Research Assessment Exercise 2020
Panel 6 - Engineering
Panel-specific Guidelines on
Assessment Criteria and Working Methods
(September 2018)

Content:

Introduction

1. This document sets out the assessment criteria and working methods that the Engineering Panel of the Research Assessment Exercise (RAE) 2020 will apply. It should be read alongside the General Panel Guidelines of the exercise. The provisions set out in this document serve as further elaboration and amplification on the assessment criteria and working methods as applied to the Engineering Panel. In areas where no additional information has been specified, the provisions in the General Panel Guidelines will prevail and apply in the assessment process of the Panel. These guidelines do not replace or supersede the requirements for submissions that are set out in the Guidance Notes for the RAE 2020.

2. This document describes the criteria and methods for assessing submissions in the Engineering Panel. It provides guidance on the type of information required in the submissions. It also provides a single, consistent set of criteria that will be applied by the Panel and sub-group(s)/sub-panel(s), if any, when undertaking the assessment having regard to any differences in the nature of disciplines of respective units of assessment (UoAs) under purview. It also provides a common approach to the working methods applied within the Panel.

Section A: Submissions

UoAs under the Panel

3. The Engineering Panel will assess universities' submissions from the following UoAs –

Code	UoAs
14	mechanical engineering, production engineering (incl. manufacturing & industrial engineering), textile technology and aerospace engineering
15	chemical engineering, biomedical engineering, other technologies (incl. environmental engineering & nautical studies) and marine engineering

4. The Panel expects to receive submissions whose primary research focus falls within the respective remit of the above UoAs. The UoAs under the Panel's remit cover the full spectrum of basic and applied engineering in the areas of mechanical, production (including manufacturing, industrial and systems), chemical, marine and biomedical engineering, textile and other related technologies such as environmental engineering and nautical studies. Topics may include, but are not limited to: acoustics; aerodynamics; automotive engineering; avionics; biochemical and biomedical engineering; computational methods; control; robotics; automation; dynamics; engineering design; engineering management and logistics; environmental engineering (particularly water purification and waste treatment, and air pollution generation and reduction at source); failure analysis; food process engineering; fluid power; fluid mechanics; fluidics; fuel technology and energy engineering; heat transfer; manufacturing technology, processes and systems; materials (particularly processing, forming, structural design and mechanical application of materials); maritime engineering; mechanics; mechatronics; naval architecture; product design; product and process engineering; solid mechanics; sustainable engineering; thermodynamics; turbo-machinery and propulsion; and vibration. It also includes pedagogic research in mechanical, production, chemical, marine and biomedical engineering, textile and other related technologies such as environmental engineering and nautical studies.

Inter-disciplinary Research

5. The Panel also recognises that individual UoAs do not have firm or rigidly definable boundaries, and that certain aspects of research are naturally inter-disciplinary or span the boundaries between individual UoAs, whether within the Panel or across panels. The Panel will adopt the arrangements for assessing inter-disciplinary submissions as set out in paragraphs 39-40 of the General Panel Guidelines.

6. Areas of inter-disciplinary research that are relevant to the Panel include biomedical, energy and environmental engineering, optimisation and materials science and technology.

Assignment of Eligible Academic Staff in Each UoA

7. Pursuant to paragraphs 7-11 of the General Panel Guidelines, the Engineering Panel expects to receive information on any sub-discipline(s) under a research area that each eligible staff member and respective research output(s) belong to. With reference to the list of sub-disciplines below, each eligible staff member could have up to four sub-disciplines applied, or the number of sub-discipline(s) equivalent to the number of his/her submitted output(s), whichever is lower. An output could have one sub-discipline applied, which must be one of the staff member's sub-discipline(s).

List of Sub-disciplines

Research Areas		Sub-disciplines	
14a	mechanical engineering	14a-01	solid mechanics and engineering materials
		14a-02	thermal fluids
		14a-03	robotics, dynamics, acoustics and control
		14a-04	engineering design
14b	production engineering (incl. manufacturing & industrial engineering)	14b-01	manufacturing technology
		14b-02	manufacturing system
		14b-03	industrial and systems engineering
		14b-04	engineering management and logistics
14c	textile technology	14c-01	textile technology
15a	chemical engineering	15a-01	process engineering
		15a-02	kinetics and transport processes

Research Areas		Sub-disciplines	
15b	marine engineering	15b-01	marine engineering
15c	other technologies (incl. environmental engineering & nautical studies)	15c-01	energy storage
		15c-02	energy production
		15c-03	water and waste treatment
		15c-04	air pollution control
15d	biomedical engineering	15d-01	biomechanics, biomaterials and tissue engineering
		15d-02	imaging systems and devices
		15d-03	biomedical sensors and analysis

8. It is critical that research outputs are assessed by the most appropriate panel. If a panel suspects any anomaly regarding universities' assignment of eligible academic staff (and therefore their outputs) to research area(s) and UoA(s) under its remit, it will follow the procedures for re-assignment of the eligible staff according to paragraphs 10-11 of the General Panel Guidelines. The Panel also recognises its responsibility to handle submissions arising from any re-assignment of eligible academic staff to the Panel.

University's Research Strategy Statement

9. Following paragraphs 2.16-2.18 and Appendix B of the Guidance Notes and paragraph 15 of the General Panel Guidelines, the Research Strategy Statement submitted by each university will provide contextual information for the Panel when assessing the submissions. These Statements will not be assessed, but may help the Panel to understand better the material that is presented in each submission, particularly insofar as UoAs refer to the overall position of their university. The Statements will also help the University Grants Committee (UGC) when viewing the quality profiles of the universities as a whole upon completion of the RAE 2020.

10. *(Template paragraph deleted)*

Section B: Assessment Criteria: Research Outputs

Output Types

11. The Engineering Panel will consider the eligibility of research outputs as described in paragraphs 16-18 of the General Panel Guidelines, paragraphs 5.7-5.11 and Appendix F of the Guidance Notes.

12. The Panel will assess the quality of each eligible output on its own merits and not in terms of its publication category, medium or language of publication. The Panel will examine each item in detail and will not assess outputs mechanistically according to the publication venue. The Panel recognises that there can be work of the highest quality in various output forms, and no distinction will be made between types of output submitted nor whether the output has been made available electronically or in a physical form.

13. Forms of research outputs that are admissible and specifically relevant to the Engineering Panel include the following examples. This should not be regarded as an exhaustive list. Equally, there is no implication of priority or importance in the ordering of examples in this list –

- books, book chapters and research monographs
- peer-reviewed conference papers
- patents awarded or published patent applications
- published papers in peer-reviewed journals
- review articles where these incorporate new research, or new hypotheses
- standards documents.

14. Research outputs will be assessed for the quality of original research they include. The Panel will accept the submission of books, review articles and standards documents only where they contain a significant component of unpublished research or new insight which, as specified in paragraph 18 of the General Panel Guidelines, is identified in the accompanying abstract or added at the end of the abstract in no more than 100 words. Such outputs will be judged only on their original research or novelty of insight. That said, the Panel recognises that the process of peer review entails careful refereeing of papers submitted to academic publishing outlets.

15. The Panel will consider subsequent editions of previous work only where they include new research, which should be detailed in the accompanying abstract or added at the end of the abstract, as specified in paragraph 18 of the General Panel Guidelines, in no more than 100 words.

Double-weighting of Research Outputs

16. Paragraphs 29-31 of the General Panel Guidelines indicate that in exceptional cases a submitting university may request that outputs of extended scale and scope be double-weighted in the assessment. The Panel recognises that there may be outputs of such scale and scope and will consider the items submitted for double-weighting in line with the General Panel Guidelines.

17. When requesting for double-weighting of an output, universities should submit a statement in not more than 100 words, explaining in what ways the output is of sufficiently extended scale and scope to justify the claim. The Panel will decide whether to double-weight the output on the basis of quantity and significance of original work.

Co-authored/Co-produced Outputs

18. The Panel affirms the principles and arrangements on assessing co-authored/co-produced research outputs as set out in paragraphs 32-34 of the General Panel Guidelines.

19. The Panel will consider co-authorship to be a normal element of research activity in its UoAs and expect all named co-authors to have made a significant contribution to the research process leading to the output concerned. Where there are more than six co-authors and where neither the first, last nor corresponding co-authors are a part of the submission, the Panel requires a statement of no more than 100 words outlining the significant contribution of the researchers who are a part of the submission. In assessing co-authored outputs, the Panel will give particular consideration to the contribution of those co-authors who are a part of the submission.

Non-traditional Outputs

20. The Panel considers it unlikely that research outputs in non-traditional form will be submitted, but should they be submitted they will be considered according to paragraphs 35-37 of the General Panel Guidelines.

Criteria and Quality Levels for Assessing Research Outputs

21. Panel members will use their professional judgement with reference to international standards in assessing research outputs.

22. In assessing outputs, the Panel will look for evidence of originality, significance and rigour, and will grade each output into one of the five categories of quality level as set out in paragraph 19 of the General Panel Guidelines. The generic description of the quality levels as set out in paragraph 20 of the General Panel Guidelines will be applied in the Panel's assessment.

23. The Engineering Panel provides the following amplifications on the criteria of assessing research outputs –

- originality: will be understood as the extent to which the output introduces a new way of thinking about a subject.
- significance: will be understood as the extent to which the output has exerted, or has the potential to exert, an influence on the academic field.
- rigour: will be understood in terms of the intellectual precision, robustness and appropriateness of the concepts and methodologies deployed within the output.

24. In addition, the Panel provides the following advice on their understanding of the quality definitions adopted for assessing research outputs –

The Panel will take into consideration the following characteristics in particular –

- scientific rigour and excellence with regard to the design, research method, execution and analysis of the work.
- whether or not the output has been subject to peer-review.
- significant addition to knowledge and to the conceptual framework of the field.
- potential and actual significance of the research both within and beyond the field concerned.
- the scale, challenge and logistical difficulty posed by the research.
- the logical coherence of argument.
- contribution to theory-building.
- significance of work to advance knowledge, skills, understanding and scholarship in theory, practice, education, management and/or policy.

Metrics/Citation Data

25. Pursuant to paragraph 24 of the General Panel Guidelines, the Panel acknowledges that metrics and citation data may serve as advisory or secondary information, and that they should not be used in any algorithmic or deterministic way for the evaluation of research quality.

26. While the Engineering Panel will examine each output in detail for the assessment, the Panel may informally use metrics or citation data by referring to discipline related metrics and citation data to inform its assessment of individual items. However, such metrics and data will not be used in any algorithmic or deterministic way for the evaluation of research quality. The Panel is aware of the limitations of citation data, in particular their variability within as well as between disciplines, and the need to consider that some excellent work takes time to demonstrate its full achievements.

Additional Information on Research Outputs

27. Other than the information required on research outputs as specified in the Guidance Notes, and unless specifically required by the Panel during the assessment process, no other information should be provided, and the Panel will take no account of any such information if submitted.

Section C: Assessment Criteria: Research Impact

Range of Impacts

28. The Engineering Panel will accept submissions on research impacts that meet the generic definition and criteria as set out in paragraphs 47-48 of the General Panel Guidelines.

29. The Panel will assess the quality of all eligible impact submissions based on their merits on equal footing with no consideration given to the differences among submitting universities/units in terms of staff size, resources and histories. The Panel recognises that impacts within its remit can be manifested in various ways and may occur in a wide range of spheres whether locally, regionally or internationally.

30. Examples are provided to illustrate the range of potential impacts from research across the Engineering Panel in Table A. These examples

are indicative only, and are not exhaustive or exclusive. Equally, there is no implication of priority or importance in the ordering of examples in the list.

31. Universities are expected to submit their strongest impact cases and not to align submitted cases specifically with the particular types of impact listed, as an impact case may describe more than one type of impact.

Table A: Examples of Impact

Economic impacts Impacts where the beneficiaries may include businesses, either new or established, or other types of organisation which undertake activity that may create wealth	• The performance of an existing business has been improved through the introduction of new, or the improvement of existing, products, processes or services; the adoption of new, updated or enhanced technical standards and/or protocols; or the enhancement of strategy, operations or management practices. • A spin-out or new business has been created, established its viability, or generated revenue or profits. • A new business sector or activity has been created. • A business or sector has adopted a new or significantly changed technology or process, including through acquisition and/or joint venture. • Performance has been improved, or new or changed technologies or processes adopted, in companies or other organisations through highly skilled people having taken up specialist roles that draw on their research, or through the provision of consultancy or training that draws on their research. • Potential future losses have been mitigated by improved methods of risk assessment and management in safety or security critical situations.

Impacts on public policy and services Impacts where the beneficiaries may include government, non-governmental organisations (NGOs), charities and public sector organisations and society, either as a whole or groups of individuals in society	• A policy has been implemented (including those realised through changes to legislation) or the delivery of a public service has changed. • (Sections of) the public have benefited from public service improvements. • In delivering a public service, a new technology or process has been adopted or an existing technology or process improved. • Policy debate has been stimulated or informed by research evidence. • Policy decisions or changes to legislation, regulations or guidelines have been informed by research evidence. • Changes to education or the school curriculum have been informed by research. • Risks to the security of nation states have been reduced. • The development of policies and services of benefit to the international community has been informed by research.
Impacts on society, culture and creativity Impacts where the beneficiaries may include individuals, groups of individuals, organisations or communities whose knowledge, behaviours, creative practices and other activity have been influenced	• Public discourse has been stimulated or informed by research. • Public interest and engagement in science and engineering has been stimulated, including through the enhancement of science and engineering-related education in schools. • The awareness, attitudes or understanding of (sections of) the public have been informed, and their ability to make informed decisions on issues improved, by engaging them with research. • The work of an NGO, charitable or other organisation has been influenced by the research. • Research has contributed to community regeneration.

Health impacts Impacts where the beneficiaries may include individuals (including groups of individuals) whose health outcomes have been improved or whose quality of life has been enhanced (or potential harm mitigated) through the application of enhanced healthcare for individuals or public health activities	• A new drug, treatment or therapy, diagnostic or medical technology has been developed, trialled with patients, or adopted. • Patient health outcomes have improved through, for example, the availability of new drug, treatment or therapy, diagnostic or medical technology, changes to patient care practices, or changes to clinical or healthcare guidelines. • Public health and quality of life has been enhanced through, for example, enhanced public awareness of a health risk, enhanced disease prevention or, in developing countries, improved water quality or access to healthcare. • Decisions by a health service or regulatory authority have been informed by research. • The costs of treatment or healthcare have reduced. • Quality of life has been improved by new products or processes.
Impacts on practitioners and professional services Impacts where beneficiaries may include organisations or individuals involved in the development of and delivery of professional services	• Changes to professional standards, guidelines or training have been informed by research. • Practitioners/professionals/lawyers have used research findings in the conduct of their work. • The quality or efficiency or productivity of a professional service has improved. • Professional bodies and learned societies have used research to define best practice. • Practices have changed, or new or improved processes have been adopted, in companies or other organisations, through the provision of training or consultancy. • Expert and legal work or forensic methods have been informed by research.

Impacts on the environment Impacts where the key beneficiaries are the natural environment and/or the built environment, together with societies, individuals or groups of individuals who benefit as a result	• The environment has been improved through the introduction of new product(s), process(es) or service(s); the improvement of existing product(s), process(es) or services; or the enhancement of strategy, operations or management practices. • New methods, models, monitoring or techniques have been developed that have led to changes or benefits. • Policy debate on the environment, environmental policy decisions or planning decisions have been stimulated or informed by research and research evidence. • The management or conservation of natural resources, including energy, water and food, has been influenced or changed. • The management of an environmental risk or hazard has changed. • The operations of a business or public service have been changed to achieve environmental (green) objectives including industrial sustainability. • Direct intervention, based on research evidence, has led to reduction in carbon dioxide and / or other environmentally damaging emissions.

(Note: Other examples of research impact as assessed in other jurisdictions may be accessible online such as <http://results.ref.ac.uk/Results/SelectUoa> from the United Kingdom.)

Impact Overview Statement

32. Following paragraphs 7.7 (a) and (b), 7.8 and Appendix G of the Guidance Notes and also paragraph 49 of the General Panel Guidelines, submitting units are required to describe how they have sought to enable and/or facilitate achievement of impact arising from their research during the assessment period, and how they are developing and adapting their plans to ensure that they continue to do so. This is distinct from the

environment overview statement, which should describe how the units support the conduct and production of research.

33. The impact overview statement should include relevant illustrative explanations with examples and traceable references where possible, rather than broad, general statements. The Panel expects the impact overview statement to include –

- context: main non-academic user groups, beneficiaries or audiences for the unit's research; main types of impacts specifically relevant to the unit's research, and how these relate to the range of research activities or research groups in the unit.
- approach to impact: the unit's approach to interacting with non-academic users, beneficiaries, or audiences; its approach and mechanism to support the achievement of impacts from its research; this could include but is not limited to indicators such as participation in knowledge exchange schemes; industrial training provided or consultancy undertaken.
- strategy and plans: how the unit is developing a strategy for achieving impact including its goals and plans for supporting and enabling impact from its current and future research.
- relationship to the case studies: how the selected case studies relate to the submitting unit's approach to achieving impact; how particular case studies exemplify aspects of the unit's approach or informed the development of the unit's approach; moreover, the Panel recognises that impact case studies are underpinned by research over a period longer than the assessment period, and that individual case studies may not directly relate to or necessarily arise from the unit's current approach.

Impact Case Study(ies)

34. Following paragraphs 7.7 (c) and (d), 7.9-7.10 and Appendix H of the Guidance Notes and also paragraph 51 of the General Panel Guidelines, submitting units are required to provide a narrative account in each case study that should be coherent, clearly explaining the relationship between the research and impact, and the nature of the changes or benefits arising.

35. Each impact case study should include appropriate evidence and indicators that support the claims for the impact achieved, including who

and what has/have benefitted. Individual case studies may draw on various corroborative evidence and indicators, which may take different forms depending on the type of impact.

36. Examples are provided in Table B to illustrate potential evidence or indicators that may be mostly relevant to the Engineering Panel. These examples are not intended to be exhaustive. Equally, there is no implication of priority or importance in the ordering of examples in the list.

Table B: Examples of Evidence or Indicators for Impact

Economic impacts	• Business performance measures, for example, sales, turnover, profits or employment associated with new or improved products, processes or services. • Licences awarded and brought to market. Licensing income. • Jobs created or protected. • Investment funding raised from government and/or non-government agencies (venture capital/Business Angel, and so on) for start-up businesses and new activities of existing businesses. • Evidence of critical impact on particular projects, products and processes confirmed by independent authoritative evidence, which should be financial where possible. • Priority shifts in expenditure profiles or quantifiable reallocation of corporate, non-profit or public budgets.
Impacts on public policy and services	• Documented evidence of policy debate (for example, in Legislative Council, the media, material produced by NGOs). • Documented evidence of changes to public policy/legislation/regulations/ guidelines.

	• Measures of improved public services, including, where appropriate, quantitative information; such information may relate for example to the quality, accessibility or cost-effectiveness of public services. • Documented evidence of changes to international development policies. • Measures of improved international welfare or inclusion.
Impacts on society, culture and creativity	• Visitor or audience numbers and feedback. • Critical reviews in the media and/or other professional publications. • Evidence of public debate in the media or other fora. • Evidence of sustained and ongoing engagement with a group. • Measures of increased attainment and/or measures of improved public understanding of science and technology.
Health impacts	• Evidence from clinical trials. • Measures of improved patient outcomes, public health or health services. • Documented changes to clinical guidelines. • Evidence of take-up and use of new or improved products and processes that improve quality of life.
Impacts on practitioners and professional services	• Traceable reference to inclusion of research in national or international industry standards or authoritative guidance. • Traceable references by practitioners to research papers that describe their use and the impact of the research.

	• New or modified professional standards and codes of practice. • New or modified technical standards or protocols. • Documented changes in knowledge, capability or behaviours of individuals benefiting from training.
Impacts on the environment	• Sales of new products or improvements in existing products that bring quantifiable environmental benefits. • Traceable impacts on particular projects or processes which bring environmental benefits. • Evidence of generic environmental impact across a sector. • Documented case-specific improvements to environment-related issues. • Traceable reference to inclusion of research into government policy papers, legislation and industry guidance. • Traceable reference to impact of research in planning decision outcomes. • Policy documentation.

(Note: Other examples of evidence or indicators for research impact in other jurisdictions may be accessible online such as <http://results.ref.ac.uk/Results/SelectUoa> from the United Kingdom.)

37. Impact case studies should include the following factors –

- An impact case should cover five main aspects: summary of the impact, underpinning research, references supporting the underpinning claim that the research is of at least 2 star quality (including grants in support of this research), details of the impact (e.g., economic, social, environmental, health, policy, etc.), sources to corroborate the impact.

- Demonstration of reach through the "breadth" of activities, companies, population, environment, etc. positively affected by the underpinning research;
- Demonstration of significance by the "depth" of activities, practice, companies, population, environment, etc. positively affected by the underpinning research;
- Statement on underpinning research could include awards and prizes.
- Individual references to the research could be marked for best quality items.
- Evidence of impact could include authenticated private communication, articles/reports in public media, senior company officials from whom confidential impact details could be obtained, media reports, etc.
- Indicators for impact include verifiable quantitative data on the positive changes brought to economic, social, environmental, health, policy, etc. perspectives.

Underpinning Research

38. The Panel acknowledges the level of quality required for research underpinning impact cases, i.e. equivalent to at least 2 star (2*) or international standing, as stipulated in the General Panel Guidelines. Impact case studies should include appropriate evidence or indicators of the quality of underpinning research, such as details on peer-review funding or prestigious awards received for the underpinning research. Where necessary, the Panel will review the outputs concerned in order to ensure the quality of the research is of at least 2 star (2*).

39. Provided that the Panel is satisfied that the quality threshold has been met, the quality of the underpinning research will not be taken into account in the assessment of the quality of impact. Underpinning research referenced in a case study may also be submitted for assessment under the research output element. The evaluation of the outputs concerned under the impact element is a separate assessment only for assuring the threshold of underpinning research. In this case, the guidance on output types and criteria for assessing research outputs as stipulated in paragraphs 11-15, 21-24 above would apply.

Criteria and Quality Levels for Assessing Research Impact

40. Panels will exercise their expert judgement in assessing the quality of each impact submission, and will not judge in terms of the type of research underpinning the impact cases.

41. In assessing impacts, the Panel will look for evidence of reach and significance, and will grade each impact submission as a whole and give a rating using one or more of the five categories of quality level following paragraphs 53-55 of the General Panel Guidelines. In respect of the Engineering Panel, the criteria of reach and significance will be understood as follows –

- **Reach** is the extent and breadth of the beneficiaries of the impact.
- **Significance** is the degree to which the impact has enabled, enriched, influenced, informed or changed the products, services, performance, practices, policies or understanding of commerce, industry or other organisations, governments, communities or individuals.

42. The Panel will make an overall judgement about the reach and significance of impacts, rather than assessing each criterion separately. The criteria will be applied in the assessment of the research impact regardless of the domain to which the impact relates.

Section D: Assessment Criteria: Research Environment

Research Environment

43. The Engineering Panel will accept submissions on research environment according to paragraphs 57-58 of the General Panel Guidelines. The Panel recognises that excellent research can be undertaken in a wide variety of research structures and environments. The Panel has no pre-formed view of the ideal size or organisational structure for a research environment. As a general principle, evidence of attention to achieving a suitable level of diversity in the make-up of the research environment will be regarded positively. The Panel will assess each submission based on what has been presented in relation to the work of the submitting unit in providing and ensuring a good environment.

44. As a research environment submission may relate to a single coherent faculty and equally to multiple departments, submissions may depict the commonalities and dynamics among faculties and departments within the submitting unit, and define their prime activities, how they operate and their main achievements.

Environment Overview Statement

45. Following paragraphs 9.6 (a) and (b), 9.7 and Appendix I of the Guidance Notes, and also paragraph 59 of the General Panel Guidelines, submitting units are required to describe how they have supported the conduct and production of research. This is distinct from the impact overview statement, which should describe how the units encourage and facilitate the achievement of research impact.

46. Within the terms of the Guidance Notes, the Engineering Panel will expect in particular to see the following in the environment overview statement –

- overview: submission in this part is expected to briefly describe the organisation and structure of the unit, which research groups are covered in the submission and how research is structured across the submitting unit.
- research strategy: evidence of the achievement of strategic aims for research during the assessment period, and details of future strategic aims and goals for research; how these relate to the structure described above; and how they will be taken forward; methods for monitoring attainment of targets; new and developing initiatives not yet producing visible outcomes but of strategic importance; identification of priority developmental areas for the unit, including research topics, funding streams, postgraduate research activity, facilities, staffing, administration and management.
- people: staffing policy and evidence of its effectiveness; how individuals at the beginning of their research careers are being supported and integrated into the research culture of the submitting unit; information on postgraduate recruitment, training and support mechanisms; mechanisms by which standards of research quality and integrity are maintained for example ethics procedures and authorship.
- income: information on research funding portfolio; evidence of successful generation of research income; major and

prestigious grant awards made by external bodies on a competitive basis.

- infrastructure and facilities: provision, access and operation of research infrastructure and facilities, including special equipment, library and online databases, supercomputer, technical support, space and facilities for research groups and research students; information on joint-university or cross-institution shared or collaborative use of research infrastructure.
- collaborations: information on support for and exemplars of research collaborations; mechanisms to promote collaborative research at local and international level; support for inter-disciplinary research collaborations; research collaboration with research users.
- esteem: prestigious/competitive research fellowships held by individual researchers; external prizes and awards in recognition of research achievement.
- contribution to the discipline or research base: exemplars of leadership in the academic community such as advisory board membership; participation in the peer-review process for grants committees or editorial boards.

Environment Data

47. Following paragraphs 9.6 (c) and (d), 9.8 and Appendix J of the Guidance Notes, and also paragraph 60 of the General Panel Guidelines, submitting units are required to provide environment data in conjunction with the environment overview statement. The Panel will consider the environment data within the context of the information provided in the environment overview statement, and within the context of the disciplines concerned.

48. Data on "staff employed by the university proper" including research personnel and technical staff providing research support in full time equivalent (FTE) and "graduates of research postgraduate programmes" will be used to inform the Panel's assessment in relation to "people" (section (3) (i) and (ii)). Data on "on-going research grants/contracts" will be used to inform the Panel's assessment on "income" (section (4)). Additional quantitative data or indicators that are particularly relevant to the Panel are indicated in paragraph 46 above. Such additional information should be submitted within the appropriate section(s) of the environment overview statement.

Criteria and Quality Levels for Assessing Research Environment

49. Panels will exercise their expert judgement in assessing the merits of each environment submission, and will not judge automatically in terms of the scale of research environment concerned.

50. In assessing environment, the Panel will consider research environment in terms of vitality and sustainability, including its contribution to the vitality and sustainability of the wider discipline or research base. The Panel will grade each environment submission with weighting attached to individual aspects as follows –

- strategy – 5%
- people – 10%
- income – 25%
- infrastructure – 25%
- collaboration – 15%
- esteem – 10%
- contribution to the discipline or research base – 10%

The Panel will use one or more of the five categories of quality level as specified in paragraphs 62-64 of the General Panel Guidelines for assessing each aspect within the environment element and by aggregating assessments of individual aspects to form an overall assessment for each environment submission.

51. The Engineering Panel provides the following amplifications to supplement the generic criteria for assessing research environment –

- vitality: the extent to which a unit provides an encouraging and facilitating environment for research, has an effective strategic plan, is engaged with the regional and international research community, is able to attract excellent postgraduate and postdoctoral researchers through a worldwide reputation.
- sustainability: vision for the future and investment in people and infrastructure and, where appropriate for the subject area, the extent to which activity is supported by a portfolio of research funding.

52. The Panel will make an overall judgement about the vitality and sustainability of research environments, rather than assessing each criterion separately.

Section E: Working Methods

Use of Sub-Group(s)/Sub-Panel(s)

53. To facilitate assessment on specific research area(s) under the Engineering Panel, the Panel may choose to form sub-groups to assess such submissions. The final assessment and grading will be decided by the Panel as a whole.

Allocation of Work in the Assessment Process

54. The Convenor, consulting the Deputy Convenor and other panel members, as appropriate, will allocate work to members and, if necessary, impact assessors and/or external reviewers in light of their expertise and workload. In allocating the work, the Convenor will also take into account any potential conflicts of interest of respective panel members and assessors. All panel members will take account of the requirements of the General Panel Guidelines to ensure that the exercise is conducted fairly and equitably.

55. Panel members will examine the submitted outputs in detail, and put forward a recommendation to the Panel for a collective decision on the final grading. To ensure fairness and consistency, each research output will be assessed in detail by at least two members, one of whom should be a non-local member to the extent possible. For UoA(s) which is(are) only housed at one or two local universities, submissions will be assigned to at least one non-local member in order to ensure fair and impartial assessment. Final grading on research outputs will be decided by the Panel as a whole.

56. Subject to conflicts of interest of individual members, the impact and environment submissions will be assessed by panel members and, if formed, impact assessors in the sub-group(s)/sub-panel(s) under the Panel. Final grading of individual submissions will be a collective decision of the Panel.

Cross-Panel Referrals

57. This Panel will follow the procedures in paragraphs 41-43 of the General Panel Guidelines when initiating referrals to other panels and assessing submissions cross-referred by another panel.

58. Generally, research on pedagogy and education issues submitted to this Panel will be assessed by panel members or external reviewers with expertise in pedagogy or cross-referred to Panel 13 – Education.

59. Cross-panel referrals are envisaged in areas such as: biomedical engineering, energy and environmental engineering, and materials science and technology.

External Advice

60. This Panel will follow the procedure in paragraph 66 of the General Panel Guidelines when referral to external reviewers for expert advice becomes necessary for panel assessment. External reviews may be sought in the cases for which members of the Panel do not have the necessary expertise such as outputs in foreign language or niche research work.

Trial Assessment

61. With reference to paragraphs 89-91 of the General Panel Guidelines, the Panel will conduct a trial assessment using a sample of submissions selected from universities' submissions. These sample submissions will be assessed by all members of the Panel. Members will share among themselves any important observations in the assessment to ensure fairness and consistency in the actual assessment. Submissions used for the trial assessment will be assessed afresh during the main assessment period regardless of their assessment results during the trial. The Panel will decide on the sample size after the submissions are received.

Panel Feedback Report

62. With reference to paragraph 71 and Appendices E and F of the General Panel Guidelines, the Panel will provide feedback to the UGC after the assessment process. Non-local panel members will be involved in offering comments for an impressionistic international comparison. The Convenor on behalf of the whole panel will submit the panel feedback report to the UGC by 10 November 2020.