Expert report, panel 1

KTH's Research Assessment Exercise (RAE) 2021

Panel chair:
Professor Murray Fraser

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Introduction

This expert panel report is part of the Research Assessment Exercise (RAE) 2021 at KTH Royal Institute of Technology. The report is based on the self-evaluation by Panel 1 and aims to provide recommendations and feedback to the departments involved and to KTH generally.

Expert panelists:

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- [Dag Björklund](), Samhällsbyggarna + Björklund Fastighetskompetens AB, Sweden

- [Associate Professor Eleni Chatzi](), ETH Zurich, Switzerland

- [Professor Graham Haughton](), University of Manchester, UK

- [Professor Allison Kealy](), RMIT University, Australia

- [Professor Christopher Kennedy](), University of Victoria, Canada

- [Professor Jarek Kurnitski,]() Talinn University of Technology, Estonia

- [Professor Alfred Nordmann](), Technical University of Darmstadt, Germany

- [Professor Eeva-Liisa Pelkonen](), Yale School of Architecture, USA

- [Professor Vanesa Castán Broto](), University of Sheffield, UK

Panel 1

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Vice-coordinator: [Prof. Mats Wilhelmsson,]() KTH Royal Institute of Technology
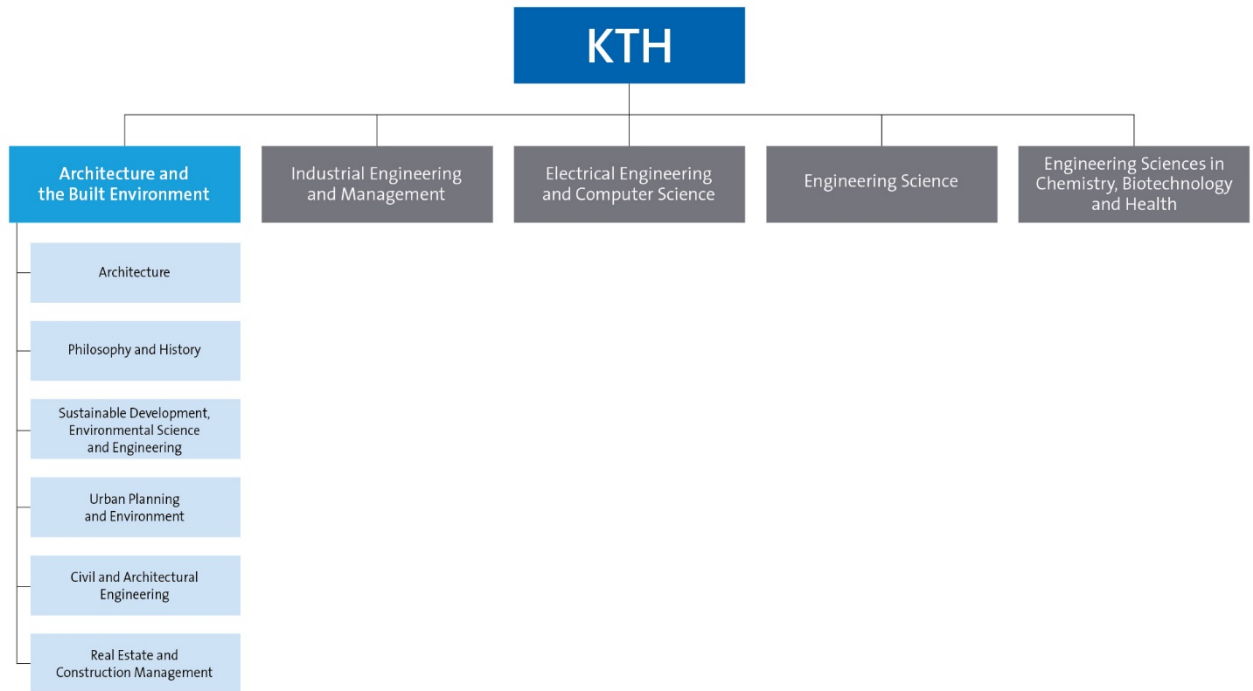
Part A: Summary of the whole panel

1. Strengths, weaknesses, and recommendations

Common to the departments within the research area covered by the panel

Strengths	Weaknesses
In the main, the departments in the ABE School are very healthy in research terms and jointly have a notable international profile. There is clear evidence in all departments of large research groups which have a notably strong culture alongside an impressive record of outputs and impacts. There are also innovative specialised research programmes challenging the future of knowledge for the built environment (for example the Department of Philosophy and History of Science and Technology, which is a bastion of humanities research within KTH).	KTH's internal funding system appears to be causing uncertainty and stress among faculty staff, while also reducing the number of PhD candidates. The current funding model based on external funding also seems to be dictating research content and research approaches too much. As a result, pragmatic applied research seems to predominate in the school, thereby stifling efforts towards blue-sky, innovative thinking. Communication and dissemination internally and externally about the school's research work and impacts could be stronger.

It is positive that the departments between them are involved in 8 research centres, and 2 strategic innovation programs, which span across KTH. There have been consciously active efforts to develop a good gender balance among research staff, and among PhD students, with some excellent results (especially in the Department of Architecture).	Need to find ways to synergize research work around topics or themes that can span across different departments. Need to address EDI policies more stringently in terms of intersectionality through issues such as race/class/sexual preference/disability, and thus not only dealing with gender issues.

Recommendations

The panel's key recommendations for school-wide research are as follows:

- The ABE School needs to work closely with KTH centrally to devise a more fluid and creative funding system for research, reducing thereby the need/stress placed on faculty staff to chase external research income to pay for so high a proportion of their salaries and thereby also helping ensure a better career progression for staff.

- Develop strategies to increase the international reach of the research, including taking up the challenge of working more with actors and academics around the world, especially in the Global South, in ways that are however mindful of current post-colonial debate and calls to decolonize what is being taught and researched by western universities.

- However, what the ABE School needs especially are new internal policies and structures that can promote fundamental, 'blue sky' research to help rebalance the currently dominant pragmatic, smaller-scale approach.

- There ought to be a school-wide research coordinator whose task is to encourage, facilitate and publicize multidisciplinary/interdisciplinary research across the departments.

- The ABE School needs to continue to investigate the causes of staff stress and develop strategies and remedies that will reduce these work pressures so that a more healthy, positive research culture can thrive.

- Working alongside KTH centrally, the school needs a more sophisticated and ambitious approach to EDI issues by adopting an intersectional approach that goes beyond gender equality, if it wishes to match up more closely with leading international universities.

2. Feedback on the formulated visions and strategies

That can lead to increased quality of research at KTH and increased impact

The panel was provided with very good and timely information in advance by the ABE School's self-evaluation document, and then in the online meetings with the different departments. Furthermore, the panel asked for supplementary information from the RAE 2021 coordinator and vice-coordinator that was always supplied quickly, providing even more detailed data to help our evaluation.

It means that the comments and suggestions expressed in this report are well-grounded and solid. In general, the panel was very impressed by the research of the six departments, eight research centres, and two strategic innovation programs that it had been asked to look at. From our investigations, it became evident that the ABE School as currently constituted is very much oriented toward applied research. In certain ways this is a strength which could be pushed further by integrating it more into teaching, and in pursuing even greater impact on society and industry. Conversely, it could be seen as a deterrent to more open, critical, challenging modes of research, as will be discussed again below.

3. Ideas and recommendations for essential steps

To be taken to renew research areas

One obvious step that the ABE School could take would be to appoint a research coordinator to encourage, facilitate and publicize multidisciplinary and interdisciplinary research across its departments. This research coordinator does not need a large budget or complex administrative support, simply sufficient access to seed-funds to launch a range of interdisciplinary initiatives that would mandatorily involve at least two (and ideally more) departments. This would do a lot to build up a critical mass and cross-fertilization within the school-wide research agendas and projects.

4. Potential links and synergies

Between the departments within the research area *covered by the panel and other parts of KTH*

There are some obvious areas where there could be more research linkages between the different departments in the ABE School. Perhaps the most glaring is in geodesy/geoinformatics. Research activities related to the broad subjects that underpin geodesy and geoinformatics are currently covered separately and seemingly independently within two departments (Department of Urban Planning and Environment, and Department of Real Estate and Construction Management). Applications of both geodesy/geoinformatics are used in the development of research programs within SEED and it is highly likely that there are other schools within KTH pursuing similar research that could be brought into the mix too.

A particular area of strength that also could be exploited further is sustainability. There are real obvious strengths in SEED and the Department of Urban Planning and Environment, but all departments are involved in research related to the UN's Strategic Development Goals (SDGs) and sustainability is a well-known theme at KTH generally, so greater synergy is surely possible. Similarly, the Department of Architecture could work more closely with the Department of Urban Planning and Environment and the Department of Civil and Architectural Engineering to make the case for the societal benefits of high-quality design for Sweden and other countries internationally.

At the more pedagogical level, the ABE School could make use of the research strengths of the Department of Philosophy and History of Science and Technology in a more concerted and strategic manner, promoting it also within KTH as the core of humanities teaching/research across many disciplines. The panel believes this would help cater to growing student interest in that area.

5. Recommendations for strengthening the departments and their future potential

At a more general and administrative level, the panel believes that each department needs its own Strategy Committee/Council, whether this is combined or not with other management committees. Such a body should not only include the division heads, but also younger researchers and faculty staff of different ranks. Run by the research coordinator, it should create opportunities for the flexible allocation of pooled funding, creating thereby seeds for fundamental or high-risk/high-gain projects.

6. Recommendations applicable to the whole of KTH

There are two aspects in which the panel felt that KTH might address in wake of its investigations, being situated at a level above the ABE School and its departments. The first is to rethink the organisational/financial structure which seems to be working against recruiting the highest quality staff because of the need for Associate Professors and Full Professors to win external research funding to pay for such a larger proportion or their salaries, and which is also making the taking on of PhD students more difficult. The second aspect is to reframe its policy on impact, which seems to be weighted more towards talking to state regulators and legislators, by increasing further its links with Swedish municipalities. The latter, comprising around 290 entities, control much of the public expenditure in Sweden and clearly need research to support their policies – so KTH could alter its impact strategy accordingly. Both points will be explained more in the report sections that follow.

Part B: Report for each department

Department of Architecture

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
Internationally renowned and highly visible in its research profile and outputs. Research is helped by being a well-run department with a strong and extensive record in collaborative projects. Eminent group of female Full Professors, along with generally a good gender balance among faculty staff. Research agenda is diverse and well-adjusted to deal with vital issues such as neo-liberal planning policies, climate change and social sustainability. Possesses a strong humanities-based research culture in architecture and urbanism which is closely aware of the need for impact and relevance.	Need to more closely integrate the research being done in Lighting Design, as it still feels too separate from the rest. Communication internally and externally about the impacts arising from the department's research could be more explicitly described. Slightly behind the curve in terms of design-based research, and hence this aspect needs to be pursued more concertedly. Needs to be greater efforts made to develop clearer themes in technological research. Composition of faculty staff needs to become more diverse on top of its good gender balance. Current funding model based on external funding is maybe dictating research content too much.

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

The research goals set out by the Department of Architecture – not least in relation to the United Nation's SDGs – are well conceived in terms of their relevance and vision for the future. The commitment to addressing issues of social and environmental sustainability is evident and persuasive. It is likewise good to see that the department is placing so much emphasis on collaborative research, whether among staff internally or with partners in KTH or outside the university. The vision for growth set out in the self-evaluation document thus seems to be well-framed and achievable – although there did appear some concern that the current research funding model in Sweden, and the emphasis on immanent social impact, is perhaps diluting the department's activities at the expense of it being able to engage in more speculative, 'blue sky' methods such as architectural design research.

It is also positive to see the department's commitment to continue its engagement in high-quality research that brings international recognition, as part of efforts to ensure that its impressive track-record in research outputs can lead to even greater levels of impact and engagement. To help this, there is a similar commitment to providing a positive research environment for faculty staff, not least in finding ways to use the Department of Architecture's new building to optimum effect.

This careful fine-tuning of the research strategy is undoubtedly tackling the complex issue of how best to integrate research in Lighting Design, this being a unit that was only transferred into the department in 2017 and whose process of integration has thus been affected more recently by the restrictions caused by the COVID-19 pandemic.

3. International community engagement

The Department of Architecture performs well in terms of the number and range of international links yet – as is common in most universities – this is evidently taking place more at the level of individual researchers' connections rather than as part of a broader strategic research policy devised by the whole department.

Maybe a totally coordinated overall vision for international engagement is something that is impossible to achieve, but it certainly felt to the panel that a focussed review of the current international links shared between all the department's researchers would be useful in deciding which kinds of connection ought to be pursued – and indeed supported financially – in future. In that goal, identifying the existing areas of strength where the department can legitimately claim to have international leadership, such as research themes related to the field of sustainability, might prove helpful. Furthermore, taking a greater lead in research initiatives within the Nordic and Baltic academic communities is something that could also be prioritized even more in future.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

The Department of Architecture is therefore in a strong position within the front-line of international research, but one aspect where it is still behind the curve is in terms of design-based research. This then would seem to be the research area which needs to be pursued more concertedly.

To help meet that goal, it is essential however not to throw the baby away with the bathwater: in other words, the contribution of Humanities-based research still needs to be regarded as important, and so it is more a case of realizing that equally essential is developing the role that art and design can play in helping to shape social changes and cultural values.

Indeed, it appears that a real opportunity, and indeed potentially a crucial contribution that the department could make – if suitably backed by the School of ABE and KTH in general – would be to present a powerful public case for the social benefits of a concerted, high-quality design culture whether in Sweden, the Nordic/Baltic region, or globally. The research that the department presented to the panel seemed somewhat reluctant to express, or indeed was devoid of, any clear stance about the potential socio-aesthetic and ethical contribution of architectural design.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

The key recommendations for the Department of Architecture are therefore:

- To acknowledge more explicitly that architecture is an arts-humanities-social science-design hybrid and thus proclaim greater ownership over this unique interdisciplinary field.

- To take on the role of arguing in various public forums and media channels for the importance of architectural design by defining and communicating its vital socio-aesthetic and ethical basis to a broader audience.

- To push on more concertedly with the development of design-based research, with this most likely being linked also to greater efforts to offer a cohesive PhD by Design programme.

- In tandem, to identify and sharpen a vision for building technology research within the department, providing thereby a better framework to include the research in Lighting Design.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

The research work by faculty staff in the Department of Architecture is internationally significant, indeed eminent, in several different subject areas that include:

- Rethinking and framing architecture and urbanism from a feminist perspective.

- Examining the transition from Welfare State models of architecture and urbanism to those that are produced in the 'free-market' conditions of neo-liberalism.

- Exhibitions/publications which explore intersectional themes often drawn from critical theory.

- Urban design and urban theory, especially in relation to the sustainable development of Stockholm and other Swedish cities.

b. Contributions to the advancement of state of the art within the research fields of the department

There are strong contributions to cutting-edge research internationally in all the above-named research areas. Where there is scope for improvement is in design-based research and technological research, not least in developing greater synergy with the work being done by faculty staff in Lighting Design. As yet, however, it is still not evident how well this latter research is bedding in.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

As well as the impressive research outputs, and linked conferences/exhibitions that have been mentioned, the Department of Architecture has done well in terms of national and international research collaborations. Especially notable was the six-year period (2011–17) when the four architectural schools in Sweden came together to apply successfully for Formas funding to set up a 'Strong Research Environment' in the subject – an exemplary move that was much applauded in other European countries. In this regard, it would have been helpful in the department's self-evaluation to have heard a bit more about the achievements of this 'Strong Research Environment' and about which new opportunities and directions became opened up for faculty staff. In other words, what is the legacy of that significant Formas grant?

d. Follow-up from previous evaluations

The Department of Architecture feels far stronger and more confident in its research strategy and outputs than it did in RAE 2012, and, in that sense, it has clearly acted productively in addressing the recommendations made by that review process.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

The level of internal and external funding for research work in the Department of Architecture has tended to be relatively modest over the past few years, certainly when compared to other departments in the School of ABE. This is however not that surprising as the department operated in an academic field in which there is relatively little money available for research grants. It is a typical situation as most countries tend to prioritize scientific research, and so as such it cannot be used to stigmatise the department. Architecture is inherently an interdisciplinary field, and thus it needs to be acknowledged that it generally finds itself hard to fit into many official funding models.

The department's participation in the Formas 'Strong Research Environment' scheme from 2011–17 was thus extraordinary, not least in leading to a definite ongoing benefit in the form of the ResArc network for doctoral student/research staff training. This shared platform continues to link the four Swedish architectural schools, as seen most recently when becoming part of a pilot scheme with the aim of establishing pan-European PhD training, and which is being led by the BauHow5 consortium (UCL, Chalmers University, ETHZ, TU Delft, TU Munich). It is not a route which has brought in research funding to date but could offer an interesting income stream in future.

b. Academic culture

The research culture in the Department of Architecture is well engrained and lively and productive, with strong cross-fertilization between different research teams within the university. It is also undoubtedly helped by the fact that the most senior figures in the department are all active researchers who have strong international profiles in their subject fields. More worrying perhaps is what one might caricature as a 'Hunger Games'-style battle for external research funds that appears to be affecting the department's culture and morale, with the younger faculty staff in the worst situation.

c. Current faculty situation and composition of the research team(s)

Recently, three retitled research terms have been identified to describe the sub-divisions within the Department of Architecture's PhD programme, this being a reduction on what had previously five groups. These reformed teams are:

- Architectural Design, Technology and Representation

- Architectural Theory, History and Critical Studies

- Urban Design and Urban Theory

This framework seems relevant and healthy, and it will presumably now be used more extensively to describe and shape the department's overall research strategy. This reframing could perhaps also help in forging stronger synergies with researchers in other department in the ABE School, as there definitely seems an opportunity for closer integration for instance with research projects taking place in the Department of Urban Planning and Environment.

d. Recruitment strategies

There is evidence of a constructive and thoughtful recruitment strategy in terms of the appointment and support given to female academics, and indeed it is remarkable that all the Full Professors in the Department are female – a situation that really doesn't happen elsewhere in the world.

In this there seems to have been an excellent start in terms of inclusivity and diversity, and now it would be good to apply this appointment policy to bring in more faculty staff from other social groups that are not usually represented at Full Professor level because of ethnicity, disability etc.

e. Infrastructure and facilities

The research infrastructure and facilities available to faculty staff in the Department of Architecture appear to be positive, with the department now having a new building that offers them a far stronger visual presence within KTH. That said, some remarks by faculty staff seemed to imply that the spaces in the new building, while attractively designed, did not in fact provide the optimum work environment for researchers – the implication being that there was perhaps too much communal space and not quite enough for personal research activities.

With this point in mind, it would be interesting to know what the department intends to do about this space issue to enhance the use of its new building to support the research infrastructure, as that was not entirely clear to the panel.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

The three new research terms (Architectural Design, Technology and Representation; Architectural Theory, History and Critical Studies; Urban Design and Urban Theory) appear to offer a solid basis for continuing improvement in research ambitions and outputs. In that sense, the key goals for development over the next 5-10 years would primarily seem to build upon current strengths.

This acknowledged, there is still the opportunity for the Department of Architecture to become bolder in its efforts in pursuing design-based research and in increasing its investigations into technological subjects. Some internal negotiation however still needs to be carried out before setting out what would be an even broader strategy for research, and for research-based teaching, in the department.

b. Congruence with university-level goals

The department seems to be well aligned with KTH's general goals and strategies, with for instance a clear lead being provided by the current Head of Department as a benefit of their previous role at institutional level. In this sense, the panel could not detect any difficulties or problems in meshing the department's research with university-level policy.

c. Leadership structure and collegial structure

It became obvious to the panel that the Department of Architecture has a clear leadership structure that appears to engender a substantial degree of respect and support for research staff at all levels. There were remarkable few criticisms of how the department operates research-wise, although the same concerns expressed also by other departments about centralised bureaucracy, high overhead charges, and such like.

In helping the panel to assessing this particular issue it might have been helpful to have heard more from PhD candidates in the department – yet based on those that did present, the doctoral students appear to be similarly appreciative of the strong collegial atmosphere that prevails.

d. Strategies for achieving high quality

The faculty staff have a strong sense of how they need to work to produce high-quality research in their subject areas. However, it was noticeable that in the self-evaluation document, concern was expressed about staff members feeling they were being pushed ever more into writing essays to be included in refereed journals with high rankings/impact, due to KTH's university-wide method for research validation. It is crucial to note that such a strategy will not work in a subject like architecture because there is nothing like the same focus on publishing in refereed journals: instead, far more important and influential in the field are monographs, edited books, design project portfolios, etc.

In this sense, our recommendation is that the Department of Architecture should strongly resist any attempt to compel its staff to publish essays in specified journals merely to look better internally in response to KTH bibliometrics. This would likely be detrimental to the department's research quality and international reputation were it to go down that line. Instead, the department should argue against any such pressures to change its research policy by finding ways to sustain and build upon its strong current focuses. For instance, it could be more productive to encourage faculty staff and PhD candidates to engage in contemporary debates as public intellectuals rather than trying to chase the 'perfect' score in peer-reviewed journal publication. Likewise, outputs in non-peer reviewed formats – including exhibition catalogues, anthologies, design journals (both print and online), and so on – ought to be counted as being equally important within KTH's research assessment system.

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

The department was introduced to the panel as having c.500 students at the three set levels of education (Bachelors, Masters, Doctoral). Most of these students are part of the professional qualification programmes, plus also some that are taking MSc courses in Architecture or Lighting Design, or else are engaged as PhD candidates. Overall, therefore, there appears to be a healthy recruitment environment in what is undoubtedly the best-known architectural school in Sweden, and one which has a high reputation internationally.

What we were surprised not to hear more about are the reciprocal links between research and teaching within the department. This, after all, is a significant topic in leading universities that are looking to strengthen their pedagogy further by offering teaching that is more explicitly integrated with research work, even starting with the tutoring of students at Bachelors' level. Given this growing interest in research-based teaching, it could well provide a productive topic for the Department of Architecture to discuss and develop more explicitly. As a possible example, one would expect to see that PhD candidates in the department were teaching on more courses in a capacity of assistants, something that would also benefit those of them wishing to become academics in learning their trade.

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

The engagement of the Department of Architecture with local municipalities, building clients and professional practices is sound enough, although perhaps not nearly as intensely pursued as in some other Swedish/Nordic universities. It would be asking too much to alter this approach to any major extent, yet there could certainly be a more explicit policy drawn up to decide and explain what kinds of links with external entities the department ideally would wish to have.

b. Research dissemination beyond academia

In terms of spreading the word about its research outputs, the department is relatively energetic and impactful. It remains the case, however, that – like other architectural schools globally – the department struggles a bit to explain and promote its research impact beyond academic circles. Such efforts could thus be expanded to include wider public forums, such as writing Op-Ed articles in well-known newspapers. Perhaps KTH could even offer workshops to help in this respect.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

The urgent necessities of the UN goals are well covered in the research work of faculty staff, although it also should be said that this happens more at a broader theoretical level rather than – as in other departments in the ABE School – there being dedicated research teams set up to address specific goals in a more explicit and concentrated manner.

Indeed, it was rather noticeable to the panel that while researchers in the Department of Architecture are clearly addressing issues related to climate change, biodiversity, urban sustainability etc, the wording used to name and describe its research groups seem to deliberately avoid the usual research buzzwords of the moment. While the motive for this is understandable, there could be benefits for the department's researchers if they framed their projects to link more closely and concertedly with those aspects of sustainability in which KTH possesses a major international role, indeed leadership.

d. Plans and structure for increased impact

In examining the department's research impact, a similar point can be made as for all departments in the ABE School in that what appears to be required most is a clear, focussed institutional strategy that would attract greater attention from the general public, relevant target groups, potential funders, etc. It felt to the panel that a tighter impact strategy and communication plan ought to be formulated by the department to set out its position.

This level of analysis is needed precisely because there are obviously many potential routes towards research impact, and thus the Department of Architecture absolutely needs to take firm decisions about which impact pathways it wants to follow and those it does not. It can then link this to a cohesive communication plan, aided by giving it more finance and staff effort, which can broadcast the relevant stories about real-world impacts stemming from the staff's research.

6. Recommendations for strengthening the department and its future potential

These are our recommendations for strengthening research within the Department of Architecture:

- The department needs to discuss and implement a clearer and sharper policy for research-based education at all its pedagogical levels.

- It should forge a more concerted and ambitious culture for architectural design research, ideally along with an expanded PhD by Design/Practice stream as the foundation. Indeed, there needs to be far more ownership of the design research agenda, with a clear statement by staff about carrying out this type of research at the very highest international level. Currently, the approach to design research feels rather muted, and so maybe what is needed is for a new figure to be appointed to lead these efforts. Key questions should be what does it mean to conduct research through design, and how should one communicate and disseminate this kind of output?

- Considering the technical basis of KTH, the department needs to decide upon a stronger approach towards technological research in all the potential areas: design, fabrication, manufacturing, etc. What are the latest technologies that are emerging? How might the department participate in these, for the benefit of all parties? This sort of ambition also required more concerted efforts to integrate humanities research with technological research through the examination of communal issues such as aesthetics, ethics, economics, etc.

- There is a need to find more creative ways to integrate Lighting Design into what is the largely humanities-dominated research culture in the department. It would be worth considering for instance whether Lighting Design research should be viewed a technological or artistic endeavour – or even, considering the important legacy of the 1930 Stockholm Exhibition, of whether it could become a key area of the department's historical research!

- More generally, the department should become more vocal and active in the issue of Open Access research. Could someone be charged with making the Department of Architecture the leading Open Access champion in the subject in Sweden and further afield?

- The department needs to discuss and draw up an explicit and connected policy on research impact, selecting its impact pathways in a clearer and more strategic manner.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

Overall, we were impressed with the quality and confidence of research activities among faculty staff in the Department of Architecture, with plenty of evidence of high-quality international-level projects and outputs in the main existing research teams – as was explained very fulsomely in a well-written self-evaluation document. This obvious position of strength could now be furthered by augmenting work in less established subject areas, such as design research and technological research, as well as by adopting the various other recommendations above.

The panel felt that it was provided with sufficient information about the department's research, although if one were looking for suggestions as to what else might be useful for future research reviews, two main aspects became apparent: the first would be a clear explanation of the links between research and teaching, and the second would be to explain more about the relationship to the aims of the PhD programme, for instance in how doctoral candidates are able to plug into the department's research/teaching vision. More emphasis might also be given to a consideration about job prospects at all career levels, given that the goal of educating future research leaders is so important.

Department of Philosophy and History of Science and Technology

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
Formidable research by both the Philosophy and History divisions is helping to frame positive approaches to humanities teaching and research across KTH.	Despite its high ranking in RAE 2012, and other plaudits since, the department remains somewhat precarious in terms of its position within the university.
The Philosophy division builds strongly upon the Swedish tradition of practical philosophy, helping others in KTH to think about modelling, risk and safety, biodiversity offsetting, etc.	Although strong in terms of gaining external research funds, the department's small size and relative lack of teaching means it finds it hard to plan financially or strategically.
The History division, and most notably Environmental History, offers a leading global approach from a technology perspective.	This shortage of internal funding is leading to at least one potential senior professorial post remaining unfilled.
Both divisions are extremely competitive and successful in obtaining external research funds.	The department seems torn about whether to turn increasingly to external sources for research funds, or else to try to integrate more into KTH's general teaching provision.
Both divisions have a great deal to offer in teaching their subjects across KTH.	

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

The Department of Philosophy and History of Science and Technology consists of two divisions which, for academic and intellectual purposes, need to be considered separately. Their conjoined title of 'Philosophy and History' is a misnomer since it suggests that these two fields are represented in their entirety or breadth, and that KTH has formidable strengths in the humanities overall. Instead, both divisions are highly adapted to the specific context of a technical university: they are formidable, indeed, but in this specialized manner. Together they have been thinking hard about the best ways to represent, from their vantage points, the 'humanities' in light of the prominence of science and technology within contemporary society. Here, the Environmental Humanities Lab serves as a marvellous, well-respected testing ground in that it openly invites a range of methodological approaches, including those derived from aesthetic practice and the arts.

The department has two main goals and pursues both with a real sense of purpose. The first ('external') goal is to make meaningful research contributions, given the available funding, by latching onto schemes that do not just contribute slightly, but build knowledge strategically, and thus contribute to society; the second ('internal') goal is to find ways to establish the humanities in a more sustainable manner at KTH. Both goals are essential for the department's very 'survival', yet the two divisions are taking care to pursue them in a meaningful, and indeed strategic, manner that is rooted in the well-founded conviction that any transformation to a more sustainable society requires an understanding of

transformative processes – and thus the necessary integration of the humanities into scientific and technological research. To reinforce this essential concept, they make appeal to KTH's own strategic vision and development plan, offering to help articulate this vision and back it up through appropriate research. Indeed, they dedicate some of their own resources towards this wider strategic process.

3. International community engagement

Both divisions enjoy a very good international reputation. They readily attract international students and guests, they engage in international research collaborations, they attract high-level European grants, and they publish in internationally visible journals.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

The Department of Philosophy and History of Science and Technology, one might say, is all potential – indeed, it has already fully demonstrated this potential.

As for the 'external' goal of making socially meaningful research contributions, all it would need to do is carry on at its very high level of publication and funding success. In doing so, it will continue to be one of the most productive departments within KTH. Yet to consolidate this success story more sustainably, the department needs to be more anchored into the ABE School to enable longer-term thinking. Otherwise, the department's success may well end up undermining its own ability to realize its full potential. Ever since its 'AAA' research rating in the RAE 2012 review, and with KTH failing to heed some of the core recommendations made then for the development of faculty staff, the department has nonetheless improved its research output and funding record even further. Yet this achievement does not invalidate the need to enact previous core recommendations. The reputation and long-term success of any department still depends on its staff, and KTH cannot rely forever on the goodwill, entrepreneurial drive and collaborative spirit of researchers who still have no real sense of future if they stay in the department.

As for the 'internal' goal of fostering integrative humanities at KTH, and articulating its transformative role, the demonstrated potential of the Department of Philosophy and History can only be realized if it is fully recognized and appreciated by KTH at an institutional level. The department has the potential to serve as a platform – in effect a Humanities Institute – wherein all faculty staff and students at KTH could come together and engage in reflective, experimental, collaborative thinking about the role of engineers and engineering in society.

KTH's suitable take-up of this second 'internal' goal could have positive repercussions on realizing the potential of the first 'external' goal — a better integration of humanities teaching in engineering education at KTH will not only further its own development plan, but also consolidate the department's financial base so it can make the required appointments of new faculty staff.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

The Department of Philosophy and History is operating carefully in a research environment that is being increasingly shaped – also worldwide, but perhaps especially at KTH – by the reduction of core funding and an increased reliance on third-party funding. Within this environment, the department seeks to maintain, even strengthen, the very idea of the 'university', arguing that academia allows opportunities for transformative thinking. Given the department's tremendous success, even in the

absence of the closer integration into KTH structures that was recommended by the RAE 2012 review, one might recommend that they should abandon their second 'internal' goal altogether, and just focus entirely on pursuing externally funded research. In many ways, this might spare the department a lot of grief. However, no-one in the Department of Philosophy and History, and hardly anyone else in KTH either, really wants that to happen. Instead, there is general recognition of the inherent value that the second goal could have in serving KTH's development plan.

To support this implicit recognition of mutual need, what is required is flexibility on all sides. To achieve greater integration of humanities teaching at KTH, it would be helpful (yet not necessary) to have more courses like 'Theory and Methods' in the Philosophy division which now form essential elements of the undergraduate degree course in several different disciplines. There could also be new courses that cater to the specific needs of other departments in the ABE School, in the form of modularized contributions or co-teaching schemes. It would take little imagination for the KTH community to identify these other potential avenues. At the other end of the spectrum, KTH might reward the department's sustained success in generating external research income by relaxing its internal spending rules to allow for the hire of faculty staff based on so-called 'soft money', not just on core funding.

The panel's overall recommendation is that the recommendations made RAE 2012 should be taken up and implemented, which would mean that the two divisions of Philosophy and History would get to recruit at least 1 Associate Professor and 1 Assistant Professor each. Without permanent research positions in subjects like Ethics, History of Science and Environmental Humanities, the specific profile of the two divisions cannot be credibly represented. Avenues for the stronger integration of undergraduate teaching should be creatively explored, and furthermore, the department should be encouraged to develop a Master's-level programme with at least two areas of specialization.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

The central research questions for the Philosophy division concern the intersection of epistemology and ethics in modelling, decision-making, assessments of risk and safety – precisely by exhibiting the place and role of values with these activities. This involves a highly theoretical and analytic tradition of philosophy which tends towards very practical concerns, an approach for which the Philosophy division is well known and respected, and which has since been expanded to cover a wider range of practices and activities. The central research questions for the History division concern the geopolitics of scientific and technological development as a condition for social as well as ecological sustainability. All of these are academically innovative and societally relevant questions, with the department engaging in a deliberate process to create and maintain a balance between its two parts. Research activities and outputs encompass the whole spectrum from Swedish through to international publications, funded projects from Swedish and European sources, various forms of conferences and networks, and, as mentioned, the operations of the Environmental Humanities Lab.

One small recommendation for the department's improvement would be for the History division to reflect more critically upon whether its apparent focus on the human built environment is leading it to neglect the 'natural' world. In other words, there is perhaps an overly anthropocentric bias, and hence it should expand its considerations – an approach that could also then augment its emphasis on existing ideas about ecology and biodiversity.

b. Contributions to the advancement of state of the art within the research fields of the department

In the case of Philosophy, its specialization has evolved over the years as documented in previous RAE research reviews. Fitting well with the overall strengths and traditions of Scandinavian philosophy, it adopts a rather analytical approach which is guided by logic and the ambition to clarify concepts – often, within KTH's terms, in relation to technological modelling and practice, including issues such as biodiversity offsetting and pioneering research towards a philosophy of risk and safety. This broadly technological orientation enables consideration of research practice which shade into questions of ethics – not as 'derived' or 'applied' from the classical works of moral philosophers, but from the role that values have in the production of knowledge and the development of technology. As ethical or value considerations are currently in high demand, the Philosophy division is able to address these in a specific and concrete way to engineering students and faculty staff, cooperating closely in project-based settings. Whereas there is today internationally a strong move (perhaps hype?) towards issues such as the 'ethics of AI' or 'digitalization,' the division remains for the most part focused upon sustainability. To maintain its international standing, high-calibre professors are required, and so it is concerning that one prominent position remains unfilled.

In the case of History, the division's name in fact covers three established sub-fields: History of Science; History of Technology; and Environmental History. Their decision to draw together not just the first two sub-fields, but all three, gives a special status to this division and serves to unify what is otherwise highly diverse research. What emerges is a geopolitical or planetary perspective from which very specific, localized questions are then addressed in often innovative ways. Again, the long-term focus is on sustainability, including a critical questioning of the various dimensions of the concept itself. This division is interdisciplinary not only in orientation but also in composition, and like other departments elsewhere in the field of science and technology studies, it reflects on social interactions as well as contemporary research practice – as such offering a highly reflective understanding of the realities, limits and opportunities involved very deliberately setting out (with their colleagues in the Philosophy division) to create a model for integrative humanities for KTH as a technical university.

Together, both divisions are extremely competitive and successful in obtaining research funding, and both have a great deal to offer in teaching their subjects.

In virtue of maintaining their research profile and producing excellent results, both divisions are also advancing the state of the art in their respective fields. In particular, and with the History division taking the lead, the department is now establishing a model that helps to define the emerging field of Environmental Humanities – that it, not just in bringing a humanities approach to environmental science, but in positioning the Environmental Humanities as a central aspect within the humanities generally. This includes a genuine commitment to methodological pluralism which is, however, partially constrained by a rather problem-oriented conception of interdisciplinary research.

In contrast, the Philosophy division works in a far more methodologically unified manner, applying tools from analytic philosophy to decision-making in modelling, risk and safety, biodiversity offsetting, etc. While this kind of research is of great value to the practitioners in those fields, it also has immediate benefits for collaborative research processes. This philosophically focussed work might not attract a more specialist, rather than a broad, audience yet this seriousness of approach is a good price to pay if it keeps philosophy out of the usual moralizing chatter common in public affairs today.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

Rather than a departmental-level strategy, is mostly individual researchers who are participating in international collaborations. Some of these links are more practice oriented, while others are dedicated to the development of theory and general understanding. These kinds of collaboration appear to be evenly distributed across all researchers in both divisions, not just a few distinguished individuals.

Many of the collaborative project are very distinguished, including peers in other universities who are at the forefront of research in their fields.

d. Follow-up from previous evaluations

As noted, the previous RAE review culminated in a 'AAA' rating for the department. As with this panel now, there were no major recommendations at the departmental level, except to endorse certain desiderata like new faculty staff positions in Ethics, History of Science, and Environmental Humanities. Since the greatest obstacles to the realization of the department's potential came from internal policies, regulations, and decision-making processes at KTH, the suggestions from RAE 2012 were directed more towards the KTH leadership and administration. Regrettably, there appears to have been little follow-up on those recommendations for the development of faculty staff, the introduction of a Master's-level programme, and the expansion of the department's role in undergraduate teaching.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

The Department of Philosophy and History is extraordinarily successful in attracting external funding, and as such is probably one of the leaders in terms of per-capita external income generation at KTH (being even higher than the Department of Civil and Architectural Engineering, for example). Internal funding is however disproportionately small and does not allow for the consolidation of the department's research successes. It has therefore embarked on what appears to be the only avenue within KTH's current system of practices and rules, which is to expand its contribution to engineering education. It therefore now articulates a model for teaching Environmental Humanities that could become a core element of a variety of mandatory courses. The pursuit of this strategy requires support from the ABE School KTH overall, not least in greater flexibility for co-teaching or modularized teaching schemes that would enable some resource sharing which, by calculating teaching/credit hours, would generate more internal income for the department. It is evident that the Department of Philosophy and History deserves more support, not only because of its academic excellence and success in external research funding, but also because there is a real need to fill the planned staff positions if KTH wants credibly to maintain its ambition of integrating the humanities as indispensable for the self-understanding of sustainable engineering within a leading technical university.

Another strategy might involve a relaxation of the university's spending rules, allowing faculty staff hires on the basis of sustained success in attracting external funds. It is strategy that would require open acknowledgment and recognition of the department's success by KTH generally.

b. Academic culture

From what one can tell from a panel review held, the academic culture in the Department of Philosophy and History seems remarkably good. Though the two divisions are quite different, and do not engage much in joint-research collaborations, they have come to agree upon a joint-strategy and in doing so they speak in one voice regarding the department's future. All the staff members in the panel meeting appeared to have a trusting relationship with one another.

c. Current faculty situation and composition of the research team(s)

The situation is well documented in the self-assessment document and reveals by any standard – whether internationally or KTH internally – extreme disproportionality between the number of faculty staff and the number of researchers. Among the non-faculty researchers, quite a number measure up by productivity and reputation to faculty staff such that it is hard to discern them, which is not how it should be.

d. Recruitment strategies

In the absence of credible recruitment options, it is difficult to assess the strength or not of recruitment strategies. The department attracts guests and researchers at a high rate, and it is internationally visible as an intellectually vibrant place. However, at least one key professorial position remains unfilled.

e. Infrastructure and facilities

This again is very hard to judge properly through an online assessment but based on the department's video and statements made in the panel meeting, these aspects appear to be quite sufficient.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

The Department of Philosophy and History can be deemed very successful if it manages even to maintain the status quo over the coming decade. Given the current situation with several ERC grants, which as all now are extremely competitive, it is rather unlikely that the current level of external research income can be maintained, in fact. Some fluctuation therefore ought to be expected.

The department's own goal is to move, incrementally, toward forming in effect a Humanities Institute within KTH as a technical university. This institute would be on the one hand a platform for interdisciplinary sustainability research across KTH, and on the other hand a platform for teaching courses and modules and other student-centred activities.

b. Congruence with university-level goals

As the Department of Philosophy and History points out emphatically, KTH's strategic plan clearly calls for an integrated approach that also includes the humanities – this, the university states, would place it in a special position to take a 'holistic view and systematic approach' to sustainability. The department has therefore begun to articulate and concretize this vision. No matter how vaguely stated it is in the strategic plan, the pursuit of this goal requires sustained reflection about what it means to be an engineer in the 21st century, and how a technical university needs to transform itself to be more inclusive of the humanities.

c. Leadership structure and collegial structure

From all appearances, the leadership structure in the Department of Philosophy and History enables good working relations between the two divisions. There is an alternating Head of Department so that each of the divisions is represented in turn, with then a Deputy Head who speaks for the other division. Currently, the Head of Department comes from the History division and seems to enjoy the support from colleagues across the whole department. For the main part, both divisions have their own steering group, retreats, strategy meetings, etc – while obviously keeping in tune with one another.

d. Strategies for achieving high quality

Both divisions deliberately aim to balance considerations of their research profile against pursuing external funding opportunities: to the extent that this is feasible, they seek this external funding strategically. The History division has a designated officer to oversee research planning and coordination.

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

The Department of Philosophy and History has an excellent PhD programme, yet despite the RAE 2012 recommendations and subsequent departmental efforts to this effect, neither of the divisions offers a Master's-level programme, and the department's contribution to undergraduate teaching has if anything diminished in recent years rather than increasing. Of course, if KTH's internal funding is tied to teaching load, and if internal funding is necessary to achieve core objectives, then this model will tend to militate against the kinds of integrative interdisciplinary teaching that could help the department to build a broader pedagogic base.

The department's breadth of research and its close engagement with societal issues provides a strong rationale for greater integration into undergraduate teaching and learning at KTH. Yet this interaction of research and teaching remains under-developed for the time being, leading to unrealized potential, whereas the interaction between research and teaching at the PhD level is as close as one would expect anywhere. The titles of doctoral dissertations over the last years nicely underscores the breadth of the department's research profile.

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

As described above, the research orientation of both divisions is clearly based on questions of social relevance and engagement. It sometimes begins with close interaction in the research process yet almost always has wider repercussions. Here the core notions are robustness, resilience, social inclusivity, global justice etc, all of which tend to fall under the heading of social and economic sustainability, and only in a secondary manner address the problems of digitalization.

b. Research dissemination beyond academia

The Environmental Humanities Lab is the element of the department that is most explicitly committed to research impact. Especially in the Philosophy division, some of projects involve work with practitioners in the field and even the research process itself becomes a productive dissemination strategy. In the History division, most research projects are framed with societal impact in mind and present valuable findings to interested members of the general public.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

The SDGs are taken up, critically reflected upon, and promoted in a comprehensive manner by the Department of Philosophy and History in ways that include considerations of geopolitics, environmental ethics and social justice. As noted, the History division could expand on its largely anthropocentric research to embrace more issues of ecology and biodiversity.

d. Plans and structure for increased impact

The department has a strong structure and tradition for ensuring impact from its research, although while the level of this impact is currently high, one should not expect this to continue consistently or indefinitely.

6. Recommendations for strengthening the department and its future potential
- The single overall recommendation is that the recommendations from the last RAE should be finally taken up and implemented, with the Philosophy division and History division being able recruit at least 1 Associate Professor and 1 Assistant Professor each, especially in the areas of Ethics, History of Science and Environmental Humanities.

- Filling these requested faculty positions is necessary for KTH to credibly maintain its ambition to integrate the humanities as an indispensable for a leading technical university.

- The department should be encouraged to develop a Master's-level programme with at least two areas of specialization, and avenues for the stronger integration of undergraduate teaching ought also to be creatively explored.

- To enable the department to consolidate its obvious international research successes, there needs to be greater support from KTH in the form of flexibility for co-teaching or modularized teaching in other part of the university, to better share the financial resources.

- Alternately, KTH should relax of spending rules to allow faculty hires on the basis of the department's sustained success in attracting external research funds. This kind of reformulation of financial rules is also needed to increase the number of PhD students in the department.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

The last RAE review of the Department of Philosophy and History was extremely positive, with specific recommendations being made to KTH to draw more upon the department's strengths for undergraduate and postgraduate teaching, and to consolidate the faculty staff. This time around the department presented itself to the panel even more impressively, and hence the old recommendations present themselves even more urgently. Having not been sufficiently acted on before, now the reasons are even stronger to do so.

The general impression one gets is that KTH, as the powerful over-arching entity referred to by representatives of all departments, is a hybrid of a very traditional and a very contemporary university. Yet as hybrids go, it is not flexible and dynamic but somewhat rigid and unreflective. The Department of Philosophy and History has direct experience of this problem. In contemporary universities worldwide, academic salaries are being increasingly financed through external funding. And yet at KTH, any new position for faculty staff or PhD students can only be created if there is a guarantee of sufficient internal/core funding being available, deriving as it does mainly from teaching. However, there is proportionally less and less of this internal/core funding within KTH, plus it is also very variable, ranging from 50% of the total income for some departments in the ABE School down to only c.10% in the Department of History and Philosophy.

Thus, a situation now arises that should never exist, in that, for this department, KTH itself appears to be the single most constraining factor on its research potential and its PhD recruitment, mainly because it is not being allowed to teach more students. This disconnect raises key questions about the mission, disciplinary profile, and problem-oriented research of a contemporary technical university. These questions and these discussions are truly international, being felt in the USA, UK, the Netherlands, etc. On the other hand, all leading universities, KTH included, acknowledge the importance of the humanities especially when these can serve as a forum or platform to reflect upon the historical impact of science and technology, as well as on the potential that science and technology has to contribute to the transition towards more sustainable societies. Many cutting-edge technical universities have even created humanities centres that are positioned as core elements within an integrated research culture. In the case of KTH, however, the impression one gets is that this vision exists on paper only.

It is clear the Department of History and Philosophy desperately wants to make its contribution to analyzing and understanding this predicament. From this they derive their sense of opportunity and mission to provide best-practice models for what the humanities could offer to the whole of KTH, hoping that this potential will be recognized and acknowledged – while being frustrated that it is not taken up, or not yet. One might argue that the department is doing very well just as it is, but this success is only strengthening the resolve of its faculty staff to articulate and play the role that has been assigned to them: to be 'the humanities' at KTH.

Department of Sustainable Development, Environmental Science and Engineering

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
Despite having been only newly created, there are already increasing levels of research collaborations and joint projects. As a result, the department has developed a strong and visible research profile. It hosts three of the Research Centres in KTH, a disproportionately high number for the department's relatively modest size. It now has the potential to be the glue for a lot of the sustainable development research taking place at KTH.	Still in a formative state, with the process of merging and synergising yet to be completed. Concerns are that in certain ways the department's approach is much too administrative. In general, its research work is too much of the basic applied variety – hence it needs to develop and express a more ambitious research vision. There are genuine worries some of its laboratory equipment deteriorating and becoming obsolete.

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

The Department of Sustainable Development, Environmental Science and Engineering (SEED) is still in a formative state following its creation in 2013 and its move to a joint building alongside further reorganization in 2017. The merger is a success in that researchers are now collaborating where once they were competing, and it seems to have contributed to strengthening the research at the joint department as well the sustainability profile of KTH. The department has a strong research profile and a lot of research activity. SEED has had impressive continuous success in attracting varied external funding and has potential to grow further. The department now hosts three centres, which gives the department access to important networks and a favourable position in to further develop these topical research areas.

Still, there are challenges in advancing SEED's research within the complex domain of sustainability science, where natural sciences, social sciences and engineering are fused together. The research is generally of the applied kind. The panel wonders therefore whether the department is struggling to establish its intellectual agenda. There are undoubtedly promising developments, such as work on scenarios for sustainable futures. Yet the vision and future goals for the Department seem surprisingly general and administrative for an institution with so much activity that reflects an ambition to play a central role in societal development as well as in international sustainability research.

3. International community engagement

Researchers in SEED are well engaged in the international scientific networks – and some are also engaged in local communities overseas. Subject to availability of funding, the department might now attempt to increase its research work on sustainable development in places outside of Sweden.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

The integration of the former departments does not seem fully completed and so it still has further potentials. For example, the PhD programmes of the former departments are now being merged into one programme with three distinct streams to reflect the different skills. This formation of a joint programme may be a very important step for improving understanding and stimulating collaboration between former research areas and developing a common identity, and joint visions and strategies for the department.

SEED has the potential to be the glue around which a lot of sustainable development research at KTH can gel. Members of the department are already collaborating well with other researchers in the ABE School, and with other schools in KTH. Greater interaction with the Department of Philosophy and History, and more attention to the Social Sciences, are other aspects which show great potential.

The department should be able to offer ordinary faculty staff positions to successful researchers who could also be valuable as teachers and supervisors. To support such efforts, it would be desirable that KTH reforms its structures towards posts for Assistant Professors that will allow more teaching and can also be partly financed by external research grants. It would also be desirable that KTH provides more funding to hire faculty staff to those departments that over time are so successful in attracting external funding. Furthermore, the panel was told that it is now a major challenge for SEED to modernize its laboratory and field equipment.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

- The department should further explore and articulate its intellectual agenda, making sure that in doing so it remains open to a diversity of perspectives and approaches.

- It should increase its efforts to develop joint visions for a future research agenda and strategy that makes use of its competitive advantages such as the three Research Centres.

- Internationally, the department should examine the relationships between its research and the UN Sustainable Development Goals (SDGs) with greater rigour, and it should also seek further applications of its impactful research beyond a Swedish context.

- The department should improve organization to support the development of research proposals, mobilize for larger project proposals, and create joint structures for quality review.

- It should strive for a division structure which is easier to understand for outsiders, and which better reflects the different topics or sustainability challenges addressed by its research.

- The department should make efforts to increase its share of faculty staff positions, avoiding recruiting Lecturers, for living up to the 'all teachers should be researchers' ambition. SEED should decrease the disproportionate share of researchers by offering faculty staff positions to those successful researchers who are also valuable as teachers/supervisors.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

The Department states that it has the following vision:

'SEED is a centre of excellence in disciplinary and transdisciplinary research, bridging different system levels from broad sociotechnical and ecological systems to specific technologies, including analysis, development and implementation for a sustainable future.'

To this effect, the research in SEED is organized into four divisions:

- Division of Sustainability Assessment and Management

- Division of Strategic Sustainability Studies

- Division of Water and Environmental Engineering

- Division of Resources, Energy and Infrastructure

Research work within these four divisions support the department's broad ambitions to:

- understand and support decisions that lead to the sustainable development of society by analysing the effects of those decisions from a social and environmental perspective;

- work in a transdisciplinary way with stakeholders in order to influence social development;

- promote sustainable production and consumption practices; and

- increase knowledge and innovations for use of natural and socio-technical systems for managing water, land, and other natural resources.

The department has had great success in organizing, financing and delivering these research ambitions – which are largely of the applied kind. Faculty staff have attracted a variety of external research funds that is responsible for almost half of the funding of the department, helped to establish three Research Centres, and supervised a large number of PhD students, of which an increasing number are externally funded (including Industrial Doctorates). At this point, it is unclear whether or not SEED has a well-defined intellectual agenda, a situation that could be improved by focussing upon one or more of the central research questions that span across multiple members of the department.

b. Contributions to the advancement of state of the art within the research fields of the department

Researchers in SEED are making state-of-the-art advances within a variety of research fields. The self-assessment document states that six professors are ranked within the top 2% of researchers within their fields, based on standardized citation indicators (one of that six however has a primary affiliation at the Swedish University of Agricultural Sciences). The research domains of these six give an indication of where the Department's greatest strengths lie: two are involved in life-cycle assessment; two are in hydrogeology; and the other two research into surface hydrology and soil chemistry respectively. However, there is also a lot of exciting and impactful work in other domains. These include landscape ecology; environmental impact assessment; circular economy, bioeconomy; energy and climate change; urban sustainability; smart cities; political ecology; rural development and food systems; forest ecology; marine biology; geochemistry and environmental modelling; water & wastewater technology; hydraulic engineering; and socio-hydrology, amongst other topics.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

The quantity of refereed journal publications, averaging just over 40 per year in DiVA fractional counts, is suitably high for a department of c.20 professors (Full or Associate), especially given the high levels of co-publication. The research is also unquestionably of a high quality, with publications in Nature-family journals and leading journals within specific fields.

SEED researchers are well engaged in international research. Around half of SEED articles involve international co-publishing, according to the self-assessment document. There are also specific researchers whose work has a particularly strong international focus: for example, an urban political ecologist working on southern and postcolonial urbanism with field sites that have included Cape Town, Durban, Luanda, and Kampala. Another example is a professor of groundwater chemistry whose work on drinking water contamination, includes research in Tanzania, Bolivia, and Bangladesh.

A strategic question for SEED to wrestle with is thus the extent to which its research priorities should be focussed on Sweden versus an international context. Take climate change mitigation, for example. Sweden already has a very low-carbon economy and is arguably well on track to be carbon neutral by 2040. Of Sweden's ~51 Mt CO_2e emissions in 2019, ~35 Mt are offset by forestry/land-use, leaving a net of ~15 Mt (based on Sweden's national inventory submitted to the UNFCCC). Moreover, through enlightened policy and technological development, Sweden's net emissions have gradually declined from a peak of ~40 Mt in 1994. With electrification of cars (~10 Mt), Sweden would be close to net zero (assuming the carbon intensity of power generation remains close to zero). Of course, some effort is still required to close the remaining emissions gap, and there are issues of consumption-based emissions and international air travel. Still, the arena for KTH to have the greatest impact on GHG mitigation is the global one. Similar questions apply to SEED's wider research on SDGs, as will be discussed below.

d. Follow-up from previous evaluations

SEED was created following recommendations in RAE 2012 to 'make sustainability science more visible' at KTH. Organizing for sustainable science research, however, has some huge challenges. First, it is a vast domain including a swath of research from engineering, natural sciences and social sciences. The sheer number and diversity of researchers may be such that the discipline may struggle to coalesce as one field. Second, there are different ways of structuring sustainability science. For example, research efforts could potentially be organized around four sustainability challenges: climate change; biodiversity loss; land use change and food production; water scarcity and other water issues. Or else it could be grouped around three core themes: scientific understanding of socio-ecological systems; sustainability goals; sustainability pathways, strategies and implementation.

A particular challenge for sustainability science – which SEED is faced with too – is for it to establish its intellectual agenda. At the heart of the earliest forms of sustainability science, such as ecological economics, industrial ecology, political ecology, resilience theory and transition theory, are hypotheses or axioms about the interaction between nature and society. Without hypotheses about the nature-society interaction sustainability science is arguably hollow. The department has professors with long experience in some of these established forms of sustainability science, and probably needs to continue to draw upon them. Otherwise, there is a danger of SEED getting stuck in complex swamp of ideas and ultimately just reinventing the wheel.

The panel is impressed with the talent assembled in SEED but struggles to understand the logic of the four divisions. Why are groundwater researchers split between divisions? There are researchers working on aspects of sustainable urbanism across the department. Why is the Viable Cities Centre based where it is? Is it used as a platform for integration within the department and for further development? How do the other centres achieve integration or visibly fit with a development strategy?

The answers to these questions may not be straightforward, but it would be useful for SEED to wrestle with how to structure research activities around different topics or sustainability challenges.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

Over time, 60-70% of SEED's research funding has been financed by grants from external sources. In 2020, external funding was responsible for almost half of the department's income. The most important funding sources include the major Swedish national research councils for sustainability related research, some of the most central national authorities related to sustainability issues and the European Union. The funding from the research councils shows the competitiveness of SEED research, while the funding from national authorities is an indication of its societal relevance. The high number of industrial and scholarship PhD candidates (16 out of 34) also bears witness of the recognition and well-connectedness of SEED in the Swedish context. Co-funding can be a challenge in relation to some funding sources, and the high overhead costs may decrease competitiveness in connection with some agencies. The stable success of attracting external funding seem to rely mainly on strong established research teams, which in some cases cross division borders, combined with more isolated individuals' ability to attract funding.

Besides supporting teams and individuals in their funding efforts, and trying to encourage new collaborations within the department, SEED does not seem to have a joint vision and strategy for its future research agenda. It is possible that the establishment of a research council, as a sharper version of the current SEED council, and which could be given tasks such as to support the development of proposals and mobilize for larger projects could be a way to secure and strengthen the competitiveness of the department's research proposals.

b. Academic culture

SEED has been able to establish a joint academic culture that is characterized by mutual respect and guidance, and reflexivity about equity issues, and where colleagues have opportunity to meet and discuss in connection with annual meetings, the SEED seminar series, and the SEED council. These interactions are, however, most intense among informal research teams, projects and divisions, and there is a need to encourage more discussions beyond those structures. The PhD seminars that up to now have been separate for the four different PhD subjects that host SEED's doctoral students will hopefully be held together as part of the joint departmental PhD programme.

c. Current faculty situation and composition of the research team(s)

Of the c. 115 full or part-time staff, there are only 22 faculty staff positions (Professors, Associate Professors, Lecturers), whereas there are 30 employed researchers. Since the creation of the department, the number of Full Professors and Associate Professors have decreased particularly due to those who have retired not being replaced.

The number of faculty staff is remarkably low in relation to the needs for teaching, examination, and PhD supervision. A continued decrease of faculty staff may also harm the capacity to develop competitive proposals for larger research projects. KTH's financing rules and requirements seem be the major cause of the increasing misbalance between senior faculty staff and researchers. New positions for faculty staff at KTH require corresponding internal research funding, which makes it impossible to create faculty staff positions only based on external funding and teaching. SEED has been very successful in the recruitment of affiliated faculty and adjunct professors but these should only be used as additional capacity, not for solving the shortage of internal faculty staff. Most of the researchers are permanently employed and many of them have for a long time been able to attract external funding: they have also taken on teaching, supervision and even leadership duties, but still have limited prospects to obtain positions as faculty staff.

The relatively low teaching requirements for Assistant Professors at KTH makes it difficult to use that level of appointment as the entrance to a normal tenure-track system. Junior positions which combine research and teaching equally seem to be lacking in KTH's system.

d. Recruitment strategies

The recruitment strategy of SEED focuses primarily on recruiting Associate Professors and increasing the number of Lecturers. Appointing these Associate Professors seems well-motivated, as it offers the opportunity to recruit new research leaders from outside or for long-term researchers to obtain the permanent faculty staff posts they are often well qualified for. However, the recruiting of more Lecturers that are supposed to focus entirely on teaching is questionable for such a strong research department, since it seems to go against the university ambition that 'teachers are researchers and researchers are teachers' – a policy that SEED claims to follow! The most important near-term recruitment challenge of SEED is replacing the three Full Professors that will retire soon. They will presumably primarily be replaced by promoted Associate Professors, which likely also help to improve the gender balance among Associate Professors and Full Professors.

e. Infrastructure and facilities

Besides high overhead costs, the infrastructure challenges mainly concern the organization and modernization of lab facilities and lab/fieldwork equipment. SEED has access to modern and satisfactory premises and support functions for most its staff and activities, but the new department building has no room for laboratory experiments and limited storage for fieldwork equipment. The department's own lab facility, which is in another building at the KTH campus, is in great need of modernization; even so, a large part of the lab and fieldwork related work cannot be performed there. Access to the water testing facilities at Hammarby Sjöstadsverket and the marine research centre at Kristineberg contributes to solving this situation. Investments are also needed for updating field geophysical equipment.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

The four long-term goals set by SEED are:

- Position the department as a strong and highly respectable academic institution within KTH, regionally and internationally.

- Attract, install and keep the most competent staff to support excellent research and education in the fields of sustainable development, environmental sciences and engineering.

- Develop the department into a stimulating, well-balanced and yet diverse work environment with a culture of equality, openness, critical thinking and debate.

- Combine and integrate the social and natural sciences and engineering disciplines through both detailed and systems-level studies and technologies for innovative solutions that facilitate a transition to sustainable development.

In the panel's view, these goals are rather general and unspecific, being to some extent 'local reflections' of the overall ambitions set by KTH as a technical university. Most of the goals seem achievable by such a strong, dynamic and well-connected research department as SEED. Future work in this regard will be mainly about continuing and developing current research initiatives, and further encouraging interaction and integration within the department.

However, the second goal, that of attracting and keeping competent staff, which is indeed a prerequisite for achieving all four goals in the long run, seems more difficult to achieve without stronger support from the ABE School and KTH in terms of providing increased funding for faculty staff, not least in being able to introduce more faculty positions of various kinds. To be an attractive and internationally competitive employer, SEED needs to be able to offer resources connected to faculty staff positions and career opportunities in the form a transparent tenure-track system that is well-adapted to research and teaching duties in the department. At other major Swedish universities, there is generally not such a direct connection between faculty staff funding and faculty staff positions as there is at KTH.

b. Congruence with university-level goals

SEED is very well aligned with the goals in KTH's 'Development Plan 2018-2023'. It is in many ways a leading department in connection with research and education for sustainable development, and hence SEED contributes substantially to KTH's visibility and profile in this area. The department contributes furthermore to the development of integrated research by bringing together scientists with diverse disciplinary backgrounds. SEED is well-connected internationally, and it collaborates and co-publishes with many researchers outside of Sweden, which in turn attracts large numbers of international students, PhD candidates, post-docs, and increasingly international faculty staff. All the staff are engaged in teaching. Through its many transdisciplinary projects, SEED also contribute to intensifying exchange with other parts of society and to the movement between academia and society through, for examples the appointment of affiliated faculty staff. There is also evidence of research into digitalization for sustainable development. Furthermore, the department has also a mixed gender balance in almost all employment categories.

Yet, while SEED seems very well aligned and integrated with KTH goals, it is highly questionable if KTH really provides sufficient support for the department's ambitions to be an attractive and equal opportunities work environment. The limited potential for positions for faculty staff seems to make it impossible to offer proper career paths for researchers, despite that they have often attracted substantial external funding to the university and taken on important departmental duties. Instead of being able to have access to a tenure-track system, as found in other universities, the researchers (and Lecturers) in SEED seem to be 'trapped' in their current positions. Departments at other Swedish universities, which similarly rely heavily on external funding, can instead of researcher or Lecturer employments offer faculty staff positions corresponding to Assistant Professor level (bitr. lektor, lektor) with varying degrees of externally funded research and teaching duties of between 20-60%. Such positions are still dependent on continuous flows of external funding and so are not necessarily more secure than the employment status of KTH researchers. Yet, to make all the research and teaching staff part of the same faculty team would provide a more systematic and transparent base for career planning and promotion, and this is what would make SEED a more attractive workplace!

c. Leadership structure and collegial structure

As noted, SEED is divided into four divisions that each has a head of division and meets at least once a month. Together with the Head of Department and the Deputy Head, the division heads form the management group of the department, which meets every second week. The four undergraduate study directors take part in every second management group meeting, and twice per semester there is a meeting of an 'extended management group' that also includes other leadership functions (e.g., PhD studies, administration, equity group, impact responsibilities). The SEED council, consisting of all docents and staff with leadership functions, was initiated in 2019 to discuss strategic issues. This council should have a central role to play in the future development of joint research visions and development strategies, as well as in increasing integration within the department. While the organization and the leadership structure are rather typical for any university department of this size, it is astonishing that – despite what is clearly a gender-balanced staff team – so many of the leadership and management responsibilities are held by women. This kind of imbalance in administrative responsibilities may hinder the academic career of these female staff members. Furthermore, that

many of these women in leadership positions do not even have faculty staff positions is another indication that the current structure is far from desirable, and so the department should look into this matter.

d. Strategies for achieving high quality

The department has a strong publication record and three PhD programmes (soon to be combined) that have a good reputation. SEED researchers are active in editorial and grant-funding boards, and they take part in PhD theses reviews at other departments and universities. Research quality assessment seems up till now to have been primarily handled in line with the different PhD programmes and at project and division levels, whereas joint systems for assessing research quality are missing. It should thus be an important task for the SEED council to develop joint structures for the quality assessment of research proposals and outputs. Encouraging regular, continuous, and livelier joint seminars – including debates over traditional divisions and disciplinary boundaries, which is an important of internal quality work – should likewise be an important responsibility for the SEED council. This would also be important for stimulating interaction and increased integration between the different research cultures and divisions at the department.

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

The department is heavily involved in the teaching of various programs at Bachelor's and Master's levels. Almost all the researchers and employed PhD students also take an active part in teaching and supervision, which means that students are exposed to the research work in the department. Through their project courses and theses, students may contribute directly to research projects. Course materials are often updated to reflect developments in the different research fields. SEED teachers are consciously conducting research in education for sustainable development, and as such play a central role in integrating sustainable development within all courses at KTH.

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

SEED's research is without question highly relevant and impactful for society and industry, addressing some of the greatest contemporary challenges.

b. Research dissemination beyond academia

There is an excellent description of SEED's communication of its research beyond academia in the self-assessment document provided to the panel.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

As with other departments in the ABE School, the research activities in SEED can be readily connected with the UN Sustainable Development Goals (SDGs). This is perhaps not surprising given the department's title and mandate, and so there are also several ways in which SEED could be held to a 'higher bar' in terms of 'making a difference' to SDGs:

    i.   Consider undertaking a bibliographic analysis of research connections to the SDGs (as has been done by the Department of Urban Planning and Environment).

    ii.   Bolster research on global biodiversity. It is surprising that SDG 15 ('life on land') is not amongst those most frequently addressed by SEED research, since there are five or more

professors whose work is relevant. Similarly, the new Blue Food Centre presumably has some relation to SDG 14 ('conserve and sustainably use the oceans, seas and marine resources').

iii.   Interpret the SDGs more carefully. In particular, the department should note that SDG 17 ('partnerships for the goals') has some specific targets relating to global finance, trade, technology transfer and capacity building for the Global South. In attempting to connect with SDG 17, SEED points to its transdisciplinary research projects: while these are great, research on SDG17 should arguably focus more on how the UN and global community can actually set about achieving the specified targets.

As mentioned, SEED clearly has the potential to be the glue around which a lot of sustainable development research at KTH can gel. This is aided by the fact that members of the department already collaborate well with researchers in the ABE School and other schools at KTH. There is possibly potential for greater interaction with the environmental researchers in the Department of Philosophy and History, and with those in the social sciences more generally.

There are some challenges, however, in terms of how relationships to the SDGs are being assessed by other KTH departments. There is hence a need to use the concepts of sustainability and sustainable development more carefully. For example, the term 'sustainability' always needs context. What is being sustained? There are cases where research in other departments might seem to show a relationship to issues of sustainability, yet those could just be box-ticking exercises, not deeply motivated by concerns over sustainable development. SEED researchers are well qualified to ask the tougher questions of their colleagues, such as is the research transformational or incremental (is it a new approach or a continuation of something that has been occurring for decades?), central or peripheral (is it motivated by sustainable development, or another issue?), real or theoretical (has the work made a real change to technology, process or public policy, or does it address more general issues?).

d. Plans and structure for increased impact

See previous comments.

6. Recommendations for strengthening the department and its future potential

- Develop a clearer and stronger intellectual agenda for SEED as a whole, yet one which is open to a diversity of perspectives and approaches.

- Seek to use existing advantages such as the three Research Centres, along with new initiatives, to provide the glue for KTH's research into sustainability, including taking a tougher view on which research work really tackles the UN Sustainable Development Goals (SDGs).

- The department should improve organization to support the development of research proposals, mobilize for larger project proposals, and create joint structures for quality review.

- Examine the division structure to ensure it maximises benefits for the department in both research and teaching.

- Discuss with KTH ways to increase the number of faculty staff positions, enabling better career progression for Lecturers and researchers.

- Look into and remedy the apparent problem of a disproportionate level of female academics being engaged on administrative duties.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

The review team makes its recommendations in a spirit of constructive engagement, with a view to helping SEED achieve its tremendous potential. SEED is an exciting, innovative and important department, which is already making excellent impacts in addressing challenges of sustainable development. We are confident it will continue to flourish.

Department of Urban Planning and Environment

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
Dynamic department that has moved successfully from a reconfiguration in 2018.	Pressure on faculty staff appears to be leading to incentives to focus upon small, consultancy-type research projects.
Well-managed department, with a clear organisation of responsibilities.	Structures of communication internally and externally are not entirely clear.
Vibrant research agenda, matching the demands of the sustainable society.	The department struggles with existing arrangements to recruit PhD candidates.
Research agenda aligned with KTH priorities, and international priorities as exemplified by the SDGs. Likely to be able to draw funding opportunities aligned with this agenda.	Support on basic administration from KTH is not sufficient in terms of administrative issues (data management, ethics) nor in terms of integrating the various research teams.
Strong interest in intersectionality and justice elements as a means to bridge research, teaching and organisation.	Academic career support pathways are not clear, creating further insecurity for staff.

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

Based on the information provided by the Department of Urban Planning and Environment, its goals are mainly related to maintaining continuity through the consolidation of existing research agendas in the department, including maintaining high quality research output production, addressing current and future challenges in the transformation to a sustainable society, and maintaining a supporting and inclusive research environment.

The panel agrees with these goals as being both relevant and forward-thinking.

3. International community engagement

The self-assessment document provides ample evidence of strong international community engagement, particularly links with other research-intensive universities. Our encouragement is thus for the department to continue to develop its approach to international community engagement.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

The panel is happy to support the Department's own clearly articulated strategy for developing and taking forward its goals rather than trying to impose our own thinking.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

The Department of Urban Planning and Environment has experienced a period of institutional upheaval during its formation plus staff turnaround since KTH's RAE 2012 exercise. In this context it has obviously already made considerable achievements, especially in research income and publications.

As the department was only formed in 2018 and has experienced all the restrictions of the pandemic situation in the last 18 months, our strong recommendation is for it to focus more on consolidation rather than another period of radical institutional reform. This relative stability can then provide the platform for improving integration across the three divisions of the department, and improving links with others within the ABE School, KTH in general, and also internationally.

The panel especially commends the department for its approach to issues of diversity, inclusiveness and intersectionality. This approach goes well beyond the very strong work on gender equality which KTH has been advancing, and as such could usefully now be drawn upon at institutional level to widen and take forward discussions around equality, diversity and inclusion.

With the number of PhD students in decline, the department needs to work closely with others in the ABE and School KTH to identify the underlying issues and develop solutions. The department's strong links with practice would seem to provide an excellent starting point. There may well be scope for attracting more international students, building upon the department's international reputation and international collaborations.

The panel heard concerning issues around issues of data management, research ethics, and staff stress. Each seems to be part of wider institutional issues that may be best addressed at the ABE School and KTH level. This said, the Department of Urban Planning and Environment has a high international reputation for the quality of its theoretical work on urban and regional studies. Some of this work appears not to be as fully appreciated within KTH as it is internationally, a problem related both to the metrics being used to judge research performance, and more critically perhaps, to the ways in which research workloads are distributed. Instead, the panel would suggest a switch to a 'mixed economy' approach to allocating research time and resources, one that recognises the diversity of ways in which high-quality research that creates agenda-setting work is recognised and rewarded within KTH, creating space for critical research that may be impactful in advancing critical, disruptive thinking yet perhaps not lead to high levels of external funding.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

The Department of Urban Planning and Environment has succeeded in demonstrating the alignment of its research themes with societal demands. For example, the research responds directly to the concerns of the Sustainable Development Goals, both within Sweden and beyond. The department describes its research themes as being grouped into three Research Divisions:

- Geoinformatics

- Transport and Systems Analysis

- Urban and Regional Studies

These three Divisions also intersect with two Research Centres that exist within KTH, namely the Centre for Future of Places and the Centre for Transport Studies.

The Research Divisions act as organic thematic areas of interest, each with an open research agenda. Geoinformatics focuses on 'the broad field of Geo-Information Technology,' with three themes led by three staff members. These are remote sensing/earth observation big data analytics, GIScience/geospatial analysis; mobility data mining/locational based service. Transport and Systems Analysis offers a research programme focused on the relationship of transport modelling with transport policy and economics. Finally, Urban and Regional Studies aims to contribute to the theory and practice of planning and demonstrate their engagement with social, economic, and political sciences as the centre of their investigation. Interestingly, each of these Research Divisions shares elements of common interest and potential for greater integration with work elsewhere in the ABE School and KTH, with researchers in the department clearly aware of where the potential lies for seeking synergy and reducing duplication. Given the department's relatively recent institutional reforms, we would advise against changes to the Research Divisions as they currently stand.

However, in general, there is a gap between the research conducted within each of these Divisions – which are vibrant and relatively well-funded – and the presentation of their projects/outputs to a broader public beyond the usual academic publications. For example, the websites of the Research Divisions are clear enough but also not that informative, other than to state their general theme of research along with a link to a staff list. This, of course, could be easily improved (some minor suggestions for the website are included in the section about communication below). Still, it is mentioned here as a symptom of a more generalized lack of synchronicity across the Research Divisions and their public presentation.

In contrast, the two Research Centres present more fully formed programmes that follow long trajectories of research and thinking around a specific topic, and to do so bring together researchers in KTH alongside international and national partnerships with other academic institutions and key stakeholders. The vital difference is that the Research Centres explore delimitated areas of research where KTH already possesses a clear track record. The Centre for Future of Places, for example, brings together a programme of research whose core aim is to shift 'urban discourse from objects to places in order to promote healthy and liveable cities,' following research projects and conference series and partnerships with organisations such as CUNY, TU Wien, or KTH Zurich. The Centre for Transport Studies is a network to facilitate Stockholm-based research, chaired by KTH, and involving the VTI research institute, the Traffic Analysis and Transport Agency public authorities, and the consultancy

companies WSP Analysis & Strategy and Sweco: this second Research Centre resulted from reconfiguring a 10-year research project into a network, after the end of the funding in 2018.

b. Contributions to the advancement of state of the art within the research fields of the department

The contrast between the Research Divisions and the Research Centres shows the difference between developing a strategic programme of research (Divisions) and the consolidation of particular areas of interest following successful bottom-up initiatives (Centres). While the Department of Urban Planning and Environment is right to provide intellectual space for both modes of operation, the strategic aspect of research is lacking, as shown in the example above. Another symptom of the need to develop strategic direction (perhaps at the expense of 'bottom-up'-led research) is the perceived contrast between the proliferation of small projects – often related to commissioned research and consultancies – and the perceived lack in the department of large funded projects. The consolidation of the Divisions is essential to facilitate that transition beyond the obviously successful yet highly specific programmes of the Centres.

The current moment of research can be identified as the logical consequence of the reorganisation of the Department of Urban Planning and Environment in 2018. Given that radical reorganisation, it is admirable that the research team has been able to consolidate their work around the themes of the three Research Divisions. The department needs more support from KTH to consolidate their research agendas, communicate them appropriately, and use this collective work to support grant capturing. As one member of staff expressed during the meeting:

'The challenges of consolidation since 2018 include having to know each other, or even learning the names of everyone and then starting to think how we can understand each other in a new context and what kind of common discussion we have to build projects and collaborations.' [Notes taken during the panel meeting on 26th August, 2021].

A valuable aspect of the department is that all faculty staff showed an open approach to engage with research themes that are shifting and changing in a constantly evolving society. All staff have a clear commitment to critical thinking, questioning the fundamental assumptions of the discipline, and thus seeking to move beyond punctual, incremental contributions to create, instead, opportunities for radical changes in the creation of scientific knowledge. One key insight from the meeting was that the department aspires to deliver engaged research and wants to lead theoretical debates internationally in the field: this is something that requires a strong commitment to critical thinking.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

With over 30 publications among 16 professors, the Department of Urban Planning and Environment is productive, and it is regularly making visible its contributions. The information the panel was given about impact factors reflects the kinds of numerical figures within the general field of urban planning. In this case, however, information about impact factors may not always be useful in evaluating the contributions, as the leading journals in the discipline are interdisciplinary forums that respond to the changing contexts of urban sustainability (very different from the landscape in highly technical and specialised subjects in which impact factors are much higher). Another way to evaluate the department's publications is through reference to the prestige of the journals, which is something even more difficult to evaluate. Some journals that have marked the development of their respective disciplines – such as the journal, Environment and Planning A, in terms of urban economic theory – are represented in the sample list provided for the panel, showing that the faculty staff are actively engaged in current debates and regularly publish in internationally-recognised outlets.

KTH needs therefore to recognise how quality and quantity of contributions is increasingly evaluated within the discipline of urban planning, and the indicators of esteem that are garnered by these

publications. Beyond impact factors, it is where and how the contribution is cited that will influence its importance over time. For instance, the use of a particular academic output by companies, institutions and other organisations, its citation in seminal works and academic reviews as an example of a particularly new perspective or position, or published reviews of important monographs, are all examples of indicators of quality that are not present in a self-assessment document that responds to rather fixed, strict criteria within KTH that may serve other disciplines but not this department.

d. Follow-up from previous evaluations

The previous evaluation in RAE 2012 has been followed by several reconfigurations of the Department of Urban Planning and Environment, until the establishment of the current configuration in 2018. It appears as if these reconfigurations have disrupted the department, which now will hopefully benefit from a period of stability and consolidation in order to reach its full potential as a leading international centre of research excellence.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

The Department of Urban Planning and Environment has an active programme to capture research funding from different organisations via national and international partnerships (earning 58 million SEK in 2020). However, there is concern among the faculty staff that they are focussing on the delivery of many diverse and fragmented projects at the expense of consolidating research agendas into larger and more ambitious programmes. The department engages with a heterogeneous research field that accommodates both large, funded teams and individual researchers working on a shoestring. While large projects may bring staff together and consolidate research agendas, smaller projects can provide researchers with space and time to develop new, breakthrough ideas which are not yet amenable for funding.

However, the drive in the department at present seems to be not towards highly creative, disruptive small projects but rather towards individual-led consultancies that replicate, rather than create, existing knowledges and which appear to serve the demands of businesses or organisations, rather than shaping independent and critical research agendas. While consultancy projects may find a place within a large portfolio of research projects, the staff feels that their proliferation is hindering their capacity to deliver ground-breaking research. The Department of Urban Planning and Environment should engage in an internal review of what is driving this trend towards individual consultancy research, by identifying the incentives or requirements that are pressing staff to concentrate on such projects. Some researchers, for example, highlighted the perception that it is only possible to do research within the department if it is externally funded. This is an issue that will resurface later, in relation to staff stress.

b. Academic culture

The Department of Urban Planning and Environment shows strong alignment with the research priorities of the ABE School as a whole. The department is committed to find out sustainable solutions to societal challenges with research that is visible and makes a tangible difference to society. In particular, the department is proud of the extent to which it meets the objective of sustainability, arguing that 80% of its research is aligned towards sustainability goals. Digitalisation is also a growing theme of interest, as it increasingly becomes a default concern for research in geoinformatics, transport studies and urban planning.

The Department of Urban Planning and Environment shows strong interest in developing cutting-edge agendas on intersectionality and social justice. Discussions with the panel about diversity and inclusion showed great potential for researchers in the department to take the lead on these two topics of growing importance, which the ABE School needs to engage more fully with, alongside other similarly strong departments in these areas like the Department of Architecture.

Externally, the department's attitude of being 'a critical friend to practice', as mentioned in the presentation to the panel, is well aligned with current debates within the discipline of urban planning, and about the added value provided by academic research in the planning context. However, the faculty staff also highlighted that their mode of operation, which involved critical analysis, has at times constrained their relations with some policymakers (like Stockholm Municipality). Research involves a normative compromise with the subject study, so it is possible that these constraints are unavoidable. This raises a question about the constitution of partnerships for research and the extent to which the department operates within a client-supplier relationship rather than as an independent provider. These are complex questions that require further discussion beyond this report.

c. Current faculty situation and composition of the research team(s)

The research teams include 16 professors (ranging from Assistant Professor to Full Professor), 12 researchers, 5 post-docs and 37 active PhD students. The team is diverse, and its gender balance reflects the whole department's interest in addressing the drivers of institutional and cultural discrimination. This approach now needs to be taken beyond gender into intersectionality, to address multiple forms of exclusion and oppression that influence academic careers and academic life. This need was well acknowledged by the faculty staff in the department, with whom we had one of the most engaging and constructive discussions about issues of diversity and inclusion. The discussion showed that, in particular, many staff members perceive diversity and inclusion not as a tick-box exercise but as ongoing daily practice that everyone within the department must engage in.

d. Recruitment strategies

The self-assessment document suggests that there is a challenge to find continuity across the research division of the Department of Urban Planning and Environment, due to the limited availability of faculty positions guaranteed with internal funding coupled with the difficulties in recruiting PhD students and post-docs. PhD recruitment was similarly a major challenge in several other departments examined by the panel. Faculty staff explained that the problem relates to the legal need to be able to guarantee doctoral funding for 4 years before the PhD position is made available to candidates, making PhD opportunities scarce.

The self-assessment document identifies the problem of facilitating recruitment from within the department's MSc programme: as doctoral positions are so rare, and international competition is so hard, it means that very few of their own students can progress to PhD level. It is a significant concern, since having a limited number of PhDs may impact upon the innovative capacity of the department, given that doctoral students often have the time and space to take on daring and risk-intensive projects – at least within the discipline of urban planning. At the same time, increasing the number of PhD students in an environment of increasing competition for post-doctoral positions can only be justified if alternative routes towards employment can be identified. Close partnerships with the industry to fund doctoral students who can later be employed by them seems to be the most obvious route to increasing PhD recruitment.

e. Infrastructure and facilities

The infrastructure requirements of the Department of Urban Planning and Environment are in terms of data computing capacity and facilities, which are currently met by using national and international resources. There is no expectation that additional facilities will be needed immediately. Still, there are clear concerns within the department about the extent to which it is able to meet the requirements for data management in a rapidly changing external context of debates around privacy in accessing and using personal data from research partners and government institutions. The panel discussion provided examples in which the data management support requirements were not being met, such as for example in the digitalization of sensitive health data. The panel was told that these issues could not be resolved at departmental level but, instead, depended on a refreshing of data management and ethical approval processes at institutional level.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

Based on the information supplied by the Department of Urban Planning and Environment, the goals are mainly related to maintaining continuity through the consolidation of existing research agendas, including maintaining the production of research outputs, addressing current and future challenges in the transformation to a more sustainable society, maintaining a supportive and inclusive research environment, and balancing funding sources to establish long-term research projects.

The goals above depend on receiving appropriate support from KTH, particularly in moving away from simplistic metrics of success that do not fit the discipline, and in considering the balance between inclusion goals and excellence goals (as reviewed by key institutions such as the European Research Council), so as to establish transparent protocols to evaluate performance that will enable the department to establish greater congruence with university-level targets.

Intersectionality and justice appear to be two key themes that inform research across the department; these were also two themes that the panel found really compelling in the discussions with the faculty staff. We thus recommend using the Department of Urban Planning and Environment as a hub for developing these two themes and ensuring their integration in the research programmes in other parts of the ABE School.

b. Congruence with university-level goals

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c. Leadership structure and collegial structure

The Department Management Council's vision was well articulated in the panel meeting. The flow of communication was open and fluid, including conflicting perceptions about different aspects of the functioning of the Department of Urban Planning and Environment, which is a healthy sign of an openness to challenges. This, alongside the work done towards the self-assessment document, suggests an open structure of communication and a culture that encourages independent thinking and the expression of contrasting perspectives.

However, certain fundamental aspects about the working of the department were not at all clear to the panel, and so it would be helpful to make visible the information about some of those issues – for example, the distribution of internal research funding and the workload balance for faulty staff between their research and other activities – to build openness and clarity about how the department works.

d. Strategies for achieving high quality

The self-assessment document provided by the Department of Urban Planning and Environment emphasises compliance with the quality evaluation mechanisms in KTH, ranging from peer-review observation to external examiners and peer-review publications. These are well-established mechanisms in academia, and the faculty staff know them very well. What is less evident in the self-assessment document, however, are the mechanisms to foster the creative potential of the staff, something that is central to delivering high-quality research outputs in a thriving research environment.

One of the key phrases in the panel meeting was that 'our staff is our key asset.' However, the self-assessment document also highlights the stress being caused by a higher dependence on external funding, alongside questions of limited internal collaboration, uneven distribution of research funding, and limited access to standard services at the ABE School level, including data management and ethics. A sentence in the self-assessment document stands out: 'Being too heavily dependent on external

funding creates stress on individual level, and e.g. missed opportunities in creating new collaborations at department level.'

New appointees to tenured positions in the department appear to be well-supported. However, when this initial support comes to an end, faculty staff told us that they then need to generate their own external research funds if their research work is to continue. Other departments in the ABE School also appear to operate this model. However, it seems to be a particular problem for the Department of Urban Planning and Environment because of its specialist focus on high-level theoretical work in the field of urban and regional studies, which requires time and space to develop and even then may not generate major research grants, or at least not on a regular basis.

Our understanding from speaking to staff is that the result is that fundamental theoretical research is not as strongly supported as it could be, since baseline support in terms of research time or funding is not allocated even to staff producing high-quality academic publications. This seems to be incongruous with the ABE School's and KTH's stated intentions to encourage research creativity. The very real danger here is of diverting staff away from 'blue-sky', sometimes risky, thinking towards chasing grants, following rather than setting new intellectual agendas.

A key strategy must be to focus on the well-being of staff and the creation of opportunities for pursuing as wide a range as possible of emerging, exciting projects, acknowledging that not all staff will be as successful as others in gaining large grants on a regular basis. Attempting to force all staff to perform to the same template is a sure recipe for not recognising the unique qualities of each researcher, reducing collegiality in favour of a competitiveness that generates tensions at departmental level as well as personal stress in individuals. Maintaining research quality depends on maintaining a healthy work practices and ethics, as the leadership of the Department of Urban Planning and Environment strongly recognises.

This is, of course, not a challenge unique to this department or even to KTH: the COVID-19 crisis has further exacerbated people's expectations of their own achievements, as personal interaction has been replaced with efficiency-oriented interactions and online presentations that require a deep concern with performativity. Protected spaces for discussion and experimentation have mostly disappeared from research life, and networking has been largely reduced to email exchanges.

The Department has already proposed four strategies that will address these challenges directly:

- It intends to focus on creating stable and stimulating meeting places and other means to encourage increased exchange and collaboration. Time seems to be the limiting factor here. The ABE School could consider how to free up staff time to facilitate such desired exchanges.

- It also has a need to develop clearer strategies to attract research funding. This has practical challenges (for example, how to meet requests for co-funding) but also creative aspects in terms of aligning the department's research agenda with future challenges and giving opportunities to examine emerging areas of research alongside consolidated ones.

- Partly, the challenges of the department also relate to the need to balance its dual role as a hub for both strategic knowledge and practice. Engaging with practice, however, poses additional responsibilities beyond academic research, including actively seeking opportunities to influence policy-makers, businesses, NGOs, and communities. Thus, delivering impact in policy and practice also requires a strategic approach, identifying opportunities where it can be realised and accepting that not all research is impactful in a practical way – particularly when research is aimed at, for example, contesting the fundamental assumptions of practice.

- Improving communication about research is strongly linked to the point above. Communication requires identifying clear audiences; however, from the self-assessment document, the department appears to be speaking simultaneously to all possible stakeholders in the urban environment. While this aim is plausible, given the richness of multidisciplinary interests and collaborations, the act of drawing out different audiences – together with an outline of the kind of messages they may be interested in or open to – may help to improve research communication. For example, in the case of the department's website, the main audiences are students and fellow academics. Illustrative examples of the research highlights and key resources may be more attractive to those 'external' audiences than long and exhaustive lists of publications (which would be the default mode in other documents directed at internal administrative audiences).

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

An interaction between research and teaching is not clearly expressed in the self-assessment document, nor was it a strong topic during our panel meeting with the Department of Urban Planning and Environment. The self-assessment document does provide a brief introduction to different ways in which research informs teaching at all three levels, yet it pays less attention to the simultaneous co-generation of research and teaching. Innovation in research-led teaching can be introduced at different levels, such as by treating undergraduate and postgraduate students as budding researchers.

The objective is not that all faculty staff have to meet all the different minimum requirements (inclusion of current research in lectures, teaching research skills, etc) – but rather that some staff should regard teaching as an extension of their research practice and include the students as active members of the research community. Admittedly, this is something that may present specific difficulties at the undergraduate and postgraduate levels because of KTH's current structure of research education, yet it is an aspect that should be investigated.

Engaging with current debates on teaching and education in topics such as decolonizing the curriculum or facilitating inclusion in education may likewise open further opportunities for research in the topics of intersectionality and social justice, which as noted are of great interest to the department. The panel would like to see these issues further embedded into the taught elements of PhD training, something which the department is well-positioned to contribute to or possibly lead on.

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

The Department of Urban Planning and Environment makes a solid effort to engage actively with society and industry. However, it could perhaps more carefully evaluate the costs of such engagement and the role that academics play in it.

The sense that some faculty staff see themselves being reduced to consultants, and the risk that some projects are limiting the creative and speculative possibilities for researchers, are seen as key concerns by the panel. There is hence a need to distinguish between engagements in which the researcher marks out the terms of the research agenda, offering ideas that can match the existing needs of society and industry, and – conversely – those engagements in which society and industry mark out the terms of the research agenda, establishing the assumptions and reducing the critical outlook of the researcher. There will be some cases in which the second type may be particularly attractive – for example, when the funding available is substantial and extended over time or is tied to the development of future policy agendas – but the precise benefits the department receives from these engagements need to be clearly identified and weighed up.

b. Research dissemination beyond academia

The department has already made great steps in this direction, such as in developing its own agenda for being a 'critical friend to practice.' We would encourage creating a regularly updated dedicated page on the department's website to showcase its achievements and to invite others to join the conversation around co-produced research that is of value to society as a whole and sets intellectual agendas internationally. There could also be scope for specific initiatives to engage more with younger practitioners, providing a base for stronger future collaborations. InfraSweden2030 looks to be a great initiative, yet the department's website could make much more of its (and KTH's) role.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

Much of the department's research is directly relevant to SDG11 ('Make cities inclusive, safe, resilient and sustainable'). All that SDG's concerns are explored, often explicitly, in the research agendas of faculty staff. Their work, however, is also cross-thematic and addresses the intersection of SDG11 with others such as SDG1 (no poverty), SDG3 (good health and well-being), SDG5 (gender equality), SDG6 (water and sanitation), SDG9 (industry, innovation and infrastructure) and SDG10 (reduced inequalities). In summary, the department is clearly responding to research questions for which there is a strong societal demand, and for which there is funding – particularly from FORMAS and VINNOVA.

d. Plans and structure for increased impact

This is an excellent part of the self-assessment document that shows co-creation at the core of the department's research practices, such as in involving social and industrial actors in the research, linking the interaction between research and PhD recruitment, and committing to impact through education. These well-devised plans now require a period of consolidation and development of long-term partnerships, alongside strategic planning to identify the best opportunities for impact.

6. Recommendations for strengthening the department and its future potential

- Facilitate a period of consolidation that focuses particularly on taking forward the current agreed research agenda. This consolidation includes the need to map out capabilities and interests at the departmental level and to build new collaborations within KTH, and beyond.

- Conduct a review of the incentives and requirements that are leading to the proliferation of consultancy-based research, both at the ABE School and KTH levels.

- Establish individual long-term research objectives for staff that are realistic, focussing on excellence over quantity, and recognising the different living conditions and career stages.

- Gather the support of the faculty staff in offering to lead research agendas on intersectionality and social justice across the ABE School as a whole.

- Further improve the communications channels, both internally so that staff are fully aware of how the department works, and externally by for example revamping the website.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

KTH's review protocols for research success prioritize quantifiable indicators (e.g. impact factors) which may be less relevant for this department. Also, the protocols focus upon research in DiVA and seem to miss out on monographs and key publications, emphasising instead peer-reviewed conference papers of less importance in this field.

Department of Civil and Architectural Engineering

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
Structured into what are well-conceived divisions. Well-managed department that has a sizeable number of research staff and PhD students. Openly aimed towards dealing with important research issues of relevance for society and industry. Impressive level of externally funded research. All the divisions have plentiful and visible research outputs, with aims to become world-leading in certain areas.	Much of the research work tends to be detailed and practical, focussed on application rather than broader 'blue sky' thinking. There could be an increased level of international research engagement. The department still has far too low a percentage of female faculty staff. Academic career pathways are not altogether clear especially for younger staff. Communication structures need to be improved, both internally and externally.

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

The Department of Civil and Architectural Engineering is carefully structured into well-balanced divisions, each of which have a good number of research staff and PhD students. Hence there is no doubt about the critical mass of the department's research work and the relevance, both scientific and practical, of the outcomes for society and industry whether in Sweden or abroad. External research funding is impressive and the research outputs solid and well visible in all divisions. In addition, a number of presented research activities, including undertakings in modelling of transport and commuting/socializing processes in the face of the pandemic, data-driven modelling, intelligent infrastructure and design of hybrid structures, reveal a clear ambition to develop towards producing world-leading research in their specific fields.

3. International community engagement

In general, there seems to be a good level of engagement with international researchers and institutions in affiliated fields. However, possibly as a result of funding opportunities, the focus seems to be more heavily towards national collaborations (e.g., this forms most of Section 2e in the self-assessment document), while international collaborations seem to form less of a focal point, albeit pursued on the level of individual researchers. European projects can be exploited as vehicles of participation in international consortia which promote seeding of new interdisciplinary ideas.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

The Department of Civil and Architectural Engineering is a good position currently but should now aim to become bolder and more ambitious in its research agenda for the future. In materializing this goal, it is imperative to embrace a new direction of research that targets 'blue sky' research for instance in the domains of digitalization or data science in civil engineering, cyber-physical systems, circular and low carbon materials, robotic fabrication/automation in construction, as well as sustainable building technologies that encompass climate neutrality and occupant-centric solutions. The investment in such paths will certainly require a prioritization of the funding resources, and should represent a collective decision, one that can be achieved through the establishment of a Strategy Commission (or Research Commission) at departmental level.

The close engagement of the department with local industry, cities and authorities is a significant strength which can be exploited to pave the way into more impactful research. Perhaps it is a catch to remain too limited to the short-term horizon demands of industry, which leads to research projects often requiring an advanced Technological Readiness Level (TRL). Given the strong communications streams that are in place, the department should consider exploiting these to push for external industrial investment that fosters bolder innovation.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

Drawing on the former summary, as well as on the elaboration the follows, the panel would like to make the following suggestions:

- The divisions seem to carve individual strategies and priorities, with some of them presenting a more forward-looking vision, while others pursue a more pragmatic approach, often tied to projects that directly fulfil local industry and public sector demands. In general, the department would benefit from existence of a Strategy Commission (or Council) as an instrument that can work synergistically with the current management committees.

- Such a Strategy Council should not only include division heads, but also younger researchers and faculty in different ranks. The committee should be tasked with exercises on funding prioritization, talent recruitment, and carving of faculty positions with a view to the future.

- Push on with the development of proposals and funding opportunities for 'blue sky' projects, or, in other words, research that is high-risk/high-gain. This is not intended to imply that engagement in industry-relevant research should be abandoned, but rather that additional efforts should be made in writing EU and national research grant proposals.

- Take actionable measures to remove any discriminatory barriers that might disproportionately be affecting female faculty staff in the department – for example, by examining recruitment processes and how these may be preventing the hiring of female candidates – and look into the department's overall work culture (timetables, distribution of responsibilities) to see if this might be excluding, for instance, those individuals with additional care responsibilities.

- Engage more heavily in KTH's existing research infrastructures, or else possibly invest in the department's own infrastructure that will enable it to boost projects that are at the forefront of research.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

Research in the Department of Civil and Architectural Engineering appears to be oriented toward timely themes that align closely with the ABE School's vision, especially in the areas of sustainability and digitalization. Activities in the domains of Smart Building/Infrastructure Monitoring Solutions, as well as Transport Infrastructure (EuropesRail, InfraSweden 2030, Road2Science) demonstrate excellent instances of impactful research.

However, the panel also noticed a general feel for applied research, with a clear connection to industrial and societal needs. While there is an obvious need for applied research as well, in a sense the over-reliance on that kind of research prohibits the department from leading and pushing forward the frontiers of research in its respective domains. As examples, there could be stronger engagement in the following domains in future: research into recyclable, biodiverse and new low-carbon materials within the context of zero-emissions targets; research into digital fabrication as the new direction for revolutionizing construction/building processes; exploitation of the already rich activities on environmental monitoring to use in analysing augmented cyber/physical environments; research which brings the human/passenger into the loop in terms of mobility- and transport-related research; and more ambitious research into buildings' energy performance and indoor environments, targeting issues of climate neutrality, occupant-centric solutions and wellbeing all at the same time.

As an added comment from the panel, while it is true that all the research projects which were list did ultimately address the need and purpose of sustainability, the sustainability aspect in several of these research endeavours seemed to be less prominent. In other words, it appears to form less of a main driver and more of a secondary, yet desirable, by-product. The Department of Civil and Architectural Engineering is generally framing sustainability though questions about durability, life-cycle assessment, and extending the usability of existing infrastructure, which are certainly issues that are present in numerous research projects. However, what seem less prominent are investigations into the development of materials, processes that build upon sustainability principles (e.g., circular materials/construction), or energy performance of buildings. Moreover, whereas climate adaptation was mentioned by the department, it was not made that clear to the panel how this issue, which forms a key example of a timely research direction, is directly linked to existing ongoing research projects.

b. Contributions to the advancement of state of the art within the research fields of the department

As aforementioned, a number of areas exist where the department is really pushing at the boundaries of state-of-the-art research internationally, such as in the modelling of transport and commuting/socializing processes in the face of the COVID-19 pandemic, digital twinning, smart solutions for monitoring and assessing ageing infrastructures, as well as design of hybrid structures. Full efforts should be made to develop these strands into world-leading competencies. This could be coordinated with support from the proposed Strategy Commission to create competence kernels, which will also further help to set a level of performance for other researchers in the department to follow.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

The quantity of research outputs and other contributions is undoubted, and there is also real evidence of high-quality research in all the divisions. It would however be beneficial for the department to set up relevant mechanisms to raise the quality of research outputs even further, notably through the Strategy Council that has been suggested as a main recommendation.

As a further suggestion, it would be meaningful to engage more heavily in European projects that offer the opportunity for involvement in highly interdisciplinary international consortia, such as via participation in large-scale initiatives and actions (e.g., RIA, CSA, ERC, ITN). These could form a strong vehicle for increasing collaborative research outputs both in the short-term and long-term.

d. Follow-up from previous evaluations

The department had a solid review during the RAE 2012 exercise and seems to have followed up sensibly and carefully on those recommendations, thus moving into a stronger position today.

In terms of specific comments on the suggestions from that previous research evaluation:

- 2012 comment: 'The area of sustainability, as a holistic approach, needs to be lifted to a higher level in order to get a shared understanding of the concept and formulate its aspirations.'
  Current status: As discussed, sustainability now forms a main element of the department research strategy, but could be treated as more of a frontal subject as opposed to a by-product (something that is also a prerequisite for national research funding schemes).

- 2012 comment: 'Further suggestions pertained to recruiting more international faculty in order to maintain intellectual diversity, as well as to promote gender balance.'
  Current status: The department's efforts in both these directions are acknowledged by the panel. However, there remains clear room for improvement and so in both aspects, continual effort is needed.

- 2012 comment: '"To make basic research more visible, it is recommended that KTH researchers publish more often with external partners. KTH could also consider reappraising its processes for identifying research output worthy of commercialization and that patenting and innovation activities ought to be strengthened through education and networking with industry.'
  Current status: This is a suggestion that has been actively taken up, while the panel also acknowledges the difficulty of patenting in the construction domain, which should thus not form a concern of the department.

- 2012 comment: 'The panel recommends the establishment of a research centre for green, smart, economical buildings and transportation infrastructure to establish necessary collaborations and provide access to laboratory facilities. Other recommended facility enhancements include updating and enlarging the material and structural laboratory and establishing at least one experimental facility to demonstrate innovative materials and building technologies under real-world conditions.'
  Current status: This recommendation was adopted in formulating the Road2Science Centre in transport infrastructure (alongside the Centre for Traffic Research), which now forms a main strength of the department and a model that should be followed to establish and strengthen the next initiatives in forefront research.

- 2012 comment: 'Other recommended facility enhancements include updating and enlarging the material and structural laboratory and establishing at least one experimental facility to demonstrate innovative materials and building technologies under real-world conditions.'
  Current Input: The department has followed up with acquisition of a computed X-Ray tomography facility, which is exploited by several research groups. The panel would like to encourage investment in further such unique facilities (e.g., virtual/augmented reality facilities, 3D printing/additive manufacturing), possibly through project funding. We also though acknowledge that KTH needs to centrally adopt a strategy that allows departments to develop

and maintain such experimental facilities with adequate support on acquisition of space and technician staff.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

The restriction in available internal funding seems to the panel to be limiting the freedom of faculty staff and researchers in their pursuit of broader, 'blue-sky' research agendas and projects. Instead, the continual need to secure external funding, in many cases even just to support and thus justify their own salary for Associate Professors and Full Professors, is leading towards the pursuit of smaller projects, typically industry- or municipality-driven, which represent 'lower-hanging fruit' in terms of research ambition. In the panel's various meetings, and thus not only with the Department of Civil and Architectural Engineering, it was very surprising to hear about the highly competitive nature of academic salary finance within KTH (and Sweden generally).

Discussions with the department about its own perspective on the domains where the different divisions are conducting world-leading research, tended to emphasize the fact that KTH is a university that needs to be integrated with – and, in a sense, ought to comply with – the general structure of the Swedish academic system. This kind of perspective however did not seem to be in line with KTH's very high international reputation, prompting a further question from the panel as to whether tenure-track/tenured positions within the department are being successful in attracting top-tier international researchers. From the response, it seems that funding restrictions might be making such a goal harder, thus posing a very real problem. In order to promote a bigger research vision and bolder research projects, a reconsideration of internal financing seems to be needed at the ABE School level and at main KTH level. This would be well justified in the case of this department, since several research areas and research groups are already showing promising potential for international breakthroughs, and this can be accelerated if more sustainable funding is secured. Here, it would help to consider the pooling of funding to finance research projects that have a bold vision and are focussed more on fundamental – these could be awarded based on an internal application procedure – as opposed to the more practice-oriented research.

b. Academic culture

The above-listed restrictions on internal funding for faculty staff is likely placing additional burdens upon those younger staff and researchers who are working their way through the promotion process – that is, Assistant Professors applying to become Full Professors, or researchers who are seeking a permanent staff position. It is important that these faculty staff and researchers are protected and supported during the promotions path, such as by ensuring that they have a restricted teaching and administration load, as well as offering them some sort of start-up package or seed-funding for them to initiate their research projects.

c. Current faculty situation and composition of the research team(s)

In the Department of Civil and Architectural Engineering the percentage of female faculty staff/researchers is very low compared to male staff/researchers, which is of course not only an issue at KTH but is found in most engineering departments worldwide. Thus, the percentage of female teaching staff is just 20% of the total, and this figure becomes even lower when looking just at Associate Professors or Full Professors.

Furthermore, while the (relatively few) existing female faculty staff and researchers who are employed by the department certainly should be part of the committees and bodies which shape its strategy, the panel recommends that the department should be careful not to continually overburden them with administrative activities (such as the role of Division Heads or Study Directors), since that will prevent them from doing the research work they will need for their future career progression. The efforts of the

existing female members of the Department of Civil and Architectural Engineering are truly commendable in this respect.

d. Recruitment strategies

In order to ensure a better recruitment of female talent, it is suggested that the department considers adopting a recruiting process that includes, firstly, setting a minimal quota of female interviewees (e.g., at least 2 out of 6 shortlisted candidates should be female), and secondly, a policy of active recruitment (e.g., preparing a list of female talent within the domain in Sweden and internationally, and then inviting them to apply). A designated gender delegate in each recruitment committee could help ensure these criteria are properly put into place.

e. Infrastructure and facilities

Research in the domain of Civil and Architectural Engineering is clearly reliant on research infrastructure that enables researchers to innovate through experimentation. However, the SWOT analysis by the department in the self-assessment document mentions that the available labs are far from being at the level of structural engineering labs at well-reputed universities internationally. The fact that the department's labs also need to comply within the system of chargeable rental space in KTH is definitely not favourable to the development of large-scale testing and experimenting facilities, which are usually such important drivers in a department such as this.

In this regard, providing more infrastructure support at the ABE School level, which could ensure a fixed allocation of space for a central lab for the department, could be one solution. A further option would lie in exploring the possibility of obtaining funds at state-level to create large-scale lab infrastructure, which would help build up research capacity. In such a case, limited use of the facilities for commercial testing would be a way to ensure continuing supplemental funding. At the same time, KTH does offer a variety of facilities, as part of its research infrastructure, yet the usage or exploitation of these facilities was not highlighted either in the self-assessment report or the panel's meeting with the department. While the department is already making use of the Visualization Studio (VIC), perhaps other available facilities such as the Hultgren Lab and Odqvist Lab could be of direct relevance to some of its research projects. It is therefore suggested that the department should more actively pursue ways to participate in such central KTH infrastructure, given the obvious potential to carry out (for example) large-scale testing/monitoring/fabrication.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

The stated goals for the Department of Civil and Architectural Engineering seem very appropriate, yet it might be worth the department trying to be even more ambitious.

As aforementioned, the panel suggests that a Strategy Commission (or Council) would be useful for boosting the department's research vision and, critically, for deciding upon the profile of new faculty staff positions that can succeed the several upcoming retirements. An example of one such position that would align with the latest global research trends would be in Data Science or Artificial Intelligence/Machine Learning. This is the kind of appointment which could also offer input across many of the divisions in the department, and indeed it could be anchored in more than one division.

b. Congruence with university-level goals

From what was presented in the self-assessment document, and from the panel meeting with the department, it seems that the ambitions of the Department of Civil and Architectural Engineering are in close congruence with the agenda of the ABE School and of KTH more broadly.

c. Leadership structure and collegial structure

There appears to be very good departmental leadership in general, as well as in terms of organising the research work of faculty staff, yet at the same time it is also clear that increased exchange amongst the divisions is something that the department should be motivating. This goal can be achieved for instance via activities such as Open Research days (with the participation of faculty staff at all levels, researchers, PhD students), or else by retreats where the department can run enabling workshops for faculty staff.

d. Strategies for achieving high quality

The proposed Strategy Council could be responsible for pooling money at the departmental level for allotting more flexible (seed-type) projects to novel and fundamental research. Furthermore, it could carve a strategy for devising and organizing consortia for ambitious proposals at European level.

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

The SWOT analysis in the self-assessment document reveals a low ratio of faculty staff in relation to the amount of teaching that is required, and so it would seem necessary to remedy this situation if the Department of Civil and Architectural Engineering truly wishes to ensure high-level research whilst maintaining a top-notch quality in its educational provision.

As a close integration of research and teaching reflects a healthy academic system, the introduction of targeted courses – possibly offered with participation of faculty staff across divisions – which can focus on the domains of sustainability and digitalization would undoubtedly strengthen both areas in research terms. During the discussions between the department and the panel, the interaction with teaching did not come across as a main focus, although it was mentioned that the element of sustainability in particular forms an underlying theme of the more specialized courses at Master's level. While it is acknowledged that concepts such as sustainability are ubiquitous in various courses in the department, and across the ABE School, it would nonetheless be meaningful to also set up dedicated modules, or even new courses, to help spread the department's research amongst KTH's pedagogic provision. Moreover, such offerings could help to educate a new generation of engineers that can actively contribute to research already in their coursework at Bachelor's or Master's level, through dedicated degree projects. The benefit in such an approach lies in instilling a feel for cutting-edge research and in cultivating relevant skills in interested students, particularly if it is feasible to offer such specialized, advanced courses as optional modules (or even as block courses).

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

The Department of Civil and Architectural Engineering has demonstrated close and highly successful engagement with society and industry, which is indeed commendable. However, in its recommendations above the panel suggests that this be balanced with research that features a more daring and visionary perspective via 'blue sky' projects. Such a balance is necessary for remaining socially engaged while also maintaining a leading academic profile. While it is understood that research needs to be driven by availability of sponsorship/financing, it is important to set up and retain active streams that can support and promote directions at the forefront of research.

b. Research dissemination beyond academia

The department clearly has a strong presence and engagement with industry and practice at a national level in Sweden. These activities are real an asset and demonstrate societal relevance. This type of

stewardship should be highlighted more in the department's communication strategy to highlight the overall research contribution, and the dedication of all divisions in this respect.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

The research in the Department of Civil and Architectural is well linked to the UN's Sustainable Development Goals (SDGs), with some of these ambitions being pursued explicitly on a range of fronts that including SDG.11 ('sustainable cities and communities'), SDG.7 ('affordable and clean energy.), SDG.9 ('industry, innovation and infrastructure'), and SDG.17 ('international partnerships').

d. Plans and structure for increased impact

The department has hired a person to take charge of information and communication, which it expects to boost visibility within the ABE School, KTH, and also – rather importantly – to the broader public. The department further insists on documentation of the impact or success of ongoing research activities, which is a further positive step. It could perhaps become more automated by using a standardized type of report (including items on outputs, collaborations, follow up funding, etc.) that could eventually be used for aggregating the relevant statistics across divisions.

What is rather missing however from the self-evaluation report in terms of impact is the potential connection to teaching, and wider public education, which certainly offers a channel to be exploited in that direction – such as by via focussed continuing education activities.

6. Recommendations for strengthening the department and its future potential

- Consider the introduction of a Strategy Committee (or Council) that can take a wider view on research agendas and practices.

- Try to balance practice-oriented research project with visionary, cutting-edge research endeavours, such as through collaborative seed-funding initiatives and such like.

- Pursue more involvement in EU project consortia to step up the level of international research collaboration.

- Adopt formal measures and procedures to give a greater gender balance across all ranks of faculty staff to match the achievements in other departments in the ABE School.

- Collaborate more in KTH's research infrastructures or else invest more in the department's own infrastructure.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

The panel wishes to express its appreciation of the rich and well-organized material that placed at its disposal for this research review by the Department of Civil and Architectural Engineering.

Department of Real Estate and Construction Management

Major findings

1. Strengths and weaknesses of the department

Concerned and recommendations for improvement

Strengths	Weaknesses
There is impressive research with clear societal relevance across the department. Strong research themes are in examining how buildings are procured, and how a digitalized analysis of land and property can better inform changes to the built environment. Many good examples of research impact, and the new Sustainable Finance Lab is potentially excellent and ground-breaking. New impetus in geodesy, linked to geoinformatics, is starting to open up fresh areas of research.	Much of the research work tends to be too short-term, and thus detailed and practical, as opposed to new ground-breaking research. The size of the research teams is perhaps still too small to achieve sufficient impact. There could be much more research synergy with SEED and the Department of Urban Planning and Environment in particular. Definitions of diversity and inclusivity are recognised as needing to be broader. Like KTH generally, the department's reputation sits more within academia than the 'real-world' context outside.

2. Relevant and forward-looking objectives

Are the goals relevant and forward-oriented?

The objectives set by the Department of Real Estate and Construction Management seem to be well considered and appropriate. A fertile research culture has been established, and what is needed now is to find ways to develop research leadership in the department that will build longer projects (3-5 years), and which could also possibly connect with other parts of the ABE School such as SEED and the Department of Urban Planning and Environment.

One important area for research development is analysing how society uses the built environment in actuality. The principle of managing what is the existing infrastructure more effectively is probably the best way to meet sustainability goals in economic, environmental, and societal terms. This aim is also crucial in order to adapt our current built infrastructure to the immediate effects of climate change, including the development of economic and legal applications in that specific field.

Longer-term economic analysis, not only regarding specific issues, but also in a wider societal context on the local, regional and national level, could also be an interesting and fruitful research field for the department to develop. It is evident that decision-makers in the public sector in Sweden and elsewhere tend to lack that kind of information when making decisions that have such major effects on our common environment, and hence there is a good opportunity for innovative research in this area.

In general, there is today a real potential to increase and emphasize a holistic view for managing and developing the built environment. Although KTH would seem to engage in the broadest coverage of the built environment among Swedish universities, the nonetheless panel feels that there is a need to introduce an extra, unifying perspective. To increase the overall benefits from societal investments in physical infrastructure we need to review the interaction between different academic specialisms to see can be provided by a more holistic view approach to the built environment. This complementary view is a position still not claimed by anyone, not even at governmental level. To be useful, it would have to study management and governance at a high level on strong connection to national economics and social sciences.

3. International community engagement

There are some very good examples of collaborating with researchers in the field in other countries, although this does tend to happen at the level of each individual faculty staff member rather than as a coordinated, targeted department-wide strategy. Perhaps therefore there should be more coordination within the department in terms of how to build up engagement with the relevant international academic communities.

4. Future potential of the department

For a positive development towards fulfilling their goals, operating on the front line of international research, and exerting a beneficial impact on society

There appear to be many potential routes to expand the scope and impact of the research being carried out in the Department of Real Estate and Construction Management. For instance, the newly founded Sustainable Finance Lab seems to the panel to offer an excellent and timely opportunity for international impact.

Similarly, there is a clear potential for a stronger impact for geodesy in Sweden, with this impact encompassing both theoretical and practical aspects. In this sense, the appointment of a new Professor of Geodesy would create a real opportunity to focus the agenda for the existing team's research efforts, and in doing so, create more international impact. This new professorial appointment could for example represent an opportunity to develop the use of geodesy within construction management, or perhaps that is considered as a lower priority for the role. It is important to note that it is unlikely that the Geodesy research group on its own – even with a new professor ¬ would ever achieve sufficient critical mass for it to be able to exploit the cutting-edge emerging technical and application trends in Global Navigation Satellite Systems and other positioning/navigation technologies. A much greater investment would be needed for that to happen in the department. Instead, the Geodesy group already has strong alignment with the national government agencies in Sweden, and so it should focus on continuing to deliver impact in that way. Perhaps the integration of geodesy with the broader geospatial research activities in Urban Planning and the Environment – or even bringing these two departments closer together in their research – would expand KTH's opportunities for involvement in the growing space industries in Europe.

Furthermore, there also exist real opportunities to unite these geospatial teams to deliver capabilities for both research and industry, and impact for sustainability and digitalisation. For example, and as noted before, the ABE School could create foundation spatial data sets that are important and useful for a range of applications and decision making. Opportunities for broader industrial collaborations such as this would however need to be actively supported at the ABE School level or the KTH level since they are such a small research group.

In the Swedish building industry, and among municipalities, there has been a very rapid development of applied geodata to help the legal process prior to embarking on building projects, with an aim of optimizing the economic investment and minimizing the environmental impact. KTH thus has an opportunity to catch up with development by offering a structure that could review ongoing pilot projects and develop general calculation models through increased digitalisation. In addition, it could also investigate how one could initiate the changes in legislation and regulations that are clearly going to be needed.

5. Recommendations

Based on your overall observations and analysis of the department, please provide the recommendations that you find most useful to the department for the future development of high-quality research and research environments

There are four key recommendations for the department's future research development:

- There needs to be greater strategic research planning at the level of the ABE School to market the capability of being able to carry research projects out in a holistic manner and thus create demand for the broad-based research knowledge and skills available within the department.

- Individual research groups are less well placed to achieve major impact, whereas a greater degree of coordination within the department itself would enable larger problems to be successfully tackled and draw in wider expertise.

- To address the issue of making the department's research reputation much wider than only academia, the department should be looking to work even more closely with Swedish municipalities than it does at present.

- For the new impetus in geodesy to prosper, there will need to be closer research links with the geoinformatics team in the Department of Urban Planning and Environment and perhaps with other parts of KTH.

Specific issues

1. Research profile and quality

a. Central research questions and themes, and main research activities

As a direct observation, the department is too small to cover most of the research aspects of Real Estate and Construction Management. Consequently, in both internal and external communications it is essential to make clear in which areas the department is at the leading end of research activity, and which areas are being led by other universities in Sweden or elsewhere. Then, from this careful analysis, the department can then start to initiate collaboration with these other universities so that it manages to embrace, and be involved in, a wider spectrum of Real Estate and Construction Management at an international quality of research.

To take one subject, building procurement is a very important research theme as it encompasses almost all the current investment and reinvestment in the built environment. This area can be developed by the Department of Real Estate and Construction Management if it focuses upon sustainability and digitalization as its areas of strength. Digitalisation can also be prioritized in regard to land development, urban planning and the design of buildings and other constructions. The department could also do more to address the legal and economic aspects of contractual relations, which is today really an important need for sustainable development. To push this further, the department should seek to be more closely connected to, and even involved in, the research efforts taking place in Geodesy in the Department Civil and Architectural Engineering and the Department of Urban Planning and Environment.

In terms of research impact, the department could pursue this more strongly by responding to Swedish legislative proposals and being involved in development proposals as appointed experts. The most interesting newcomer in relation to impact is the Sustainability Finance Lab. Improved communication and dissemination, linked to KTH's 2018 development plan, and connected with existing research projects in the department, could have the potential to increase research impact and funding – as well as increasing attractivity for new students at all levels.

b. Contributions to the advancement of state of the art within the research fields of the department

All initiatives to increase interaction between the departments within the ABE School will be immense benefit. One such opportunity is to unite the geospatial teams across various departments to deliver greater capabilities for research that addresses the needs of industry, bringing in turn more impact for research in sustainability and digitalisation. To give one promising example, the Department of Real Estate and Construction Management could create foundation spatial data sets that are important for a range of applications and decision making. Opportunities for greater industry through broader collaborations across ABE need to be supported at the School or University level for such a small group.

c. Quality and quantity of contributions to the body of scientific knowledge, engagement in national and international research collaboration within academia and its outcomes

It is difficult to make direct comparisons of both the quantity and quality of scientific outputs due to the wide range of disciplines within the Department of Real Estate and Construction Management, and their differing publication practices. However, overall, in terms of quantity, the number of publications seems low. With 44 full-time faculty staff, the number of fractionalised publications per year is less than one per year per academic. Although the writing of books will certainly involve greater effort than journal publications, the department ought to undertake a concerted effort to increase the quantity, and of course the quality, of publications. This effort should be facilitated by creating the role of Research Director (or similar) within the Department to improve publication practices.

This needs also to look at impact factors of journals that the department's faculty staff are publishing in, since that also seems low. In regard to refereed essays, it would be useful if the department would benchmark the journals and (more importantly) the number of citations that its publications achieve. Hence it would have been of benefit if the department had provided the panel with a statement of the significance of the chosen outputs that it featured: for example, it is not clear why a doctoral thesis was chosen as one of the top publications.

This point having been made however, it should be stressed that journal impact factors and citations are not the only ways to measure impact. This is vital in the case for instance of the many outputs which are in the Swedish language only. Such restrictions clearly hinder wider global impact but are nevertheless vital for satisfying key stakeholders at the national level, so a better mechanism for including these outputs should be devised alongside giving a short statement about their impact. For a future research review, therefore, the panel should be given a rationale for the choice of each output, statements of impact, achieved citations, etc. There needs to be more of a focus on understanding and improving the quality of the department's research outputs.

In the same sense, the department's self-evaluation document is overly concerned with expressing the quantity of publications: its focus ought to be expanded to talk also about research impact. When it comes to outcomes there is a definite potential to expand the story, with societal impact for instance being divided into two target groups: practitioners and governmental bodies. It could be the task for the suggested new role of a school-wide research coordinator to pinpoint the relevant results in these two categories. A focus on those connections, and telling the story about them, could be useful to attract new students, faculty staff, funding, etc – as well as providing a base to develop the department's reputation and authority in the field.

An obvious potential for a contribution to wider society and the research community is the new Sustainable Finance Lab. If well-managed, it could prove to be an international innovator. One example could be for it to investigate the long-term effects when nation states and the European Union decide on 'how' instead on 'what' in their political decisions, and then follow this up through huge amounts of dedicated financing.

d. Follow-up from previous evaluations

The Department of Real Estate and Construction Management should be congratulated for making significant improvements since the previous RAE 2012 assessment. In particular, the identification of the need for cross-division collaboration is welcome, as is the better coordination of research budgets, which is necessary for strategic research. Additionally, the increasing internationalisation of the staffing profile is essential to ensure that KTH is well placed to collaborate and provide impact on a global scale, and to avoid isolation. The focus on international PhDs and guest researchers is also to be commended, as is involvement in international programs.

Nevertheless, it is not clear that there should be such an explicit nexus between funding for research and teaching. The reason why this nexus is potentially dangerous is that the best teachers are not necessarily the best researchers, and vice versa. Instead, internal funds for research should be targeted towards strategic research to boost the department's impact. This could be in the form of seed-funding grants or other strategic opportunities, yet such research funds should not be seen as a 'reward for good teaching'. Additionally, an over-reliance on internal research funds can be to the detriment of pursuing high-impact research. Instead, the department's research efforts still need to be focussed on winning competitive grants and, to do so, meeting the needs of national and international stakeholders. High-quality research will always be funded in some manner, and so the small internal funds should be used to leverage external funding, or to support activities that will help unlock competitive grants.

2. Viability and research environment

a. Internal and external funding; current status and strategies for the future

The overall level of funding per academic is good, yet not outstanding relative to other internationally leading universities. The panel also notes that the Department of Real Estate and Construction Management has identified that there are real limitations on the external funding it can bid for. This should be seen as a red flag, and as such should call into question whether internal funds should be devoted to projects that cannot or will never be funded externally. After all, there are reasons why external bodies such national and EU research agencies do and do not fund certain disciplines. If research is impactful and significant, it can almost always find funding from external bodies who are keen to see a return on investment (including in terms of prestige, such as via the funding of high-impact research).

By appointing a dedicated Research Director with the goal of increasing the impact of the department's research, internal funds can be used more strategically to generate further impact and unlock further sources of funding. The Director of Research should also facilitate improved engagement with stakeholders, including industry, to pursue other financial routes too. Hence, if used intelligently, internal research funds to seed or leverage other external funding schemes will improve the flows of funds to the department and also ensure that higher quality research is produced.

b. Academic culture

Despite its small size, the research team in the Department of Real Estate and Construction Management is in a good position. They are producing high-quality research in all the areas they operate in, although there is also a need to market themselves better as a team that can carry out research in the applications sector on real-world projects and such like. Indeed, there are significant opportunities for the department to better position itself by broadening their scope to accommodate a range of new topics. As with all small research teams, there is a need to focus the overall vision so that it can prioritise the high impact areas, for example in housing and climate change with an emphasis on how to deal with rising sea-levels.

c. Current faculty situation and composition of the research team(s)

Like in most other parts of the ABE School, there is generally a good balance in terms of female faculty staff – but the department now needs to ensure that the diversity and inclusivity of researchers also includes aspects of intersectionality, if it truly wants to achieve the full benefits of EDI policies.

d. Recruitment strategies

This more fulsome commitment to EDI values has also to become the driver for recruiting new faculty staff, and in this regard, it is positive to hear that the Geodesy research group has already correctly identified the fact that they need to recognise broader aspects of diversity beyond gender.

e. Infrastructure and facilities

In general, the Department of Real Estate and Construction Management has identified a rather low requirement in terms of dedicated physical research infrastructure and equipment. Instead, it chooses to stress the importance of digital databases and other forms of digital infrastructure. The dual use of such infrastructure for research and teaching is important as it ensures that students can receive the best possible training. However, at the same time it is important that the needs of research are not compromised by the excessive use of infrastructure for teaching purposes. Significantly, the relative priorities of research and teaching use were not mentioned in the department's self-evaluation document, and so the panel suggest that these should be discussed more explicitly.

Because the various divisions within the department have very different infrastructure requirements, it would have been beneficial if the panel could have been provided with a more detailed list of the infrastructure and facilities used by each of these divisions, as well as a strategic plan to facilitate future growth. It is recommended that this information be provided for future research reviews.

3. Strategies and organisation

a. Goals for development 5–10 years ahead

The department is right to try to strike a balance between consolidating its existing research groups and finding new themes and approaches. As noted, one real goal for the next decade will be to build up a very strong impact for the Geodesy group in Sweden, linked also of course to international developments. It is important to attempt to do this along with the other geospatial research groups across the ABE School if the initiative really hopes to succeed.

b. Congruence with university-level goals

In general, KTH's culture seems to be creating organisational issues that, to some extent, are overshadowing efforts regarding the search for external research funding and are even impacting substantively on research activities themselves. It feels as if too much effort is going towards management and administration, which creates a more negative situation for research and teaching. Therefore, it could be a good idea to investigate alternative administrative structures within KTH, including carrying out a comparison with other national and international universities.

A stated mission on the KTH website 'is to perform research, educate and share knowledge … Our aim is to find smart solutions to today's and tomorrow's challenges.' That implies the expectation of an impact on society beyond academia. KTH's aspiration to be world-leading in research however still tends to be conceived within the academic context, slightly forgetting Swedish legislation on universities includes the need to contribute to society. This 'third responsibility,' alongside teaching and research, is therefore to interact and implement the results of the university's research as much as possible in societal terms, and hence the department needs to embrace this wholeheartedly.

KTH has a good solid focus on research impact, and this aim is clearly articulated in many areas of problem-solving research that also go beyond simply the technical consideration. And there does appear to be good progress in areas related to sustainability and alignment with national and global programmes. University-wide efforts towards diversity among research staff are clearly articulated and integrated in almost every part of the Department of Real Estate and Construction Management. That said, the panel got the real sense that KTH's organisational structure in regards to the balance between teaching and research, and the workings of its internal financial system, seem be to limiting recruitment and growth, as well as stifling cross-, trans-, and multi-disciplinary research opportunities – with these problems then being felt at departmental level.

c. Leadership structure and collegial structure

There are also general issues across the Department of Real Estate and Construction Management that again reflect some of the organisational issues flagged above. For instance, there is evidence of greater collaboration internationally by researchers in the department, yet there does not seem to be the same commitment or success in linking internally across the research groups within the ABE School. And the dependence on finding external funding to support faculty staff recruitment and PhD students is greatly diminishing the opportunities for growth in the Department of Real Estate and Construction Management, as in the other departments with small research teams. It is a situation that leaders/managers at departmental, school and institutional levels need to get together to work out ways to resolve.

d. Strategies for achieving high quality

As mentioned, the department should appoint a Director of Research, with the key goals of improving the impact of research, increasing funding, and enhancing stakeholder engagement. Internal research funds should be used strategically to unlock further external funds rather than being used to fund research directly. The nexus between teaching load and research funding should be broken so that research excellence can be pursued by faculty staff as an important goal itself.

The identification by the department of Open Access (OA) publication is interesting. However, a clear strategy to increase the number of OA publications would be necessary and this was not articulated in the documents provided to the panel. It may be beneficial to create a dedicated fund for OA publishing, yet it should also be stressed that not all OA publications are equal. Publications should only be submitted to reputable OA journals, avoiding predatory and other inappropriate journals.

4. Interaction between research and teaching

a. Interaction between research and teaching at all three levels (B.Sc., M.Sc., Ph.D.) of education

The panel was disappointed that the text in section 5a of the department's self-evaluation document seemed somewhat generic. What is written about the links between research and teaching appears to be the minimum that would be expected of an internationally significant university, and it would have been good to be told about some more creative activities. It is possible to include Bachelor's students directly in research work through targeted programs and summer internships. Such activities enrich undergraduate experience, provide further context to support ongoing studies, and could also increase the research capacity within the department. Additionally, the provision of vacation internships/scholarships can also provide easy access for stakeholders (especially industry) to work with students and identify potential candidates for their future staffing needs. This improves student outcomes and would only further enhance KTH's reputation and external engagement.

5. Impact and engagement in society

a. Relevance, scale, and impact of the department's current engagement with society and industry

There are many instances of research that engages with society and industry in the Department of Real Estate and Construction Management, with the Sustainable Finance Lab being perhaps the most promising in terms of its potential scope and indeed international impact. To help to push forward this side of research, the department need to develop models for research vision and research leadership that will steadily help researchers to embark on more ambitious, longer-term projects – connecting for example with SEED and the Department of Urban Planning and Environment, etc.

b. Research dissemination beyond academia

The research dissemination activities as articulated in the department self-evaluation document are fine and fairly standard throughout the sector. What is lacking is a clear statement about the impact of these activities: related to this is a lack of any metrics associated with the activities. Without clear metrics it is difficult to judge the return on investment of these activities, and whether the Department of Real Estate and Construction Management should be focussing on these or other activities that could disseminate its research more broadly.

In terms of potential markets, there is a demand from developers, consultants, municipalities, and others to adapt land legislation and contractual economic regulations to the fast development of digital tools for planning, design, and construction management. The same goes for managing existing

infrastructure. KTH's landlord, Akademiska hus, is for instance creating a digital twin in Campus Örebro that it could be very interesting to follow in this regard. While these actors in the development and management of the built environment are involved in a lot of digitalization experiments, it could be fertile to extend this to the Department of Real Estate and Construction Management as well as other departments in the ABE School.

c. Relation to sustainability and the United Nations' Sustainable Development Goals (SDGs)

The department's alignment to the UN's Sustainable Development Goals (SDGs) is very important and is well articulated in its self-evaluation report. It is clearly a strong theme that rightly permeates much of the department's research activities, although, again, a greater focus on explaining their impact and outcomes would have been appreciated.

When the research focus is on the long-term functions and economics of investment decisions, looking especially at the status of those decisions, then the approach shown by the department's staff is almost always in line with the SDG's. However, examinations of the legal, contractual, and common organizational structures of investors does not always support that perspective. Both in the domains of Real Estate and Construction Management, the most fertile impact that could be achieved by the department would be to look into the structural organizational pitfalls that should be avoided.

d. Plans and structure for increased impact

The department's plan to increase research impact is relatively good, but without a dedicated individual or team that can focus on research innovation then the strategic coordination required to achieve these goals is difficult to achieve. The identification of the use of Altmetric is welcome, although it should be noted that this is by now a fairly mature tool for measuring non-traditional engagement (for example through Facebook, Twitter etc). To test this out, it would be useful for the Department of Real Estate and Construction Management to identify some highly rated Altmetric outputs they already have.

The suggestion above for a Research Coordinator is one way to equip the department with a platform to communicate their research contribution to the society, and a more holistic 'story' about the built environment can gain more contribution from the ABE School and KTH centrally. Thus the aim should be to create this research story together with other departments, and actors out in the field, and spread this out to develop an increased interest among students at all three levels and an increased demand for more ground-breaking, basic research.

6. Recommendations for strengthening the department and its future potential

There are several important steps that should be taken to unlock the existing capability in the department, and to grow future potential:

- Develop a strategic plan for increase research impact to help the department achieve its ambitious and important goals.

- To facilitate such a plan, a dedicated head of research and innovation should be appointed.

- Provide internal funds that are focussed on activities that will earn additional external funding, such as by targeting significant new research infrastructure, providing seed-funding for targeted research activities, providing leveraging funds (i.e., co-funding where some 'skin in the game' can unlock further external investment), offering visiting positions, apaying for Open Access publication fees, etc.

- Strategically align future appointments to research growth while ensuring also to improve diversity and internationalisation in the staffing profile.

- Given that high teaching loads have been identified as a problem for faculty staff, consideration should be given to the appointment of teaching specialists to unlock research capacity in others.

- Try to attract young scientists by creating tenure-track positions that commence as research only, and transition later into more conventional teaching and research positions. Such positions have been found to be very attractive to ambitious academics, and faculty staff that are able to use the opportunities of such positions are typically well placed to continue attracting external funding.

7. Final remarks

In addition, state if the panel lacked any material relevant to making adequate observations and recommendations.

The Department of Real Estate and Construction Management is academically diverse. Size-wise, it is relatively small and so has capacity to grow and increase the impact of its research. Overall, it appears that the department has already identified the need to strategically increase its staffing level, with a welcome focus on improving the diversity and international profile of its workforce.

Unfortunately, it does not appear that the department has someone to head its research and innovation, and without such a role there will likely always be a lack of integration and focus.

The self-evaluation document and other items provided highlighted some important and potentially impactful outcomes, but unfortunately the full impact of these outcomes was not well articulated, and this is an issue more broadly. The department should thus work harder at trying to identify, articulate and improve the impact of its research activities. This includes increasing the number and quality of publications, along with more research engagements, committee memberships, media appearances and so on.

In terms of the connection between research and teaching, there appears to be untapped potential in the research potential of the undergraduate student cohort. By creating research projects for high-performing undergraduates – for example through internships and vacation scholarships – new stakeholder engagement opportunities can arise, and students will more quickly appreciate the connections between their learning activities and 'real-world' needs. It would also make the department's students more employable.

Overall, the Department of Real Estate and Construction Management has capacity for, and is well poised for, future growth and impact. A clearer strategic plan, coordinated by an individual or team empowered to action such a plan, will ensure the department improves its international standing, meets stakeholder needs, engages more widely, and continues its growth sustainably.