine and transform foundational technologies into sustainable products, services and systems.

The research staff is composed of 6.7 FTE scientific staff, 6.1 FTE post-docs and 35 PhD candidates (2018).

Table 11 shows the demonstrable research output of the Department of SDE.

	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Refereed articles	36	24	44	44	38	45
Books					1	1
Book chapters	18	4	1	2	4	9
PhD theses	2	5	6	8	6	6
Conference papers	52	57	30	33	45	38
Professional publications	11	9	6	9	3	1
Editorial work	13	4	2	3	3	2
TOTAL	**166**	**160**	**128**	**155**	**157**	**157**

Table 11: Total output of the Department of SDE

The composition of the research staff of SDE is found in Table 12.

	2013		**2014**		**2015**		**2016**		**2017**		**2018**	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	28	9.1	27	8.0	25	6.2	19	6.4	21	7.0	21	6.7
Post-docs	13	6.7	14	4.4	7	1.6	10	3.7	12	6.4	16	6.1
PhD students	36		36		33		38		35		35	
Total research staff	77	15.8	77	12.4	65	7.8	67	10.1	68	13.4	72	12.8

Table 12: Staff embedded in the Department of SDE

The total funding of SDE is found in Table 13.

TOTAL	2013		2014		2015		2016		2017		2018	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	3657	68%	3756	65%	3522	71%	3056	66%	3475	65%	3853	69%
Research funding[2]	222	4%	122	2%	101	2%	195	4%	233	4%	193	3%
Contract research[3]	1251	23%	2845	49%	1961	39%	2133	46%	1841	34%	1609	29%
Other[4]	246	5%	-958	-17%	-620	-12%	-734	-16%	-189	-4%	-73	-1%
Total funding	**k€ 5375**		**k€ 5766**		**k€ 4965**		**k€ 4651**		**k€ 5360**		**k€ 5582**	

Table 13: Total funding at level of the Department of SDE. All amounts in k€.

1. Direct funding by the University, obtained directly from the University, and financial compensation for educational efforts.
2. Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, EU/ERC, ESF).
3. Research contracts for specific research projects obtained from external organisations, such as industry, government ministries, the European Commission, and charity organisations.
4. Funds that do not fit the other categories.

RESEARCH QUALITY

The research quality is good/ very good. On specific subjects the quality of research is high. The department seems to be strong in sustainable materials and their application in the design of products. The department seems to have certain strong pillars of expertise, e.g. 3D printing and intelligent materials. The focus of sustainability does appear to be mostly technology-driven and viewed from a micro and meso perspective. This makes the Committee wonder whether the department has the right qualities to fully support 'sustainable design' as in: the inclusion of sustainability into all aspects of designing products and services. The department claims a large number of topics in the field of materials, manufacturing and digitisation: it is not possible to excel on all 4 subjects with the current (small number of) staff. To excel on some subjects or topics with the current (small number of) staff, choices will need to be made.

Academic achievements on knowledge and intelligence appear not to be of the desired quality, yet. However, this area can be a major strength if the department reacts fast with design-oriented approaches. It is also important to see top international conferences as major research outlets for this subject. Meantime, how this theme of knowledge and intelligence can co-exist within the sustainability application area could be an issue to address.

Relevance to society

The research of SDE is very relevant to society, both regarding research into designing with new materials aimed at increasing sustainability, and research into new (digital) manufacturing techniques for design. Also, the connection to the areas sustainability, health, and mobility is very good and works well.

The department has one group that is aimed mainly at sustainability (Design for Sustainability) and the other groups (Materials & Manufacturing and Knowledge and Intelligence Design) have a much more technology-oriented focus. The research activities of the latter two groups do not seem fit with the expectations that the name Sustainable Design Engineering carries with it.

As soon as more focus has been put on topics, the department can also work in a more focused way on cooperation with and visibility in relevant industrial networks and with industrial partners, and on building the required 'critical mass' to succeed.

Viability

The current situation of SDE gives the impression that the SDE is looking for focus for the coming years. The Committee wishes to stress that SDE is on the right track – strategically – but efforts are needed to effectuate the plans.

In the self-evaluation a great diversity of topics is mentioned. The department of SDE is the IDE department with explicit focus on technology. In its current state it is still very broad and does not come across as coherent. However, in the

additional strategy document of one of the groups “Materialising Futures” choices in topics are made and the coherence is also better represented. This gives confidence for the future. A similar strategy – in particular focus and coherence – should also be pursued across the department as a whole.

The Committee sees that the department has much more focus than at its previous assessment, but fragmentation within the department is still there and makes it a challenging starting point for the future. If collaboration is to happen from the bottom-up and in a natural way, how likely is it that the diverse research groups in the department or faculty will find each other in future projects? On the plus side: there seems to be an intrinsic willingness to develop into a coherent department, despite the current fragmentation. Also, the Committee notices success in getting in projects and hiring more PhD candidates.

RECOMMENDATIONS

The Committee recommends the following for the SDE department:

- The Committee sees that the past years the strategic focus has improved enormously. This focus needs to be continued in the department as a whole, to further reduce fragmentation; this focus on topics is also necessary to further increase the quality of the research;
- This department is still very broad; it is about technology, materials, and sustainability. Would ‘sustainable or future materials & materializing ’ better capture its focus (as ‘digital materials’ was mentioned in the presentation?);
- Take the lead in closer collaboration within the faculty, especially with the HCD department in terms of prototyping the future with emerging technologies. And try to team up with DOS as well, especially since the goal is to move to a systemic level;
- The department knows what differentiates it from other engineering departments and some concrete examples may help articulate/explain these differences;

- The department has hired 12 new researchers recently and aspires to develop its new directions in AI/data science, and IoT. This is timely and promising. Should it initiate new collaborations/ projects rather than just participating in?
- Improve the academic presence in design focused venues (journals, premiere conferences, design shows, awards, e.g. SIGGRAPH Emerging Technology for innovative ICT designs) with design-centric achievements.

Conclusion: Collaborate and Lead

The Committee's task was to evaluate IDE's performance over the period 2013-2018, but – on
request of the Faculty of IDE – with a (forward-looking) focus on strategy. This is also in line with the current Standard Evaluation Protocol and even more so with the prospective Strategy Evaluation Protocol that comes into effect in January 2021.

IDE's strategic choices are Creating Future Design, Distinguishing and profiling as an academic design research institute and Generating more societal impact. The Committee undertook an in-depth investigation of IDE's goals and strategy – along with reviewing the research quality, societal relevance and viability of IDE and the departments. The Committee believes that IDE's strategy is well-chosen. Key to successfully achieving the faculty's strategic goals is **to bring the collaboration within IDE, within TUD, and outside TUD to the next level and to take a leading role in it.** IDE is well established and well-equipped with the right knowledge, quality of staff, and attitude to make this happen.

Appendix A Lessons Learned from Online Research Review

The research assessment for Industrial Design Engineering was originally planned in March 2020 and was scheduled to take place in Delft. Due the COVID19 pandemic it was postponed to October 2020. In September 2020 it was concluded that a physical meeting was still not possible and further delay not eligible. It was then decided that the on-site visit would take place online. The online format was learning-by-doing for both the Committee and faculty. The Committee's Lessons Learned are summarised below.

Preparation phase

- The decision to turn a site visit into an online format should be taken at least six months in advance. An online site visit is an entirely different activity: the Committee needs to have at least a couple of virtual meetings before the actual site visit takes place and agendas are as always very difficult to synchronise;
- Have a place for document storage that is easily accessible for all Committee members before and during the online site visit;
- A Committee with a maximum of 6 or 7 members seems ideal, as larger teams make it difficult to actively participate in online plenary discussions;
- Differences in time zones may lead to unfavourable working hours for (some) committee members.

Site visit Phase

- Put the Committee's reflection moments at the core of the online site visit. Gathering data through the interviews takes much less time than processing the information;

- Scheduling meetings in parallel breakout rooms is very efficient, but collected data needs to be disseminated among Committee members afterwards;
- Having parallel sessions in breakout rooms, means the secretary cannot be present in all meetings. As a consequence, Committee members need to take (detailed) notes which is an extra burden. Two members' working together seems to have worked well (one led the session and the other took notes);
- Build in many breaks and explicitly schedule them in the programme;
- Chair and secretary being “on site” greatly helps the Committee connecting with the faculty. Be alert not to run a parallel site visit and make sure the entire Committee is taken along in this process as well;
- Online meeting etiquette includes: raising hands if you want to say something and put yourself to mute if you are not talking;
- Have participants ready in the waiting room 5 minutes before the meeting starts. This ensures a timely start of the meeting but also gives the opportunity to prepare the breakout rooms;
- Two shifts of Committee’s attendance – one in the morning and one in the afternoon – gives some away from the screen time and opportunity for processing the information.
- A Committee’s Whatsapp-group was not used as frequently as expected.

Appendix B Curricula Vitae of the Committee members

Professor Jan Dul, Committee Chair, is Professor of Technology and Human Factors at Rotterdam School of Management (RSM), Erasmus University. He received his bachelor's and master's degrees in Mechanical Engineering (Design and Construction Engineering) from Twente University, and his PhD degree in Biomedical Engineering from Vanderbilt University, USA. He has been researcher and consultant at the Netherlands Organization of Applied Scientific Research (TNO) and director of Erasmus University Business Support Center. His research focuses on the interaction between workers and their physical and social-organizational work environment for improving business performance (including innovation) and human well-being (including health, safety and creativity). Jan Dul has (co-)authored over 150 publications and received several academic awards. Jan is founder of the empirical research method 'Necessary Condition Analysis' (NCA) for analysing complex phenomena in a practically meaningful way. Jan's administrative and academic services include being vice-dean and chairman of the department of Technology and Operations Management at RSM, member of the board of the International Ergonomics Association, chair of the Special Interest Group Innovation at the European Academy of Management, and member and chairman of several ISO and CEN standardization committees on human performance.

Professor Hua Dong is Professor and Head of Brunel Design School at Brunel University London. Previously she worked as Professor in Design at Loughborough University, and Professor in Design and Innovation, and Dean of the College of Arts and Media, at Tongji University. Hua conducted her PhD research at the Engineering Design Centre, University of Cambridge (PhD 2005), and received her BEng is Industrial Design, MA in Architectural Design and Theory, both from Tongji University. Hua's research is focused on inclusive design and she is a convenor of the InclusiveSIG of the Design Research Society (DRS). Hua had been a council member of the DRS between 2012 and early 2020. She has been an organisor and editor of the Cambridge Workshop on Universal

Access and Assistive Technology (CWUAAT) since 2014. Hua has successfully provided inclusive design consultancy to industry, government, and consumer organisations in the UK and China, and won several awards. She is appointed Panel Member for the Creative Arts, Performing Arts and Design, Research Assessment Exercise 2020 by the University Grants Committee, Hong Kong. Hua is a visiting professor at Loughborough University and Fellow of DRS

Ir. Willem Haanstra studied Industrial Design Engineering at the University of Twente and was awarded a MSc degree in 2016. Currently, he is a PhD candidate at the Department of Design Production & Management at the same university. His PhD research is aimed at how the costs and benefits of physical assets can be assessed over their entire life cycle, with the aim of supporting Asset Management decision-making. The focus of this research are Distribution System Operators who are responsible for managing the physical systems in electrical grids, whilst taking into account the uncertain future of the energy transition. In 2019, Willem was awarded the Best Young Academic award at the CIRED conference. His research interests include: Life Cycle Engineering, Life Cycle Assessment, Sustainable design, Circular Economy and Asset Management.

Professor MariAnne Karlsson is professor(chair) in Human-Technology Systems and head of Division Design & Human Factors at Chalmers University of Technology, Gothenburg, Sweden. She received her M.A. in Education from Gothenburg University and her Ph.D. in Consumer Technology from Chalmers University. She has an extensive background in teaching courses on user studies and human-centered design to future engineers. She has also been involved in the development of the MSc programme Industrial Design Engineering at Chalmers. Her research experience comprises almost 40 years of smaller and larger, national and international, R&D projects, most of which have been multi-disciplinary to their character and run in collaboration with industry and/or public organisations. Her research efforts are directed at investigating how users understand, interact with and use new technology and the implications for design and, further, how users can be enabled to contribute with their knowledge in the development of new technical solutions.

Professor Tek-Jin Nam is a professor and the head of Industrial Design department at KAIST. He received a B.S. and a M.S. in Industrial Design from KAIST, and a PhD in Design Technology from Brunel University. He leads Co.design:Inter.action Design Research Laboratory at KAIST. He is the deputy editor-in-chief of Archives of Design Research journal, a Vice President of Korea Society of Design Science and an executive board member of IASDR(International Association of Societies of Design Research). His main teaching subjects include interaction prototyping, interactive product design, system design and design research issues. His research interests lie at design oriented human computer interaction, focusing on creating people centric values of future products and services and systematic approached to creative design and innovation. He is also interested in integrating design research and practice.

Ir. Gu van Rhijn received her MSc (cum laude) in industrial design engineering from Delft Technical University in 1993. In 1993 she received the Best Graduation Award for her thesis "design for a chair for a micro surgeon". She has been working at TNO (Netherlands Institute for Applied Research) since 1995, mainly in the manufacturing industry. As a senior project manager/scientist at TNO, she has been involved in many national and EU research and development projects in the manufacturing sector, with both larger companies and SMEs. From 1995-2010 she developed and applied (participative) working methods and (virtual and mixed reality) technology to improve production orderlead time (by 10-50%), productivity (by 10-40%), flexibility and ergonomics of personnel in about 100 industrial companies. From 2010 Gu van Rhijn is actively involved in Smart Industry programs in Europe and in the Netherlands, She is setting up and coordinating projects in Digital Innovation Hubs (Brainport Industries Campus & RoboHouse) on topics like flexible manufacturing, factory of the future in general and more specific: human robot collaboration and operator support systems aimed at efficient, effective and safe operations and maintenance. Goal is to develop, validate, apply and demonstrate new technologies like AI based cobots and augmented reality in practical demonstration set ups for industry.

Professor Anna Valtonen is Professor in Strategic Design at Aalto University, Finland. She has worked as Vice President at Aalto University (Art & Creative Practices) in 2015-2020 and was the Dean of the Aalto University School of Arts,

Design and Architecture in 2014-2019. 2009-2014 she was Professor and Rector of the Umeå Institute of Design at Umeå University in Sweden. She has also worked as Post Doc and Visiting Professor at the Management Department of ESSEC Business School, France. Currently she has a research leave to focus on her writing, mostly on design and change. Anna Valtonen has an extensive background in industry; design, management, end-user understanding, strategy, and startups. In 1997-2009 she worked in various roles in Nokia, most recently as Head of Design Research & Foresight. She has been a board member of several companies, public organisations and universities. Her current board memberships are as Chair of the Board for the Design Museum in Finland, in Vitec Software Group AB, Kalevala Jewellery, the Finnish Government's Advisory Board for Creative Industries, and in several editorial boards for journals.

APPENDIX C ONLINE SITE VISIT PROGRAMME

Note: All meetings will be on-line using the 'Zoom' application.

Thursday October 1st		
time NL 9.30	Meeting with Rector Magnificus: Prof.dr.ir. Tim van der Hagen	Chair & full Committee

Monday October 5th			
time NL	*activity*	*assessors*	*participants IDE*
8.00	Prep. time	All	-
8.30	Interview **MT IDE**	Prof.dr.ir. J. (Jan) Dul (1st) All (2nd) *Participants start with 5 minute presentation*	Prof.ir. Ena Voute *(Dean)* Prof.dr.ir. P.M.A. Desmet Prof.dr. P. Vink Prof.dr.ir, R. Mugge Prof.dr. P.J. Stappers Prof.dr. A.R. Balkenende
9.00	Wrap-up	All	-
9.30	Break/prep.	Assessors	-
10.00	Interview IDE **tenured staff**	Prof.dr. M. Karlsson (1st) Ir. G.W. van Rhijn (2nd) *Participants start with 5 minute presentation*	(DOS) Prof. dr. H.M. J.J. Snelders (DOS) Dr. G. Calabretta (HCD) Dr. ir. N. Tromp (HCD) Dr. V.T. Visch (SDE) Dr. Y. Song (SDE) Dr. mr. A.M. Onencan
10.00	Interview IDE **tenure trackers**	Prof.dr. H. Dong (1st) Prof.dr. T.J. Nam (2nd) *Participants start with 5 minute presentation*	(DOS) Dr. E.Y. Kim (DOS) Dr. ir. M. van der Bijl - Brouwer (HCD) Dr. R. Bendor (HCD) Dr. T. Huysmans (SDE) Dr. J. Bourgeois (SDE) Dr. ir. W.S. Elkhuizen
10.00	Interview IDE **PhD canidates**	Ir. W. Haanstra (1st) Prof.dr. A. Valtonen (2nd)	(DOS) MSc. J.C. Konietzko (DOS) MSc. V. Pannunzio (HCD) MSc. C. Yu (HCD) (HCD) MSc. S. Colenberg (SDE) MSc. R.B.N. Scharff (SDE) MSc. T. Yuan
10.30	Wrap-up	assessors	-
11.00	Break		
11.30	Prep. time	Assessors SDE	-

12.00	Interview **MT SDE**	Prof.dr. T.J. Nam (1st) Ir. G.W. van Rhijn (2nd) *Participants start with 5 minute presentation*	Prof.dr. P. Vink Prof.dr.ir. C.A. Bakker Prof.dr. G. Kortuem Dr. E. Karana
12.30	Wrap-up	Assessors SDE	

Tuesday October 6th			
time NL	*activity*	*assessors*	*participants IDE*
8.00	Prep. time	Assessors HCD	-
8.30	Interview **MT HCD**	Prof.dr. A. Valtonen (1st) Prof.dr. T.J. Nam (2nd) *Participants start with 5 minute presentation*	Prof.dr.ir. R.H.M. Goossens Prof.dr.ir. P.M.A. Desmet Prof.dr. P.P.M. Hekkert Prof.dr. S.C. Pont
9.00	Wrap-up	Assessors HCD	-
9.30	Break/prep.	Assessors DOS	-
10.00	Interview **MT DOS**	Prof.dr. M. Karlsson (1st) Prof.dr. H. Dong (2nd) *Participants start with 5 minute presentation*	Prof. dr. ir. R. Mugge Prof. dr. P.A. Lloyd Prof. dr. ir. M.S. Kleinsmann
10.30	Wrap-up	Assessors	-
11.00	Break		
11.30	Prep. time	Assessors	-
12.00	Interview **Scientific Career Committee**	Prof.dr. H. Dong (1st) Prof.dr. M. Karlsson (2nd) *Participants start with 5 minute presentation*	Prof. dr. U. Staufer (chair) Prof.dr. A.R. Balkenende B.E. van Someren-Rijneveld (HR)
12.30	Wrap-up		

Wednesday October 7th			
time NL	*activity*	*assessors*	*participants IDE*
8.00		Reflection time Committee	-
9.45	Break		
10.00	Prep. time	Assessors	-
10.30	Interview **Diversity Officer**	Prof.dr. H. Dong (1st) Prof.dr. T.J. Nam (2nd)	Prof.ir. Ena Voute B.E. van Someren-Rijneveld (HR)
10.30	Interview **IDE**	Ir. W. Haanstra (1st) Prof.dr. M. Karlsson (2nd)	Prof.dr. P.J. Stappers Director Graduate School Ir. R.J. Niermeijer

	Graduate School	*Participants start with 5 minute presentation*	support officer GS Prof. dr. S.C. Pont Doctoral Education
10.30	Interview **Integrity officer**	Ir. G.W. van Rhijn (1st) Prof.dr. A. Valtonen (2nd)	Dr. E. Ozcan Vieira Faculty member Human Research Ethics Committee *(HREC)*
11.00	Wrap-up	assessors	-
11.30	Break		
11.45	Interview Scientific Director	*All*	Prof.dr. P.J. Stappers
12.15	Wrap-up		
12.30	Finish		

Thursday October 8th			
time NL	*activity*	*assessors*	*participants IDE*
8.30	Interview Dean	*All*	Prof.ir. Ena Voute *(Dean)*
9.00	Wrap-up	Committee	
9.15	Discussing and writing preliminary judgements	Committee	
9.45	*Break*		
10.00	1st Concluding meeting with MT IDE	*All*	Prof.ir. Ena Voute *(Dean)* Prof.dr.ir. P.M.A. Desmet Prof.dr. P. Vink Prof.dr.ir, R. Mugge Prof.dr. P.J. Stappers Prof.dr. A.R. Balkenende
10.45	Wrap-up	Committee	
11.00	*Break + prepare interviews*		
11.30	Interview **ICT & data management**	Prof.dr. A. Valtonen (1st) Prof.dr. T.J. Nam (2nd) *Participants start with 5 minute presentation*	Dr. J. Love Faculty data steward L. Zijlstra Information coordinator
11.30	Interview **Valorisation**	Ir. G.W. van Rhijn (1st) Prof.dr. H. Dong (2nd) *Participants start with 5 minute presentation*	*B. Van den Berg (NL)* *J. van der Aa (EU)* *G. van den Boogaard* education & companies
11.30	Interview **Communications**	Prof.dr. M. Karlsson (1st) Ir. W. Haanstra (2nd)	J.R. Candy *(manager)* M. Smit

			M. de Kool
12.00	Wrap up and break	Full Committee	
12.30	Discussing preliminary judgments	Full Committee	
13.00	*Finish*	Full Committee	

Follow-up meetings			
	activity	*assessors*	*participants IDE*
28 October	2nd Concluding meeting with MT IDE	Full Committee	Prof.ir. Ena Voute *(Dean)* Prof.dr.ir. P.M.A. Desmet Prof.dr. P. Vink Prof.dr.ir, R. Mugge Prof.dr. P.J. Stappers Prof.dr. A.R. Balkenende
5 November	Presentation first impressions	Full Committee	All

Appendix D Explanation of the SEP Scores

	Meaning	***Research quality***	***Relevance to Society***	***Viability***
1	*World leading/ excellent*	*The research unit has been shown to be one of the few most influential research groups in the world in its particular field.*	*The research unit makes an outstanding contribution to society.*	*The research unit is excellently equipped for the future.*
2	*Very good*	*The research unit conducts very good, internationally recognised research.*	*The research unit makes a very good contribution to society.*	*The research unit is very well equipped for the future.*
3	*Good*	*The research unit conducts good research.*	*The research unit makes a good contribution to society.*	*The research unit makes responsible strategic decisions and is therefore well equipped for the future.*
4	*Unsatisfactory*	*The research unit does not achieve satisfactory results in its field.*	*The research unit does not make a satisfactory contribution to society.*	*The research unit is not adequately equipped for the future.*

Quality is seen as the contribution that research makes to the body of scientific knowledge. The scale of the unit's research results (scientific publications, instruments and infrastructure developed by the unit, and other contributions to science) are also assessed.

Relevance to society is seen as the quality, scale and relevance of contributions targeting specific economic, social or cultural target groups, of advisory reports for policy, of contributions to public debates, and so on. The point is to assess contributions in areas that the research unit has itself designated as target areas.

Viability is seen as the strategy that the research unit intends to pursue in the years ahead and the extent to which it is capable of meeting its targets in research and society during this period. It also considers the governance and leadership skills of the research unit's management.

The categories in this SEP and the descriptions differ from the scores in prior SEPs and are therefore not comparable.

Quicken ORGANISATIE ADVISEURS

bureau voor organisatieontwikkeling