SENATE BUSINESS COMMITTEE

A meeting of the Senate Business Committee will be held at **12.00 p.m. on Wednesday 13 November 2019** in **Committee Room 2, University Office**.

Rachael Bernard
Academic Registrar
(r.bernard@abdn.ac.uk)

AGENDA

FOR DISCUSSION

1. Approval of the minutes of the meeting held on 11 September 2019 SBC19:20-05

2. Draft Agenda for the meeting of the Senate on 4 December 2018 SBC19:20-06

FOR INFORMATION

3. Dates of meetings in 2019/20

The Committee is invited to note the next dates of the meetings to be held in 2019/20:

Monday 16 December 2019 at 11.00 a.m. in the Court Room
Thursday 20 February 2020 at 10.00 a.m. in Committee Room 2
Tuesday 14 April 2020 at 10.00 a.m. in Committee Room 2

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SBC19:20-05

SENATE BUSINESS COMMITTEE

Minutes of the meeting of 11 September 2019

Present: Karl Leydecker (Chair), Dariya Koleva, Kath Shennan, Marion Campbell, Alison Jenkinson, Ekaterina Pavlovskaia, Alfred Akisanya, Helen Martin, Iain McEwan, Neil Vargesson, Allan Sim, Michelle Pinard and Rachael Bernard (Clerk)

Apologies for absence were received from: Caroline Inglis, Cecilia Wallback, Peter McGeorge, Graeme Nixon, Scott Styles, Amy Bryzgel and Mirela Delibegovic

447. Minutes

447.1 The Committee approved the minutes of the meeting held on 24 April 2019.

447.2 The Committee noted that there will be an update on the revised structure of the Estates Committees (minute 442.3 refers). In addition, it was noted that it was planned to add Senate representation to the Capital Programme Management Committee (CPMC)

447.3 It was confirmed that all vacancies within schools would now be re-advertised on a three-yearly cycle (minute 442.8 refers). The SVP undertook to remind Heads of School of this.

Action: KL

448. Remit and Membership

448.1 In noting the Remit and Membership for 2019/20, the Committee also noted that Operating Board has been renamed to become the Policy and Resources Committee (PaRC)

449. Draft Agenda for the meeting of the Senate on 9 October 2019

449.1 The Committee noted that there would be two additional items on the agenda: an Update on REF and an item on the Declaration on Research Assessment (DORA).

449.2 The Committee approved the draft agenda with the addition of these two items.

450 Review of the Operation of the Senate in 2018/19

450.1 The Committee reflected on the operation of the Senate in 2018/19 and considered whether there may be any ways to further enhance the effectiveness of the Senate.

450.2 It was noted that there would be a review to determine the support for Senate being held at Foresterhill again

450.3 The Committee discussed the current practise of making amendments to papers from the floor of Senate. It was noted that this was causing issues as it was often difficult

for Senate to reach a clear, orderly consensus and thus it was hard to know precisely that had been decided when policies come to be implemented.

450.4 In addition, the Committee observed that the fact that various sub-committees had already met and shaped the proposals being put forward to Senate was being overlooked. It was agreed that, in drafting papers for Senate, authors should be asked to include links to relevant committee minutes and/or make it clear where proposals had already been discussed.

450.5 It was agreed that the importance of Sub-Committee members being able to represent the views of their School should be re-iterated. It was agreed that, where they exist, the role descriptors for committee members should be recirculated.

Action: RB

451. Major Topics for Discussion in 2019/20

451.1 The Committee identified several possible topics for inclusion at Senate during the forthcoming session:

- A discussion of the available online teaching and assessment options open to staff
- A discussion around how the University teaches and assesses to be led by the Vice-Principal (Education). This should inform the various Estates developments.
- Consideration of how to make the Strategy work, and what the various KPIs should be
- Interdisciplinarity

451.2 It was noted that regular updates on REF would be included on the agenda and that there would be discussions around the second phase of development on the Qatar campus.

451.3 The Committee agreed that this list should be included on the agenda for future meetings and added to as appropriate.

452. Honorary Degrees Committee Membership

452.1 Following the responses received to the communications regarding the Senate vacancy on the Honorary Degrees Committee (HDC), the Committee approved that Kate Gillies (HSRU) was nominated to serve on the HDC for a period of four years.

453. Senate Minutes

453.1 The Committee discussed a possible change in practice regarding the format of Senate minutes. It was proposed that the lengthy written minute be replaced by a clear action log to be viewed alongside an indexed recording of the meeting; recordings would be maintained on the website indefinitely.

453.2 The Committee were broadly supportive of the proposal but agreed it should be a 'normal' minute rather than simply an action log. With that amendment it was agreed that the proposal should be taken to Senate for consideration.

454. Senate Elections

454.1 The Committee noted the outcome of the Senate elections conducted at the end of last academic year as detailed below:

The following have been elected to serve on the Senatus Academicus from 01 October 2019 to 30 September 2022 (except where indicated otherwise):

School of Medicine, Medical Sciences & Nutrition

Kate Gillies

School of Psychology

Amelia Hunt
Constanze Hesse
Katharina Schnitzspahn (until 2020)

School of Social Science

Árnar Arnason (until 2020)
Johan Rasanayagam (until 2020)

455. Dates of meetings in 2019/20

455.1 The Committee noted that the next meetings in 2019/20 had been scheduled for:

- Wednesday 6 November 2019 at 10.00 a.m.
- Thursday 19 December 2019 at 10.00 a.m.
- Thursday 20 February 2020 at 10.00 a.m.
- Tuesday 14 April 2020 at 10.00 a.m.

SBC19:20-06

UNIVERSITY OF ABERDEEN

SENATUS ACADEMICUS
Wednesday 4 December 2019

The next meeting of the Senate will be held on **Wednesday 4 December 2019** at **1.00 p.m.** in the **King's Conference Centre**.

A sandwich lunch will be available in the James McKay Hall from 12.30 p.m.

Staff and student members of the University are welcome to attend meetings of the Senate as observers. Those wishing to do so are asked to respect the formal nature of the proceedings and the understanding that no intervention or lobbying will be permitted from non-members who may be invited to leave when items of confidential business are to be considered.

Agenda

1. Approval of Agenda
2. Approval of Minutes of 9 October 2018
3. Update from Principal
4. Report from the University Court

Items for Discussion & Approval

5. Strategy 2040

Items for Discussion to Provide an Academic View

6. Declaration on Research Assessment — Annex A
7. Late Submission of Work Policy
8. Student Population and Budgetary Impact 2019/20

Any Other Items for Discussion

9. Opportunity for Senate members to raise any other items of academic interest for discussion.

Items for Routine Approval or Information

10. Items for Routine Approval

10.1 Report from the University Committee on Teaching & Learning

11. Items for Information

11.1 Report from the University Committee on Teaching & Learning

11.2 Report from the Research Policy Committee

Notes

Formal Business and Questions for the Principal

Any member of Senate wishing an item for routine approval or for information to be brought forward for discussion or to propose an amendment to the Minutes of the last meeting or to put a question to the Principal on general matters is asked to email the Acting Academic Registrar no later than by 5.00 p.m. on Monday 2 December 2019, indicating the reasons for their request.

Annex A

UNIVERSITY OF ABERDEEN

SENATE
(4 December 2019)

RESPONSIBLE USE OF METRICS IN RESEARCH ASSESSMENT

1. PURPOSE OF THE PAPER

This is a paper about the use of responsible metrics in the assessment of research. It provides information on a number of voluntary instruments to which other UK universities have become signatories, and on institutional policies they have adopted to clarify how research metrics are used in decision making around recruitment, probation, promotion, annual review and within the context of preparations for REF2021.

It sets out next steps that the University of Aberdeen may wish to consider, and seeks guidance on which steps to adopt.

2. RECOMMENDED ACTION

This paper is provided **for discussion**, and seeks guidance Senators on next steps to be adopted.

For its part, Research Policy Committee recommended that the University of Aberdeen become institutional signatory to the San Francisco Declaration on Research Assessment (DORA) and that an institutional policy on the responsible use of metrics in research assessment be put in place. The Senior Management considered the issue and agreed with this recommendation.

3. DISCUSSION

BACKGROUND

With the increasing use of bibliometric data and analytic tools to assess research performance of individuals and groups, there has been growing concern about the inappropriate use of such metrics. In the run up to REF2014, a largely metrics based assessment system for research was considered as a successor to the RAE2008. During a consultation exercise undertaken in 2006, the proposal to scrap peer review in favour of a metrics based approach, similar to that undertaken by Australian funding bodies, was rejected by the higher education sector. In 2014, the then Minister for Universities and Science, David Willets, announced the *Independent Review of the Role of Metrics in Research Assessment*, supported by HEFCE. The review, chaired by Professor James Wilsdon, published its final report *The Metric Tide (2015)*, which made a number of recommendations around the responsible use of metrics, including a recommendation that institutions provide "*Clear communication of the rationale for selecting particular indicators, and how they will be used as a management tool...* [and] *consider signing up to DORA, or drawing on its principles and tailoring them to their institutional contexts* ".

The Forum for the Responsible Use of Research Metrics, a group of research funders, sector bodies and infrastructure experts working in partnership to promote the responsible use of metrics was set up in 2016.

In an international context the debate around the responsible use of metrics has brought about a number of voluntary instruments to which institutions can commit to show that they are using metrics in a contextual and responsible way.

SAN FRANCISCO DECLARATION ON RESEARCH ASSESSMENT (DORA)

In 2012, scientists at the Annual Meeting of the American Society for Cell Biology in San Francisco, signed a declaration that commits signatories to assess scholarly and research outputs on the merits of the outputs themselves and not based journal level metrics (such as journal impact factors) or other high level metrics. As of June 2019, DORA had more than 14,000 signatories, including all of the UK research councils, Wellcome Trust, Royal Society, British Academy, Cancer Research UK, British Library, Research Libraries UK (RLUK) and 44 UK institutions. We understand that many UK institutions have signed or are planning to sign the declaration. The full text of the declaration is attached at annex A.

THE LEIDEN MANIFESTO

At the 19th Conference on Science and Technology Indicators in 2014, delegates drew up the Leiden Manifesto which sets out ten principles that should govern the use of metrics in the assessment of research. These go beyond the commitments of DORA, and require, among other things, that quantitative evaluation should support qualitative, expert assessment, and that research should be assessed within the context of the institutional research mission and within the local context in which it occurs. The full text of the 10 principles of the Leiden Manifesto is attached at annex B.

UK SECTOR RESPONSE

For institutions, becoming a signatory to either or both voluntary instruments is a visible commitment to transparent, fair and robust assessment of the quality of research when preparing for REF, and during recruitment, promotions and annual review exercises. The benefits of compliance include a demonstrably transparent and robust approach to quality assessment of research for various purposes; visible compliance with an internationally accepted standard; reduction of unconscious bias when assessing research quality and compliance with funders' and publishers' that require DORA compliance. It is anticipated that, once in force, the new open access regime around Plan S will require institutions to sign up to DORA. Explicitly, the latest Plan S draft includes "*cOAlition S supports the principles of the San Francisco Declaration on Research Assessment (DORA) that research needs to be assessed on its own merits rather than on the basis of the venue in which the research is published. cOAlition S members will implement such principles in their policies by January 2021".*

A number of institutions have become signatories to DORA or the Leiden Manifesto; others have set out the principles that underpin their responsible use of metrics in an institutional policy instead of or in addition to a public commitment to either. Where becoming a signatory constitutes an aspirational statement, an institutional policy referencing DORA and/or Leiden, underpinned by an operational plan that sets out the measures required to achieve compliance indicates intent and direction of travel. The general intention behind this often is to make a visible statement and to strengthen the research environment for REF purposes.

UNIVERSITY OF ABERDEEN

The way in which we assess the quality of research in preparation for REF2021 is governed by our institutional Code of Practice, which operationalises the guidance issued by the funding councils. Court approved our Code of Practice at the end of May 2021. For REF2021, as for its predecessors, the guidance stipulates that reviewers will assess the content of a publication regardless of where and how it has been published.

Paragraph 207 of the REF2021 Panel Criteria and Working Methods states: 'No sub-panel will use journal impact factors or any hierarchy of journals in their assessment of outputs. Not output will be privileged or disadvantaged on the basis of publisher, where it is published or the medium of publication'. Paragraph 386 of the same document states: 'All outputs […] will be examined with a level of detail sufficient to contribute to the formation of a robust sub-profile for all the outputs in that submission'. In some panels, reviewers will be able to take into account output specific research metrics (citation counts, normalised for publication date and discipline) but journal impact factors must not be used in assessment. Our internal practices and guidance to external reviewers reflect this approach. In terms of REF preparations, our institutional approach is DORA and Leiden compliant.

The further particulars for vacancies set out the expectations around performance expected of a new recruit in a number of areas, including research. Although there are references to evidence of research performance including high quality peer reviewed publications they do not specify how we will assess the quality of outputs listed in a publication record.

The criteria for promotion and the process of annual review are clearly set out and accessible to all staff. They take into account a number of elements to represent performance in a variety of areas including research. They take account of progress towards agreed targets in teaching & learning, scholarship, research, knowledge exchange and impact and administration. The quality of published work is one element of overall research performance which in itself is one element of the wider contribution an individual researcher has made.

An explicit reference in the guidance to DORA or Leiden compliant assessment which mirrors the REF guidance of examining an output with a level of detail sufficient to contribute to the formation of a robust quality judgement would send a clear signal of intent. Following signature, a programme of activity would need to be undertaken to demonstrate compliance.

At its meeting of 24th June 2019, the Research Policy Committee considered DORA and agreed that a recommendation to sign DORA should be made to SMT. A number of researchers from the University of Aberdeen are individual signatories to DORA (11 to date).

The Senior Management Team considered the responsible use of metrics and discussed the voluntary instrument. It considered the following options:

- Do nothing at this point – as explained above, we are compliant in REF terms of our internal quality assessment processes, and in our HR processes. However, in view of the fact that DORA and/or Leiden compliance are increasingly seen as industry standards, we would be unable to fully promote our compliance.

- Develop our own policy around the use of metrics, referencing DORA and Leiden as appropriate. A number of institutions have chosen this option because they felt unable to commit to aspects of either DORA or Leiden. Although we would be able to point towards an institutional policy or policies we would be unable to claim full compliance and benefit from being able to promote this for REF and recruitment and retention purposes.

- Become a signatory to either DORA or Leiden and develop our own policy as part of our compliance measures. This would allow us to visibly state compliance with a sector wide standard for recruitment/retention and REF purposes while we work in an institutional policy (to be in place by the time we submit to REF2021).

Implementation for other signatories to DORA took a variety of approaches, with some taking a wide consultation with the academic community and others undertaking consultation during the implementation stages

SMT concluded that the University of Aberdeen should become a signatory to one of the instruments, with a view to develop and implement an institutional policy. On balance, SMT agreed that DORA was the preferred instrument at this stage given it is more embedded in the funders' commitments, has the higher profile and is being championed significantly by individual researchers and institutions alike. This would not preclude us from complying with Leiden at a later stage.

The detailed consideration of the issues, and the development of an institutional policy on the responsible use of research metrics in research assessment is to be taken forward by a short term working group.

RECOMMENDATION:
Senate is invited to approve the following recommendations:

- That the University of Aberdeen become a signatory to DORA

- That a short term working group be set up to develop an institutional policy on the responsible use of metrics in research assessment, recruitment, probation, promotion and annual review, along with an operational plan to implement the policy

4. FURTHER INFORMATION

Further information is available from **Marion Campbell,** Vice Principal Research (m.k.campbell@abdn.ac.uk; ext. 3161), **Simon Bains,** University Librarian, (simon.bains@abdn.ac.uk; ext. 3384) and **Marlis Barraclough,** Senior Policy Advisor, Research & Innovation (m.barraclough@abdn.ac.uk; ext. 3787)

[6th November 2019] [version] [Open]

Previously considered and agreed by	**Date**
Research Policy Committee	24 June 2019
Senior Management Team	21 October 2019

Annex A

San Francisco Declaration on Research Assessment (DORA)

https://sfdora.org

There is a pressing need to improve the ways in which the output of scientific research is evaluated by funding agencies, academic institutions, and other parties. To address this issue, a group of editors and publishers of scholarly journals met during the Annual Meeting of The American Society for Cell Biology (ASCB) in San Francisco, CA, on December 16, 2012. The group developed a set of recommendations, referred to as the San Francisco Declaration on Research Assessment. We invite interested parties across all scientific disciplines to indicate their support by adding their names to this Declaration.

The outputs from scientific research are many and varied, including: research articles reporting new knowledge, data, reagents, and software; intellectual property; and highly trained young scientists. Funding agencies, institutions that employ scientists, and scientists themselves, all have a desire, and need, to assess the quality and impact of scientific outputs. It is thus imperative that scientific output is measured accurately and evaluated wisely.

The Journal Impact Factor is frequently used as the primary parameter with which to compare the scientific output of individuals and institutions. The Journal Impact Factor, as calculated by Thomson Reuters*, was originally created as a tool to help librarians identify journals to purchase, not as a measure of the scientific quality of research in an article. With that in mind, it is critical to understand that the Journal Impact Factor has a number of well-documented deficiencies as a tool for research assessment. These limitations include: A) citation distributions within journals are highly skewed [1–3]; B) the properties of the Journal Impact Factor are field-specific: it is a composite of multiple, highly diverse article types, including primary research papers and reviews [1, 4]; C) Journal Impact Factors can be manipulated (or "gamed") by editorial policy [5]; and D) data used to calculate the Journal Impact Factors are neither transparent nor openly available to the public [4, 6, 7]. Below we make a number of recommendations for improving the way in which the quality of research output is evaluated. Outputs other than research articles will grow in importance in assessing research effectiveness in the future, but the peer-reviewed research paper will remain a central research output that informs research assessment. Our recommendations therefore focus primarily on practices relating to research articles published in peer-reviewed journals but can and should be extended by recognizing additional products, such as datasets, as important research outputs. These recommendations are aimed at funding agencies, academic institutions, journals, organizations that supply metrics, and individual researchers.

A number of themes run through these recommendations:

-- the need to eliminate the use of journal-based metrics, such as Journal Impact Factors, in funding, appointment, and promotion considerations;

-- the need to assess research on its own merits rather than on the basis of the journal in which the research is published; and

-- the need to capitalize on the opportunities provided by online publication (such as relaxing unnecessary limits on the number of words, figures, and references in articles, and exploring new indicators of significance and impact).

We recognize that many funding agencies, institutions, publishers, and researchers are already encouraging improved practices in research assessment. Such steps are beginning to increase the momentum toward more sophisticated and meaningful approaches to research evaluation that can now be built upon and adopted by all of the key constituencies involved.

The signatories of the San Francisco Declaration on Research Assessment support the adoption of the following practices in research assessment.

General Recommendation

1. Do not use journal-based metrics, such as Journal Impact Factors, as a surrogate measure of the quality of individual research articles, to assess an individual scientist's contributions, or in hiring, promotion, or funding decisions.

For funding agencies

2. Be explicit about the criteria used in evaluating the scientific productivity of grant applicants and clearly highlight, especially for early-stage investigators, that the scientific content of a paper is much more important than publication metrics or the identity of the journal in which it was published.

3. For the purposes of research assessment, consider the value and impact of all research outputs (including datasets and software) in addition to research publications, and consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice.

For institutions

4. Be explicit about the criteria used to reach hiring, tenure, and promotion decisions, clearly highlighting, especially for early-stage investigators, that the scientific content of a paper is much more important than publication metrics or the identity of the journal in which it was published.

5. For the purposes of research assessment, consider the value and impact of all research outputs (including datasets and software) in addition to research publications, and consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice.

For publishers

6. Greatly reduce emphasis on the journal impact factor as a promotional tool, ideally by ceasing to promote the impact factor or by presenting the metric in the context of a variety of journal-based metrics (e.g., 5-year impact factor, EigenFactor [8], SCImago [9], h-index, editorial and publication times, etc.) that provide a richer view of journal performance.

7. Make available a range of article-level metrics to encourage a shift toward assessment based on the scientific content of an article rather than publication metrics of the journal in which it was published.

8. Encourage responsible authorship practices and the provision of information about the specific contributions of each author.

9. Whether a journal is open-access or subscription-based, remove all reuse limitations on reference lists in research articles and make them available under the Creative Commons Public Domain Dedication [10].

10. Remove or reduce the constraints on the number of references in research articles, and, where appropriate, mandate the citation of primary literature in favor of reviews in order to give credit to the group(s) who first reported a finding.

For organizations that supply metrics

11. Be open and transparent by providing data and methods used to calculate all metrics.

12. Provide the data under a licence that allows unrestricted reuse, and provide computational access to data, where possible.

13. Be clear that inappropriate manipulation of metrics will not be tolerated; be explicit about what constitutes inappropriate manipulation and what measures will be taken to combat this.

14. Account for the variation in article types (e.g., reviews versus research articles), and in different subject areas when metrics are used, aggregated, or compared.

For researchers

15. When involved in committees making decisions about funding, hiring, tenure, or promotion, make assessments based on scientific content rather than publication metrics.

16. Wherever appropriate, cite primary literature in which observations are first reported rather than reviews in order to give credit where credit is due.

17. Use a range of article metrics and indicators on personal/supporting statements, as evidence of the impact of individual published articles and other research outputs [11].

18. Challenge research assessment practices that rely inappropriately on Journal Impact Factors and promote and teach best practice that focuses on the value and influence of specific research outputs.

References

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*The Journal Impact Factor is now published by Clarivate Analytics.

Annex B

The Leiden Manifesto – full text: https://www.nature.com/news/bibliometrics-the-leiden-manifesto-for-research-metrics-1.17351

Ten principles

1) Quantitative evaluation should support qualitative, expert assessment. Quantitative metrics can challenge bias tendencies in peer review and facilitate deliberation. This should strengthen peer review, because making judgements about colleagues is difficult without a range of relevant information. However, assessors must not be tempted to cede decision-making to the numbers. Indicators must not substitute for informed judgement. Everyone retains responsibility for their assessments.

2) Measure performance against the research missions of the institution, group or researcher. Programme goals should be stated at the start, and the indicators used to evaluate performance should relate clearly to those goals. The choice of indicators, and the ways in which they are used, should take into account the wider socio-economic and cultural contexts. Scientists have diverse research missions. Research that advances the frontiers of academic knowledge differs from research that is focused on delivering solutions to societal problems. Review may be based on merits relevant to policy, industry or the public rather than on academic ideas of excellence. No single evaluation model applies to all contexts.

3) Protect excellence in locally relevant research. In many parts of the world, research excellence is equated with English-language publication. Spanish law, for example, states the desirability of Spanish scholars publishing in high-impact journals. The impact factor is calculated for journals indexed in the US-based and still mostly English-language Web of Science. These biases are particularly problematic in the social sciences and humanities, in which research is more regionally and nationally engaged. Many other fields have a national or regional dimension — for instance, HIV epidemiology in sub-Saharan Africa.

This pluralism and societal relevance tends to be suppressed to create papers of interest to the gatekeepers of high impact: English-language journals. The Spanish sociologists that are highly cited in the Web of Science have worked on abstract models or study US data. Lost is the specificity of sociologists in high-impact Spanish-language papers: topics such as local labour law, family health care for the elderly or immigrant employment[5]. Metrics built on high-quality non-English literature would serve to identify and reward excellence in locally relevant research.

4) Keep data collection and analytical processes open, transparent and simple. The construction of the databases required for evaluation should follow clearly stated rules, set before the research has been completed. This was common practice among the academic and commercial groups that built bibliometric evaluation methodology over several decades. Those groups referenced protocols published in the peer-reviewed literature. This transparency enabled scrutiny. For example, in 2010, public debate on the technical properties of an important indicator used by one of our groups (the Centre for Science and Technology Studies at Leiden University in the Netherlands) led to a revision in the calculation of this indicator[6]. Recent commercial entrants should be held to the same standards; no one should accept a black-box evaluation machine.

Simplicity is a virtue in an indicator because it enhances transparency. But simplistic metrics can distort the record (see principle 7). Evaluators must strive for balance — simple indicators true to the complexity of the research process.

5) Allow those evaluated to verify data and analysis. To ensure data quality, all researchers included in bibliometric studies should be able to check that their outputs have been correctly identified. Everyone directing and managing evaluation processes should assure data accuracy, through self-verification or third-party audit. Universities could implement this in their research information systems and it should be a guiding principle in the selection of providers of these systems. Accurate, high-quality data take time and money to collate and process. Budget for it.

6) Account for variation by field in publication and citation practices. Best practice is to select a suite of possible indicators and allow fields to choose among them. A few years ago, a European group of historians received a relatively low rating in a national peer-review assessment because they wrote books rather than articles in journals indexed by the Web of Science. The historians had the misfortune to be part of a psychology department. Historians and social scientists require books and national-language literature to be included in their publication counts; computer scientists require conference papers be counted.

Citation rates vary by field: top-ranked journals in mathematics have impact factors of around 3; top-ranked journals in cell biology have impact factors of about 30. Normalized indicators are required, and the most robust normalization method is based on percentiles: each paper is weighted on the basis of the percentile to which it belongs in the citation distribution of its field (the top 1%, 10% or 20%, for example). A single highly cited publication slightly improves the position of a university in a ranking that is based on percentile indicators, but may propel the university from the middle to the top of a ranking built on citation averages[7].

7) Base assessment of individual researchers on a qualitative judgement of their portfolio. The older you are, the higher your *h*-index, even in the absence of new papers. The *h*-index varies by field: life scientists top out at 200; physicists at 100 and social scientists at 20–30 (ref. 8). It is database dependent: there are researchers in computer science who have an *h*-index of around 10 in the Web of Science but of 20–30 in Google Scholar[9]. Reading and judging a researcher's work is much more appropriate than relying on one number. Even when comparing large numbers of researchers, an approach that considers more information about an individual's expertise, experience, activities and influence is best.

8) Avoid misplaced concreteness and false precision. Science and technology indicators are prone to conceptual ambiguity and uncertainty and require strong assumptions that are not universally accepted. The meaning of citation counts, for example, has long been debated. Thus, best practice uses multiple indicators to provide a more robust and pluralistic picture. If uncertainty and error can be quantified, for instance using error bars, this information should accompany published indicator values. If this is not possible, indicator producers should at least avoid false precision. For example, the journal impact factor is published to three decimal places to avoid ties. However, given the conceptual ambiguity and random variability of citation counts, it makes no sense to distinguish between journals on the basis of very small impact factor differences. Avoid false precision: only one decimal is warranted.

9) Recognize the systemic effects of assessment and indicators. Indicators change the system through the incentives they establish. These effects should be anticipated. This means that a suite of indicators is always preferable — a single one will invite gaming and goal displacement (in which the measurement becomes the goal). For example, in the 1990s, Australia funded university research using a formula based largely on the number of papers published by an institute. Universities could calculate the 'value' of a paper in a refereed journal; in 2000, it was Aus$800 (around US$480 in 2000) in research funding. Predictably, the number of papers published by Australian researchers went up, but they were in less-cited journals, suggesting that article quality fell[10].

10) Scrutinize indicators regularly and update them. Research missions and the goals of assessment shift and the research system itself co-evolves. Once-useful metrics become inadequate; new ones emerge. Indicator systems have to be reviewed and perhaps modified. Realizing the effects of its simplistic formula, Australia in 2010 introduced its more complex Excellence in Research for Australia initiative, which emphasizes quality.