Tertiary Education Commission
Te Amorangi Mātauranga Matua

Performance-Based Research Fund

Engineering, Technology and Architecture panel-specific guidelines 2012 Quality Evaluation

Introduction

The Performance-Based Research Fund (PBRF) 2012 Panels have developed guidelines to assist staff members with the processes of developing and submitting Evidence Portfolios (EPs). These guidelines provide advice on specific areas that relate to the subject areas of Engineering, Technology and Architecture and do not replace or supersede the requirements for EPs that are set out in the *PBRF Quality Evaluation Guidelines 2012*.

The Engineering, Technology and Architecture panel-specific guidelines must be read in conjunction with the *PBRF Quality Evaluation Guidelines 2012*. In areas where the panel-specific guidelines do not provide additional information, this is because the advice provided in the *PBRF Quality Evaluation Guidelines 2012* applies.

The panel will be primarily interested in assessing the quality of the NROs and the staff member's contribution to them, and can also take into account the quality of the outlets through which the research has been published.

Please note that peer review panels assess EPs without reference to Quality Categories gained by staff members from their participation in the 2003 and/or 2006 Quality Evaluations.

Engineering, Technology and Architecture panel-specific guidelines

Description of panel coverage

The Engineering, Technology and Architecture Panel will assess EPs in the subject areas described below. The coverage of the panel is broad, and the descriptions should be considered as a guide only – they are not intended to be exhaustive.

Architecture, design, planning, surveying

This subject area includes:

Architecture and urban design including design, history/theory/criticism, professional practice, construction management, construction technologies, structures and materials, manufacturing processes, sustainability, ecology, communication, urban morphology, and social and human factors.

Urban and regional planning including history/theory/criticism, professional practice, sustainability, ecology, urban morphology, and social and human factors.

Interior architecture/design including spatial and furniture design, history/theory/criticism, professional practice, exhibition, performance, construction management, construction technologies, structures and materials, manufacturing processes, sustainability, communication, social and human factors, and facilities management.

Industrial/product design including design, history/theory/criticism, professional practice, manufacturing processes, sustainability, communication, and social and human factors.

Landscape architecture including design, history/theory/criticism, professional practice, construction technologies, structures and materials, landscape planning and landscape assessment, sustainability, ecology, communication, and social and human factors.

Building economics and management including professional practice, construction management, construction technologies, structures and materials, sustainability, facilities management, and social and human factors.

Building science including design, construction management, construction technologies, structures and management, manufacturing processing, sustainability, ecology, facilities management, and social and human factors.

Surveying and photogrammetry

Engineering and technology

This subject area includes:

Chemical and process/materials engineering including product and process engineering, biomedical and biochemical engineering, biotechnology, food engineering, fuel technology and energy engineering, petroleum, natural gas and mining engineering, environmental engineering, process systems engineering, pedagogic research in chemical engineering, materials engineering, nanotechnology, extractive metallurgy, thermo physical processes, control engineering, and computational methods.

Civil, resource and environmental engineering including construction management, fluid mechanics, hydraulic engineering and hydrology, geotechnical engineering, solid mechanics, computational mechanics, structural engineering and materials, transportation engineering, environmental engineering and resource management, offshore and coastal engineering, earthquake engineering, pavement engineering, natural resources engineering, forestry engineering, fire engineering, systems engineering, urban infrastructure, power generation, natural hazard, mitigation, and computational methods.

Electrical and electronic engineering including communications (mobile, satellite, networks, etc), electronic materials and devices and micro-electronics, electronic systems and circuits, optoelectronics and optical communications systems, multimedia, video and audio processing and coding, signal processing, modelling and estimation, radio frequency, microwave and millimetre wave techniques, control, sensors, mechatronics, robotics and systems engineering, electrical power, machines and drives, computer engineering, power electronics, embedded systems, instrumentation, micro-technology, nano-technology, and computational methods.

Mechanical and production engineering including acoustics, noise and vibration, aerodynamics and aeronautics, energy conversion, biomedical engineering, computational methods, automation, control, control of fluid power and fluidics, dynamics, engineering design, engineering management, hazard engineering, heat transfer, industrial design, manufacturing including manufacturing systems and manufacturing management, materials including polymers and composites, mechatronics, wind engineering, process engineering, product design, solid mechanics, structural integrity, fatigue and failure analysis, thermodynamics and fluid mechanics.

Engineering science including mathematical modelling, computational techniques, thermofluids, probability

and statistics, continuum mechanics, optimization, theoretical fluid mechanics, bio-engineering, and control engineering.

Technology including food technology, production technology, product development, quality systems, and construction technology**.**

Cross-Referrals

The Engineering, Technology and Architecture Panel will cross-refer EPs to other relevant panels or will seek input from specialist advisers where it is appropriate to supplement the range of expertise of panel members.

The membership of peer review panels is designed to enable panels to assess the quality of research in most areas, including those which have a professional or applied outcome. It is recognised, however, that a small number of staff members will have research outputs that require expert advice from outside the scope of the panel membership and/or that may need to be considered by one of the two Expert Advisory Groups.

Expectations for standard of evidence to be supplied

The Research Output component

The Engineering, Technology and Architecture Panel's coverage is broad, and research assessed will range from fundamental scientific research through professional practice-based or industry-linked research to creative work whose outputs may not necessarily be measured in terms of conventional publications. The panel will therefore address greater breadth in the types of research output and related evidence of quality offered by staff members. Key words that the panel will use to assess the research contribution will be *new knowledge, significance, rigour, creativity, innovation* and *impact.*

Quality-assured outputs are preferred as Nominated Research Outputs (NROs). Both quality-assured and non-quality-assured work can be submitted. Staff members completing EPs may wish to indicate in some way the relative ranking a journal may have.

Where an NRO is not quality-assured, or its quality assurance is not through a conventional refereeing process (e.g. journal publications), the onus is on the staff member to provide evidence of its impact. This might include providing reasons why the output represents one of their best research outputs. Examples of such evidence are: size of user community, citations by other research groups, patents, other formal intellectual property underpinning the development, evidence of successful commercialisation, or adoption by industry as new standard practice. The information should be included

in the "Description" field.

This approach is also where the staff member submits creative or innovative outputs in any field covered by the panel, for example:

- designs or design artefacts (e.g. buildings, products, prototypes, software)
- analytical methods, new standards or codes of practice based on a body of research; where the test of quality will be originality; or where the research has resulted in a step change or incremental innovation
- contribution to advancing the relevant field of knowledge
- contribution to policy and practice.

Prizes or other public recognition can be acceptable as peer review of research quality provided the independence of the reviewer(s) and the link to the NRO can be established. Where a staff member submits an exhibition as a research output, examples of quality-assurance criteria include:

- exhibitions in or acquisition by national or international institutions
- inclusion as finalist in national or international design competitions.

Where a design or design artefact (e.g. building, product, or software) is specified as an NRO, and it is said to be quality-assured, the staff member should clearly describe the innovative research contribution embodied in the design or artefact, and the nature of the quality independent assurance process that has taken place. For example, where the research has resulted in a commercial product for a commercial enterprise or firm, the staff member should describe the quality assurance used by the firm to evaluate the research results, note any formal reporting on the outcome of the process, and include supporting statements by the firm. This information should be included in the "Description" field.

(Refer also to the section "Treatment of non-standard, non-quality-assured and jointly produced research outputs").

The Peer Esteem component

In addition to the general Guidelines (Chapter 2, Section D), as evidence of peer esteem the Engineering, Technology and Architecture Panel will consider, for example:

- Invitation to serve on or head up government, business or industry task forces, liaison groups,

commissions of enquiry, review panels, or governance boards, on the basis of the staff member's research expertise.

- Engagement to contribute key innovative design elements to a major project.
- Membership of conference programme committees or editorial panels.
- Industry adoption of an output of the staff member as standard practice, for example, a type of design (engineering or architectural), an analytical method, a textbook, a research-based engineering or architectural standard. This could include recent adoption of outputs produced outside this assessment period.

For the first three items on this list, staff members must include (in the Description field) information on the standing and scope of the conference, project or taskforce etc and the extent of their role and contribution. They should also be able to provide independent evidence of this, if requested.

The Contribution to the Research Environment component

Where a staff member presents evidence of initiatives in founding significant collaborative national or international research centres or consortia, this may be quality-assured through evidence of institutional- or government-support funding achieved, growth in national or international collaborative research activity, or the attraction of a substantial number of researchers (staff members, postdoctoral fellows, students) and, where appropriate, industry sponsorship or membership.

Elaboration of the definition of Research

The following guidance is provided in addition to that in the general Guidelines (Chapter 1, Section D) in respect of research within the coverage of the Engineering, Technology and Architecture Panel.

Research undertaken individually or collectively, leading to the definition or refinement of standards or performance criteria, is an accepted form of research.

Research involving the discovery, development and novel application of analytical techniques is also accepted.

The development of databases of routine engineering, technology or architecture properties or normal practices would not generally be acceptable as research unless there was research involved in producing some particular innovative feature (which should be clearly outlined in the "Description" field).

A research consultancy or series of consultancies that

have involved research into current practice and that establish new policy, paradigms, methods and/or standards which create a landmark and extend the body of knowledge in a given area of professional practice may be acceptable as research.

Client-sponsored research is recognised as an integral component of the engineering, technology and architectural disciplines. Where quality assurance through other researchers is not possible (e.g. through constraints imposed by the client), the fitness for purpose of the research, if independently validated, can sometimes be a valid proxy for demonstrating research quality.

Where the research or inventive activity results in new designs (either as designs or realised design artefacts) or performance works, such outputs should be able to be clearly identified as innovative contributions to an area of design or technology departing from established concepts and practice. Routine production of designs following established concepts would not normally qualify. The aspect of creativity and innovation should be demonstrated through associated factors such as the award of patents, prizes, and/or the successful commercialisation of the design or technology and recorded, as appropriate, in the "Description" field.

Types of research output

The following types of research will be considered in addition to those listed in the general Guidelines (see Types of Research Output, Chapter 2, Section C).

- Attributable design standards or other standards, codes of practice, or design guidelines (where the term 'standard' is restricted to outputs promulgated through an international or national process administered by an authoritative body; the term 'code of practice' refers to a method accepted, promulgated and applied widely within a professional practicing community; and the term 'design guideline' is used to describe a practice identified and recommended by a group of practicing professionals as being a good practice).
- Patents and other similarly protected intellectual property.
- Conference contributions - refereed papers published in proceedings and invited keynote addresses would normally rank ahead of non-refereed papers (especially if not published in proceedings), poster presentations (where not published in proceedings), abstracts (where submitted alone and not as full paper), non-refereed papers and solely oral presentations.
- Designs or design artefacts (e.g. buildings,

prototypes, products or software).

- Editorial contributions in relation to compilations of research publications (for example, introductory chapters).
- Journal articles - refereed articles (particularly in leading international journals in the discipline) will normally rank ahead of a professional journal article under editorial scrutiny, and ahead of non-reviewed articles.
- Curated exhibitions of artefacts and design outputs including contributions to catalogues, curatorial organisation.

For most disciplines covered by the Engineering, Technology and Architecture Panel, a wide range of journals, refereed conference proceedings, and other avenues is available in which to publish and disseminate research outputs.

TEOs should note that all research outputs included in EPs must be consistent with the PBRF Definition of Research, as set out in the general Guidelines, and must be accompanied by evidence as to quality.

Additional advice from expert advisory groups

EPs can be referred to an Expert Advisory Group (EAG) by either a TEO or by the Chair of a peer review panel.

Where an EP has been referred to an EAG and has **at least one** NRO that meets the criteria set out by that EAG, additional advice can be sought. A score and opinion on the EP will be provided back to the peer review panel the EP is assigned to.

The criteria that will determine whether or not the Pacific Research and the Professional and Applied Research EAGs will accept EPs for consideration will be published on the TEC website.

Indications of the minimum quantity of research output expected to be produced during the assessment period

The Engineering, Technology and Architecture Panel views quality as the primary driver in ranking the performance of staff members. The minimum quantity of research would be one output.

Special circumstances

The general Guidelines apply - see Chapter 2 Section F: Dealing with Special Circumstances.

Definitions of Quality Categories

The general Guidelines apply - see the topic: What do the Quality Categories Mean? in Chapter 3 Section A: Panel Assessment: Introduction, and the final three topics of Chapter 3 Section D: Assessing and Scoring the Three Components of an EP – starting with Scoring an EP: Allocating Points for Research Outputs.

Treatment of non-standard, non-quality-assured and jointly produced research outputs

Jointly produced research outputs of whatever form need to be assessed to determine the weighting to be given to the role of the staff member in the work

	concerned, e.g. senior author, researcher, etc. Where the research output assessed is non-standard or non-quality-assured, more reliance will be placed upon the actual or potential downstream impact of the completed work – for example, through its influence on practice and standards in the profession, or through commercial outcomes such as new design paradigms, products, businesses etc. This must, however, have been measured and evidence must be supplied by the staff member. Where there are multiple authors, staff members must ensure that their contribution to the research output is clearly defined in the "My Contribution" section. In cases where co-authors include the same NRO in their EPs, staff members are encouraged to confer about the details of their contributions, to ensure that there is no conflict in the information provided.
Proportions of Nominated Research Outputs (NROs) to be examined[1]	It is intended that the Engineering, Technology and Architecture Panel will examine all NROs in the EPs submitted to it.
Use of specialist advisers	The general Guidelines apply - see the topic: Using a Specialist Adviser in Chapter 3 Section B: Allocating EPs to Panel Members and Obtaining Additional Input.
Elaboration of the descriptor and tie-points for the Research Output (RO) component	The general Guidelines apply - see topics: Scoring the RO component and Scoring an EP: Allocating points for research outputs in Chapter 3 Section C: Assessing and Scoring the Three Components of an EP.
Elaboration of the descriptor and tie-points for the Peer Esteem (PE) component	**The PE component descriptor** The PE component is concerned with recognition of the staff member's research by peers. Indicators of peer esteem include: • Research-related fellowships, prizes, awards, and invitations to share research knowledge at academic and end-user conferences and events. • The ability to attract graduate students or to sponsor students into higher-level research qualifications, positions or opportunities because of their research reputation. • Research-related citations and favourable review. In considering the former, it must be noted that the quantum of citations may be a poor proxy for peer esteem. Some research work may be cited frequently because it is an example of poor

[1] "Examined" is defined as either reading an NRO in full, substantially or sufficiently to make an informed assessment, or (for NROs which by their nature cannot be read) an equivalent level of scrutiny.

research. Consequently, emphasis should be placed on evidence of positive review and citation.

- Participation in editorial boards.
- Participation on relevant degree or professional qualification-accreditation panels.
- Invitation to serve on government, business or industry task forces, commissions of enquiry, review panels, or governance boards, on the basis of the staff member's research esteem in the relevant field.
- Membership of conference programme committees or editorial panels.
- Participation in research funding agency review panels.
- Industry adoption of an output of the staff member as standard practice – for example, a type of design (engineering or architectural), an analytical method, a textbook, a research-based engineering or architectural standard. This can include recent adoption of outputs produced outside this assessment period.

Tie-point 6

This could be reflected by some or all of the following: the receipt of prestigious prizes, or fellowships of leading learned societies/academies or prestigious institutions, or special status with professional or academic societies, editorship or membership of editorial panels or the refereeing of top ranked journals, or awards for research and invited attendance or examinations of PhDs, or presentation at prestigious academic and industry conferences/events, or invitation to serve New Zealand and foreign government ministerial or international taskforces, review panels or commissions of enquiry; or invitation to sit as government or international appointees on governance boards, or invitation to serve on international conference programme committees or editorial review panels, or international adoption of a design, analytical method, textbook, architectural or engineering standard or code of practice deriving from the staff member's research.

Tie-point 4

The EP demonstrates peer esteem by providing evidence of some or all of the following: the receipt of prizes, membership of a professional society or similar with restricted or elected membership or honours or special status with professional or academic societies, editorship or membership of editorial panels or referee of reputable journals within New Zealand or elsewhere, research fellowships of esteemed institutions, reviewing of journal submissions and book proposals,

PhD examination or invitations for keynote addresses for conferences/events that are at a middle level of excellence, or invitation to serve on mid-level national or major local industry taskforces, review panels or commissions of enquiry, or invitation to sit as an institutional member on governance boards, or invitation to serve on national conference programme committees or editorial review panels, or national adoption of a design, analytical method, textbook, architectural or engineering standard or code of practice deriving from the staff member's research.

Tie-point 2

This may be evidenced through attracting awards and invitations to present research to informed audiences, within and possibly beyond the applicant's immediate institution as well as positive reviews and citations, or being asked to referee research outputs, or being invited to serve on institutional or local industry taskforces and review panels, or evidence of membership of a local conference programme committee or editorial panel, or evidence of a research contribution to a new design, analytical method, textbook, architectural or engineering standard or code of practice led by a more senior researcher.

Elaboration of the descriptor and tie-points for the Contribution to the Research Environment (CRE) component

The CRE component descriptor

This is concerned with the contribution to the development of research students, to new and emerging researchers, and to a vital, high-quality research environment. The CRE component has a number of aspects, including:

- Research and disciplinary leadership – such as membership of research teams, and contributions to disciplinary development and debate and public understanding of the discipline.
- Contributions through students and emerging researchers – that is, supporting and mentoring students in achieving postgraduate qualifications and development as researchers.
- Contribution to institutional vitality – that is, supporting the development of research both within and across institutions (e.g. hosting visiting researchers). Attracting research funding may be an important contribution to institutional vitality, quite apart from the amount of the income itself.
- Grant income (the staff member should identify whether this is as principal investigator, how many co-investigators, dollar amounts, funding duration, the funding source, whether competitive, peer-reviewed etc).
- Number of PhD and Masters students being supervised and whether this is as principal or

associate supervisor.

- Number of postdoctoral fellows working under supervision of staff member.
- Directorships of research centres or research groups (stating how many researchers working in centre/group, budget, etc).
- Leading or participating in the establishment of inter-institutional research collaborations, consortia, or research centres – either nationally or internationally.
- Leading or participating in policy development activities that have a national or international impact on the way in which research-investment or research-funding decisions are made by government or private sector agencies.
- Leadership in research commercialisation, spin-off companies and incubators.

Tie-points

The general Guidelines apply - see topic: Scoring an EP: Allocating points for contribution to the research environment in Chapter 3 Section C: Assessing and Scoring the Three Components of an EP.