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International Landscape Study of Research and Innovation Systems

Final report

July 2019

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Summary

This report presents the findings of the International Landscape Study of Research and Innovation Systems, commissioned by Research England and carried out by Technopolis. We have studied the institutional assessment and funding systems for research-performing organisations in 20 research-active countries, with three headline study questions: what research assessment mechanisms are being used? What are the relationships between assessment and funding? How are approaches developed and evaluated?

Research assessment mechanisms

Research assessment can be used either as a basis for distributing institutional research funding based on performance or to provide an evaluation that provides strategic information but is not linked to funding. A significant number of countries distribute some or all institutional funding for research without assessment. The literature on institutional research funding, however, tends to focus on performance-based research funding systems (PRFS), where assessment is used as one basis (sometimes alongside others) for allocating this funding.

Where a PRFS is employed, most countries use it to allocate only a small proportion of institutional funding for research. The outliers are Finland (31%), Belgium (Flanders) (36%) and the UK (52%). But assessment that is not tied to funding is more common and is also in some cases used alongside a PRFS.

Research assessment often involves using peer review, metrics or a combination of the two. Peer review tends to be preferred for larger, occasional exercises and where a feedback process to inform performance supports a forward-looking dimension. Metrics are often used to specify expected performance (input metrics such as the number of PhD candidates to train) or to reward planned performance (output metrics such as the number of PhD graduations). Bibliometric indicators tend to be used in metrics-based PRFS. They are also used in some cases to support peer review. Bibliometric indicators are applied and regarded differently depending on the intended use and discipline being considered. They have been a subject of extended discussion within the academic community and although they are recognised as useful indicators, they are generally not considered a sufficient alternative to peer review. In some countries (particularly in smaller ones), there is a research information system that records all national university publications (and occasionally other types of outputs), thus capturing things that the commercial bibliographic databases do not.

Links between assessment and funding

There are several broad commonalities among most of the 20 countries considered in this study:

- All countries studied have at least elements of a ‘dual support’ system for research,¹ with state-provided institutional research funding for the universities and external research funding agencies
- In most countries, total institutional funding is based on combined consideration of research, teaching and occasionally ‘third mission’ activities. Some consider research and teaching together; others treat them as separate elements within the overall funding process
- Most countries provide institutional research funding that has at least two components, such as a block grant² combined with a performance- or PRFS-based component
- All have a national research council or science foundation, an innovation agency and often other funding associated with a range of ‘sector’ ministries over and beyond the education and industry ministries

¹ The USA is a slight exception in that institutional funding is almost solely provided by individual states

² According to the EUA, block grants are financial grants meant to cover several categories of expenditure such as teaching, ongoing operational costs and/or research. Universities are responsible for dividing and distributing such funding internally according to their needs (the flexibility may be curtailed by minor restrictions) (Estermann, et al., 2013)

Most of the 20 research-active nations considered in this study have a broad range of different approaches to distributing funding for research and innovation. Funding may be distributed via block grants based on input indicators or performance contract targets. Alternatively, formula funding may be used, based on the number of outputs achieved. Or a PRFS may be used. Many countries use a combination of these mechanisms. Some ‘blocks’ of culturally similar countries behave similarly. For example, the ‘Anglosphere’ (excl. USA and Canada) tends towards REF-like PRFS, while Norway, Denmark and Finland base their metrics approaches on a quality-controlled national research information system, capturing quality judgements of national-language publications not appearing in the commercial bibliographic databases.

Evolution, ownership and review

Underpinned by an increased focus on accountability there has been a trend in the growth of both performance-based funding more generally, and of performance evaluation not linked to funding. The use of PRFS (as one type of performance-based funding) has increased in the past but has been stabilising in the countries under consideration.³ PFRS mechanisms generally govern only a small share of institutional funding for research and there is no sign of a general movement towards periodic, large-scale exercises like the REF. In some countries where PFRS been recently introduced, the culture change has been eased by linking it only to increases in institutional funding, leaving the previous block or performance funding in place.

In countries like the Netherlands, Austria and Germany, the large-scale evaluation systems that are not linked to funding tend to be led by the scientific community, while in countries where research assessment drives a PRFS, it tends to be led by funders. The community may play a strong role in the development and delivery of the system as we see in the UK or in the delivery of the Norwegian research information system.

Most evaluation and assessment exercises are periodically reviewed, either by their operators or with the help of external contractors. These reviews often address process improvement rather than raising wider questions about the ‘why’ of the exercise. Major changes to these systems are unusual, with evolution rather than revolution the more typical outcome. The point at which a system is most open to innovation is at the initial design stage. Substantial increases in funding to which a new exercise can be applied without the risk to current recipients makes new approaches more readily accepted.

³ Note, however, that there is growing interest in PRFS in central and East European countries inside and outside the EU that have developed research and higher education systems, as evidenced by activities in the European Commission’s RTI Policy Support Facility

1 Introduction

1.1 Scope and purpose of this study

This report presents the findings from the International Landscape Study of Research and Innovation Systems, commissioned by Research England and carried out by Technopolis. This study commenced in early November 2018 and was completed in late February 2019.

The purpose of this study is to provide an overview and assessment of how different countries approach the assessment of their research and innovation performing organisations and consider how this relates to different funding approaches. The systems considered use a variety of approaches, which include some that are tied to institutional funding and others that are not. Three headline questions and several further sub-questions were set for this study:

- What are the range of assessment approaches deployed by research active nations?
 - What are the measures that are applied by the system?
 - Where multiple measures are used, how are they balanced?
- What is the relationship between a nation's research assessment approach and funding?
 - What is the funding and assessment balance within the system?
 - What is the relationship between those running the assessment system and/or deploying the funding?
- How are the approaches developed and evaluated?
 - Who is responsible for the development and delivery of the research assessment process?
 - Who is engaged in the development of the and delivery of the research assessment process?
 - What is the role of consultation in the development of the research assessment process?
 - How frequently is the assessment system subject to change?
 - Does the system develop incrementally or is radical change a feature?

1.2 Method and comparative approach

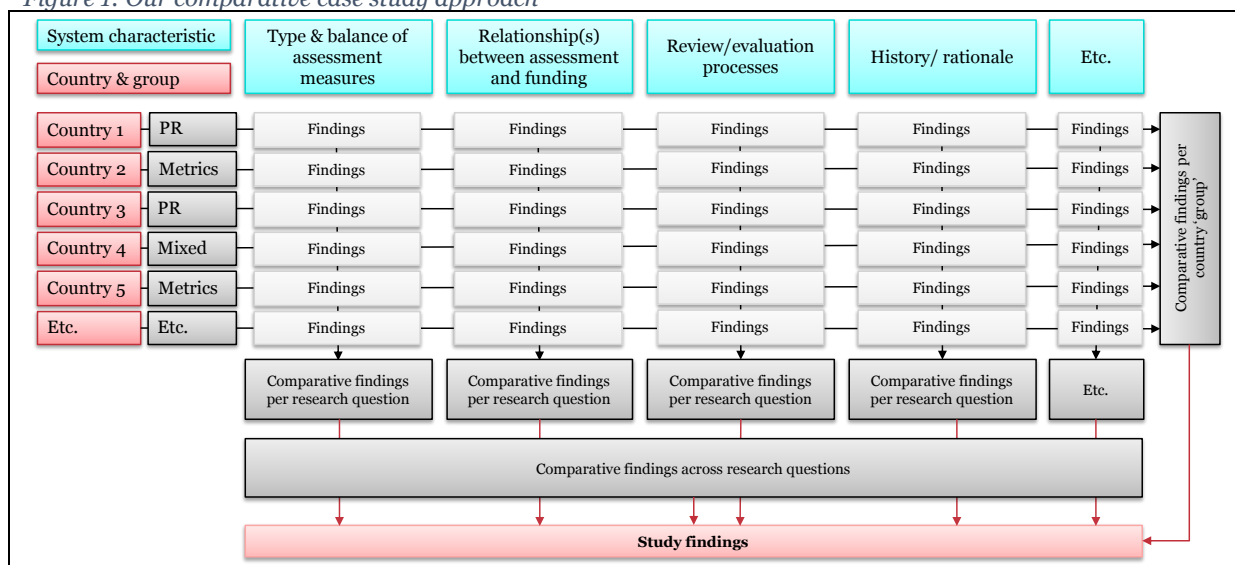
Our comparative case study approach combines a qualitative enquiry, allowing us to identify and describe unique features of each individual case, with the use of a common template building on a set of analytical dimensions and indicators, enabling comparison between them. We draw on three main sources of evidence:

- Existing literature: academic and grey literature, including various studies by the EU's Joint Research Centre (JRC), OECD and others
- Desk research: policy documents and analyses specific to individual countries' funding systems to complement the international literature
- Interviews with relevant individuals in each comparator country to fact-check the findings from the desk research and fill any gaps in documentary evidence.

Completed country templates for each of the 20 countries covered are supplied in a separate annex report.

Our structured country template is enclosed at the end of this report (see Appendix B). It was used in all 20 cases and enables us to consider individual research questions and their sub-components separately, and to draw out typologies and patterns in each one. We illustrate our case-driven comparative approach below (Figure 1).

Figure 1: Our comparative case study approach



1.3 Comparator countries

Our final selection of comparator countries was arrived at in consultation with Research England, but largely reflects our original recommendation. Our central selection criterion was that that comparators needed to be research active nations, i.e. with research and innovation systems broadly comparable to the UK in terms of size (relative to country size) and sophistication. They should also include assessment and funding systems similar to the UK as well as systems that are very different.

There are a few notable additions and omissions: Technopolis’ previous work on performance-based research funding systems (PRFS) has highlighted a number of countries that do not realistically compare to the UK in this way but are known to have funding systems subject to major recent reviews and reforms (e.g. the Czech Republic). Likewise, some countries have strikingly similar systems (e.g. Norway and Denmark), so including both would be unlikely to yield much added value to the study. This has been noted where relevant.

The selected countries make use of a range of approaches to assessing their research performing organisations and their nature and links to funding vary. Some have a PRFS in the strict sense: regular national assessment exercises that distribute at least a part of institutional funding. These are variously based on metrics or on peer review assessing research itself, research environment and in some cases research impact. Others allocate institutional funding based on input-indicators or performance contracts – in such cases, institutional funding is often referred to as ‘block grants’, a term we use to denote that it is not allocated based on performance measurements. In the case of the latter, various evaluative obligations are sometimes included. Formula funding based at least partially on output indicators (of teaching, research or third mission activities) also features. The great majority of countries covered in this report use more than one of the above approaches in combination.

Whilst national institutional assessment exercises as a mechanism for funding allocation (comparable to the UK’s REF) are not especially common, many countries also have institutional assessment and evaluation regimes that are not directly tied to funding allocations. These often add to the wider evidence base for research investment nationally.

Further, different countries have different levels of institutional diversity: in some, universities are far and above the main public R&D actors; in others, public research institutes play a substantial role. Universities of applied sciences (or polytechnics) also play prominent roles in some countries, whilst in countries with a federal political system there are often different lines of funding responsibility and ‘ownership’ of different types of institutions and funding streams. Table 1 lists our comparator countries, as well as some headline indicators on their R&D systems, including size, relative importance of the HE sector, and university-business interaction.

Table 1: Selection of comparator countries and headline R&D system indicators

Country	Pop (m)	Researchers / m. pop	HE Researchers / Total Researchers	GERD/GDP	% of GERD performed by HE	% of HERD financed by business
Australia	25.0	4,000	69%	1.88 %	30.6 %	5.1 %
Austria	8.8	5,114	31%	3.05 %	23.5 %	5.3 %
Belgium (Flanders)	11.3	4,779	39%	2.47 %	20.2 %	12.9 %
Canada	36.7	4,414	37%	1.60 %	41.0 %	7.9 %
China	1,390.1	1,217	18%	2.11 %	6.8 %	29.0 %
Czech Republic	10.6	3,491	30%	1.68 %	20.4 %	4.7 %
Estonia	1.3	3,077	50%	1.28 %	35.5 %	7.4 %
Finland	5.5	6,545	33%	2.75 %	25.1 %	3.7 %
France	67.1	4,143	29%	2.25 %	22.0 %	2.8 %
Germany	82.7	4,849	27%	2.93 %	18.0 %	13.8 %
Italy	60.5	2,099	39%	1.29 %	25.5 %	1.3 %
Netherlands	17.1	4,795	28%	2.03 %	31.5 %	7.8 %
New Zealand	4.8	3,958	53%	1.26 %	29.9 %	4.6 %
Norway	5.3	6,038	38%	2.03 %	32.6 %	3.1 %
Portugal	10.3	3,981	63%	1.27 %	45.1 %	1.9 %
Singapore	5.6	6,607	43%	2.16 %	27.4 %	7.3 %
Sweden	10.1	6,931	29%	3.25 %	26.8 %	4.0 %
Switzerland	8.5	5,176	48%	3.37 %	26.7 %	9.8 %
UK	66.1	4,402	58%	1.69 %	24.6 %	4.4 %
USA	325.7	4,237	n/a	2.74 %	13.2 %	5.3 %

Source: OECD Main Science and Technology Indicators (accessed November 2018, dates for individual countries may vary)

1.4 This report

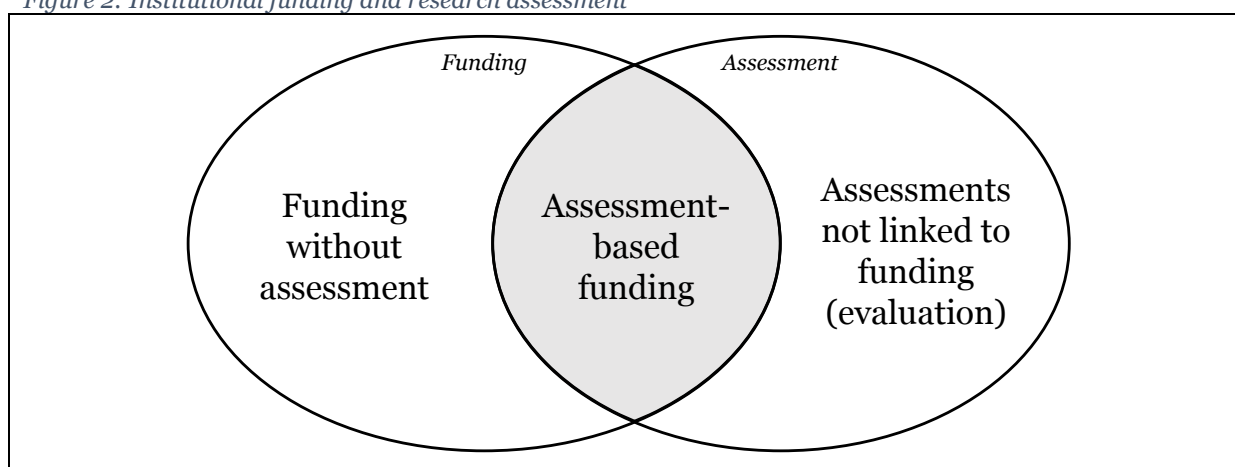
This report presents our findings under the headings of the three headline questions set for this study: What assessment and funding mechanisms are being used? What are the relationships between assessment and funding? How are approaches developed and evaluated? Our information templates on each comparator country are supplied in a separate annex report accompanying this document.

Approaches to assessment and the funding systems of which they are often a feature are complex and diverse, so it is necessary to delineate somewhat: we focus in this report largely on the institutional level assessment and funding of universities and equivalent organisations (e.g. universities of applied sciences). In some countries, public research institutes play a large role. We note this where relevant and include such organisations if they are included in relevant assessment mechanisms and associated funding, though we largely leave aside small research institute systems owned by sectoral ministries. We also discuss competitive (project-based) funding inasmuch as it complements institutional funding in various ways, but do not focus on this aspect of funding landscapes in this report.

2 Approaches used in different countries

An important headline observation to provide context for the remainder of this report is that research assessment can appear in two different forms. It can either be practiced as a way to inform the distribution of institutional funding, in which case the focus is to measure and reward research performance *ex-post*. Alternatively, research assessment also happens in contexts un-connected to funding, in which case the purposes are of a more formative nature, e.g. helping policy makers or research managers better understand parts of the research and innovation system.⁴ These exercises, more akin to ‘evaluation’ rather than ‘assessment’ tend to be more forward-looking and can focus either on institutions, or on research fields. Finally, it is worth noting that many countries also have portions of institutional funding not linked to assessments at all.

Figure 2: Institutional funding and research assessment



The literature on institutional research funding largely focuses on the category of ‘Assessment-based funding’, and in particular on performance-based research funding systems (PRFS): periodic exercises conducted according to a pre-determined assessment framework, in which research is assessed, where the results feed into a funding formula and institutional funding is distributed accordingly. The term ‘performance-based funding system’ is often used when considering national approaches to measuring research performing organisations. Hicks (2012) and JRC (2016) define a performance-based research funding system (PRFS) through the following set of criteria:

- Research must be assessed, and research evaluation must be *ex post*
- Research output and/or impact must be evaluated
- Part of the governmental allocation of institutional funding must depend on the outcome of the evaluation
- The system must be national or regional. (Hicks 2012).

By this definition, only a minority of countries have a PRFS. However, all countries have at least a component of measurement or institutional evaluation built into their funding system in some form, e.g. through formula-based allocation that make use of metrics, through contractual requirements to self-evaluate, or through a host of other means. Many countries also have assessment-based funding approaches that do not fit into the PRFS mould. In many cases, a portion of funding is based on a set of performance indicators (attached to a funding formula), which may include indicators of research performance. We consider these in more detail in section 3 of this report.

⁴ It should be noted that assessment that are linked to funding may in some cases also serve additional, strategic purposes, i.e. providing evidence to institutions, disciplines and policy makers on national research performance.

2.1 Assessment approaches used in different countries

Measuring research performing organisations is common within research active nations but the nature, focus and process varies among nations from systems purely based on input metrics that may cover more than research performance to full national peer review systems focussed on research.

Ten out of the twenty countries covered operate a PRFS of some sort. The great majority of these only distribute a modest part of institutional funding and almost all use a mix of metrics and peer review.

Table 2: PRFS in the 20 countries

Country	PRFS	% of institutional funding allocated by PRFS	PRFS: Method
Australia	No	n/a	n/a
Austria	No	n/a	n/a
Belgium (FL)	Yes	36%	Metrics & Peer review
Canada	No	n/a	n/a
China	No	n/a	n/a
Czech Republic	Yes	26% (but: system in transition)	Metrics & Peer review
Estonia	Yes	10%	Metrics & Peer review
Finland	Yes	31%	Metrics & Peer review
France	No	n/a	n/a
Germany	No	n/a	n/a
Italy	Yes	23%	Metrics & Peer review
Netherlands	No	n/a	n/a
New Zealand	Yes	21%	Metrics & Peer review
Norway	Yes	2.5-10%*	Metrics
Portugal	Yes	Unknown**	Metrics & Peer review
Singapore	No	n/a	n/a
Sweden	Yes	Up to 20%***	Primarily metrics but since 2018 also peer review of 'interaction with society'
Switzerland	No	n/a	n/a
UK	Yes	52%	Peer review
USA	No	n/a	n/a

*5% for universities and 2.5%-10% (depending on field) for institutes (includes parts of the formula that are not strictly PRFS). **Funding is allocated to specific R&D units, not to institutions as a whole. ***Varies from year to year as it includes a changing mix of additional funding and redistribution of existing funding. The redistribution does not happen every year but has governed up to 20% of basic funding. In practice, the amounts redistributed shifted are relatively modest.

Research assessment that is not tied to funding includes a broader range of different approaches. Such practices tend to be forward-looking, focussed on strategic importance, and in some cases they also have a legitimacy-granting function. In Austria, for instance, institutions are obliged to self-evaluate as part of their performance agreements. In the Netherlands, the SEP exists to ensure institutions assess their own research performance so that a 'top-down' system attached to funding is not necessary.

Table 3: Research assessment systems not linked to funding

Country	Research assessment methods not linked to funding). (excl. ad-hoc field evaluations)	Methods of non-funding related research assessment
Australia	Excellence in Research for Australia (ERA) evaluates the research undertaken at HEPs.	Metrics based peer review approach
Austria	Institutions are obliged to self-evaluate their activities as part of their performance contracts	Indicators vary between institutions, but most have come to converge on a mixture of institutional peer review (site visits by external experts) and various scientometric indicators
Belgium (FL)	Self-evaluations by universities & inter-university council	Peer review & site-visits
Canada	Funding formula (not PRFS) based on amount of external funding	Entirely metrics based
China	Select group of universities included in programmes to strive for world class status and disciplines.	Full details not available
Czech Republic	The Czech Academy of Sciences has a tradition of internal research evaluation of its own institutes	Combination of qualitative peer reviews and bibliometric information
Estonia	Regular assessments that determine eligibility for performance-based institutional funding & targeted assessments of fields of research, both conducted by the Estonian Research Council	Committee of international experts through peer review and site visits
Finland	The Academy of Finland is periodically evaluated by international experts, commissioned by the Ministry of Education and Culture. Universities and universities of applied sciences are legally responsible for taking part in external evaluation of their quality systems. Evaluations of the domestic and foreign academic publication channels are conducted by 'Publication Forum', (JUFO) which is a rating and classification system to support the quality assessment of research outputs	Peer review
France	The agency HCERES periodically carries out independent evaluations of research units and institutions at universities and research centres.	Mixed: Peer review by external expert committee of institutions and research units (incl. site visits) but also consideration of certain metrics and publications. Outcome is a statement rather than grade or ranking.
Germany	The Research Rating is a system designed by the German Council of Sciences and Humanities, which was intended to enable standardised research assessment nationwide, but is now only used sporadically at the Länder-level.	Disciplinary panels were convened to agree on indicators and definitions of high-quality research within each field (incl. metrics and peer review as deemed appropriate), resulting in a standard protocol for assessment.
Italy	1. AVA sets standards for the self-assessment by programmes and institutions but does not have a strong focus on research. 2. Third Mission and Societal Impact of Universities and Research Institutes is among the institutional activities of academic institutions. Indicators and parameters for Third Mission assessment are taken into account for the accreditation of Institutions. 3. Universities are also evaluated in reference to the three-year FFO funding plan.	1. Self-assessment 2. informed peer review. 3. Evaluation by a special evaluation committee
Netherlands	The Self Evaluation Protocol (SEP) is used by universities and institutes to run their own evaluations	Peer reviews, self-assessment reports, and site-visits
New Zealand	n/a	n/a
Norway	n/a	n/a
Portugal	Universities are free to run their own internal assessments but there are no other national assessment systems.	n/a

Country	Research assessment methods not linked to funding). (excl. ad-hoc field evaluations)	Methods of non-funding related research assessment
Singapore	n/a	n/a
Sweden	n/a	n/a
Switzerland	None (Although the SBFI has a long tradition of publishing systemic reviews on the R&I system. The SBFI regularly monitors R&I activities through a variety of publications such as the “bibliometric analysis of scientific research in Switzerland” and the impact studies on the Swiss participation in the EU Framework Programmes.	n/a
UK	n/a	n/a
USA	The US has no national research assessment systems. However, the Carnegie Ranking of HEIs assesses institutions to classify the 4000+ HEIs in the US	The Carnegie Classification uses a range of metrics (largely excluding scientometrics/bibliometrics)

2.2 Research criteria for assessment – metrics and peer review

The literature on PRFS often posits a typology, consisting of peer-review led systems, metrics and bibliometrics-led systems, and mixed systems. At face-value, the same applies when we consider the broader topic of research assessment systems among countries including those without a PRFS: metrics of various types feature heavily in many countries, as do more qualitative reviewing activities. However, an important finding from our analysis is that these broad categories, ‘peer-review-based’, ‘metrics-based’ and ‘mixed’ need to be unpicked further to fully understand how various countries assess research.

2.2.1 Two forms of peer review

On the use of peer review, a key distinction is evident from our analysis of 20 countries:

- Large peer review exercises that assess the quality of individual research outputs are rare. Outside of the UK and other parts of the anglosphere (Australia, New Zealand), only Portugal and Italy have comprehensive review exercises at this level of detail. The German ‘Research Ranking’ for example includes peer review of specific outputs, but usually limits this to the top two outputs of a research unit, so that only the ‘peaks’ are considered, and the reviewing system is manageable
- Peer review is more common at higher levels: within and beyond the funding mechanism itself (e.g. in institutional evaluations not or indirectly attached to funding) research groups, institutions or institutional/departmental strategies are frequently subject to peer review, often in the shape of site visits by international peers. These often have a forward-looking dimension, i.e. assessing significance and sustainability of what an institution is planning to do in the future. Examples include:
 - In the Netherlands, universities are obliged to conduct regular institutional self-evaluations in accordance with a set protocol, the Standard Evaluation Protocol (SEP), including strategic reviews and site visits, Sweden and France have similar approaches. Funding is not attached to the assessment directly in these approaches
 - In Austria, performance contracts between the ministry and each university contain obligations for the university to have in place internal monitoring and institutional evaluation mechanisms and to self-evaluate regularly. The ministry audits these mechanisms. The self-evaluations themselves typically involve site visits and reviews from international peers
 - Excellence schemes such as the German *Exzellenzstrategie* effectively turn institutional strategy into an application for expert scientific review, which determines the selection of ‘excellence clusters’ and ‘excellence universities’ eligible for additional institutional support

- Finally, the ‘Research environment’ dimension of the UK’s REF must be viewed in the context of forward-looking peer review at a level of aggregation higher than the individual research output.

In short, there are certainly a number of countries which use peer review to judge research output quality ex-post and attach this to funding. However, peer review is a more prominent tool at a higher level of analysis, and in forward-looking contexts.

2.2.2 Metrics – an overview of criteria

The notion of ‘metrics’ likewise needs to be sub-divided to better understand how they are used. In the first instance, we can distinguish between input and output metrics. The former are used almost exclusively in the allocation of block grants and are not performance-related. In most cases we have considered, indicators such as student and staff numbers dominate in this area. The rationale for using such metrics is to ensure institutions have stability of funding and are able to carry out their missions. Input metrics may also feature in some performance-based systems, though typically only as contextual data or multipliers, so that rewards secured in the performance-based system are commensurate with institution size (including fluctuations over time).

Output metrics by contrast are always in some form performance-related. They can relate to teaching, research, third mission activities, or any other area where governments seek to trigger behavioural change (e.g. many German Länder include output metrics on numbers of female professors and/or students). More commonly used indicators include: number or rate of PhD completions, international collaborations, linkages with local/regional academic and non-academic organisations, and third-party funding secured. Regarding the latter, particular types of funding are specified in some cases, for instance income from EU framework programmes, or industry funding, which is a marker of third mission rather than research performance.

We can further distinguish between teaching and research metrics. Many systems for instance may use student numbers as an input indicator in the block grants, but also use number of graduates or similar metrics to gauge ‘completion rates’ in the performance-based element of the funding mechanism.

It should be noted that the distinction between input and output indicators holds in all but one important case: amount of third-party funding secured. This indicator appears in both performance-based system components, but also in the formula for institutional funding that is not performance-related, where it becomes an input indicator (several Swiss cantons take this approach for example, as do Canada and Sweden). In other words: some systems see third party funding as a measure of how much research will be conducted at the institution and essentially ‘match-fund’ to some degree. Others understand it as a signifier of institutions’ demonstrated scientific ability and reward what thereby is an indicator of scientific excellence ex-post.

Leaving aside metrics related to teaching, research metrics can be further subdivided, and it is on this distinction where the contrast between PRFS and performance-based formula funding becomes apparent. We find that whilst many systems use metrics to assess research-related performance, fewer go as far as assessing individual research outputs through bibliometrics. Many systems use a ‘funding formula to allocate part of their institutional funding (Austria, Belgium FL, Finland, Germany, Norway, Sweden) and they all use at least some of these metrics and other similar ones: research performance or particular facets of research performance are assessed and rewarded, but the systems rarely evaluate research outputs as such.

Bibliometrics by contrast address individual outputs directly, and are most commonly used in actual PRFS, usually in combination with other approaches, where they support peer review or replace it in particular fields where it is accepted by the relevant academic community.⁵ Only Estonia, Norway and Sweden have mechanisms that are entirely metrics-based PRFS, and in the latter two cases, these mechanisms exist alongside other funding mechanisms (e.g. non-performance-based funding

⁵ For example, in fields where journal articles are the standard output type, with limited exceptions, where publication is categorically in English, or where there is a widely agreed upon set of top-quality journals.

accounting for most of the institutional funds distributed). Publication numbers, citation impacts, and publications in high impact-factor journals are the most common indicators in use.

The low prevalence of metrics-based PRFS is likely attributable to the fact that bibliometrics are controversial and considered limited in their application. Although bibliometrics are seen as a helpful indicator they are not widely accepted by the academic community as an effective substitute for peer review when considering academic quality. There are particular challenges in the social sciences and humanities as many publication channels for these disciplines may not feature in Scopus or Web of Science, which is a major limitation around the possibility of using bibliometrics in research assessment.⁶

Norway’s publication indicator has taken steps to overcome some of the challenges associated with limited publication data sets. The so-called ‘Norwegian model’ for bibliometric assessment of research outputs consists of three main elements (see e.g. Sivertsen 2016):

1. A complete national information system containing validated bibliographical records for peer-reviewed academic literature across all disciplines. It does not consider non-publication-based outputs
2. A publication indicator with a system of weights that seeks to make field-specific publishing traditions comparable across fields in the measurement of ‘Publication points’ at the level of institutions
3. A funding model which reallocates a small proportion of the institutional government funding according to the institutions’ shares in the total of Publication points.

For the purpose of a national information system, existing sources such as the Web of Science and Scopus were not sufficiently complete, as compared with the institutions’ internal information systems. In 2010, local systems were integrated into a national system, CRISTin, with participation of around 160 institutions. The acceptability of the system to the community is assured by the fact that the national universities association oversees it. In order to qualify for funding under the Norwegian system, scholarly publications must fulfil a number of criteria, not least that they have been peer reviewed. Publication points are then awarded for eligible publications according to the type and the quality of the publication channel as shown below.

Table 4: Publication points in the Norwegian publication indicator

	Level 1	Level 2
Journal article (ISSN)	1	3
Book chapter (ISBN)	0.7	1
Book (ISBN)	5	8

‘Level 2’ is a field-specific list of the most prestigious publication channels (e.g. journals, book publishers), representing up to 20% of the world publications in each field. The list is revised every year by discipline-based committees made up of representatives from the research community, who decide which publication channels should appear respectively in Level 1 and Level 2. This allows for Norwegian language journals not included in WoS or Scopus to be acknowledged. Publication points are measured at the level of institutions and fractional counts are calculated for co-authored publications.

The Norwegian system presents a ‘work-around’ for some of the known problems with bibliometrics: different publication types (e.g. books) can be suitably rewarded, as can work in the national language that is not captured through the standard, Anglo-centric global systems. It does not however consider the breadth of outputs beyond publications, such as performances, artefacts and datasets. The

⁶ This has been considered in depth, with Wilsdon et al’s ‘Metric Tide’ review an important recent example: http://blogs.lse.ac.uk/impactofsocialsciences/files/2015/07/2015_metrictide.pdf

Norwegian approach has necessitated a comprehensive national research information system, as well as continuous updating of what constitutes prestigious publication channels by expert committees.

2.2.3 Indicators – a brief summary

To summarise the indicators in use in the countries we have considered, we can draw on a list compiled in a study for the EUA (2015). Based on a selection of European countries’ funding systems, it presents an overview of common indicators. In the somewhat different set of countries we have studied, we can confirm a very similar array of indicators. Below we present these common indicators, noting also to which domain they relate, and whether they are input or output indicators.

Table 5: Overview of indicators

Indicator	Type	Domain
External funding obtained	Input/output	Research
International funding obtained	Input/output	Research
Bibliometrics: Publications / citations	Output	Research
No. of publishing researchers	Output	Research
No. of doctoral students	Input	Research & teaching
No. of staff	Input	Research & teaching
Doctoral degrees obtained / theses completed	Output	Research & teaching
International ranking outcomes	Output	Research & teaching
National ranking outcomes	Output	Research & teaching
Research contracts obtained	Input/output	Research & Third mission
Patent applications	Output	Third mission
Successful patent applications	Output	Third mission
Community outreach activities	Output	Third mission
Income from technology transfer	Output	Third mission
No. of BA/MA students	Input	Teaching
Credits attained/ exams passed/ year completed	Output	Teaching
BA/MA degrees obtained	Output	Teaching
Graduate employment rate	Output	Teaching
International students	Output	Teaching
Student-staff ratio	Output	Teaching
Degree completion in standard time of study	Output	Teaching
Floor surface	Input	Other
International staff	Output	Other
Diversity-related indicators	Output	Other

Adapted from Pruvot EB, Claeys-Kulik AL & Estermann T (2015) ‘Designing Strategies for Efficient Funding of Universities in Europe’, European University Association. Available: <https://eua.eu/downloads/publications/designing%20strategies%20for%20efficient%20funding%20of%20universities%20in%20europe%20define.pdf>

3 Relationships between assessment and funding

The 20 research-active nations considered for this study have a broad range of different approaches to distributing funding for research and innovation. Before we elaborate on some of the details, it is worth stating a few general observations here at the outset.

- All countries considered here have ‘dual support’ systems at national level⁷ with a mix between project-based (competitive) and institutional funding for research-performing organisations. The ratio between institutional and competitive funding ranges from 20/80 (Estonia) to 90/10 (Italy), though most cluster around 70/30 in favour of institutional funding
- In the great majority of countries, institutional funding is based on combined consideration of research, teaching, and occasionally ‘third mission’ activities to determine allocations. In fact, institutions’ teaching missions typically account for the largest share of institutional funding
- Most countries have a combination of at least two (and often more) different mechanisms to allocate various shares of institutional funding. These often reflect different rationales, e.g. a non-competitive sum to ensure stability and/or long-term planning, and a performance-related component to incentivise certain behaviours (and system optimisation more broadly)
- All countries have broadly comparable ‘versions’ of the generic competitive project funding landscape: all have public research funding councils or ‘science foundations’ typically funding basic research in the shape of projects, fellowships or similar, an innovation agency that funds technological development and supports business R&D, and various other foundations and charities running various funding instruments in a range of specialist areas. Whilst science or research ministries typically have ownership of the main funding mechanisms and agencies, other sectoral ministries also play a role in most cases. Often, they do so through their own specific research institutes, but sometimes they also have an auxiliary role in the main funding instruments.

3.1 Funding approaches

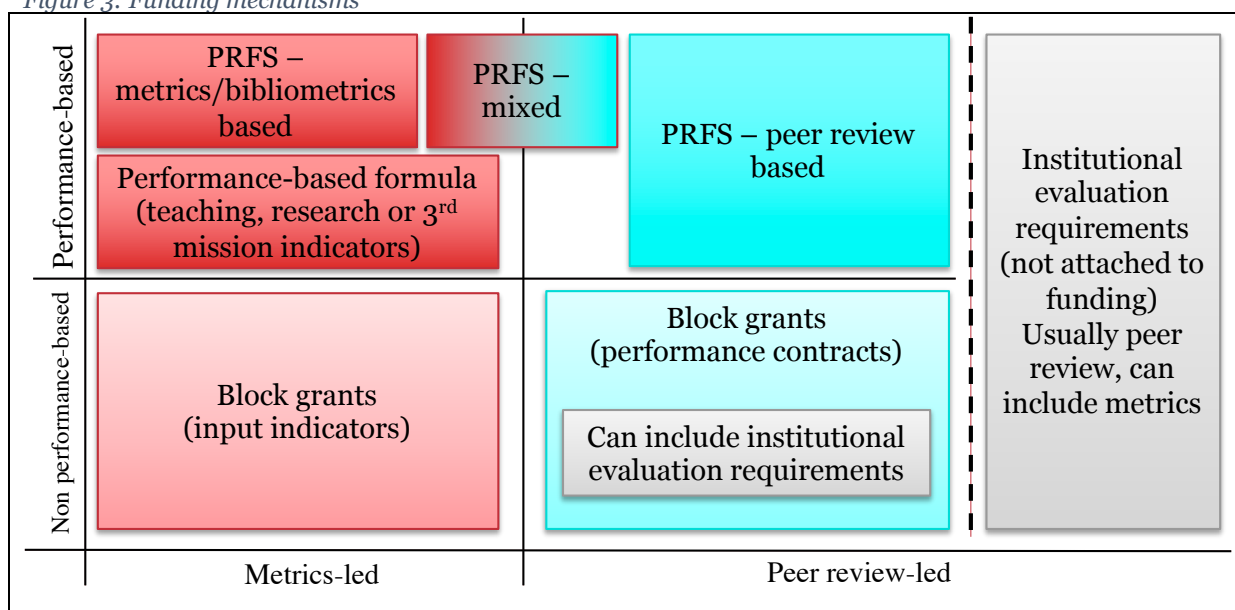
The 20 countries we have considered operate a range of different mechanisms for institutional funding. These broadly divide into five types, noted in Table 6.

Table 6: A typology of funding mechanisms

Funding approach	Research assessment
Block grants based on input indicators (e.g. number of students)	None
Block grants based on performance contracts	None, but can include contractual obligations to self-assess or participate in assessment not tied to funding
Formula funding based on output (‘performance’) indicators, or a mixture of input and output indicators. These may relate to teaching, research, third mission activities, or any combination of the three	Rudimentary – some high-level research-related metrics may feature (e.g. amount of competitive research funding secured, PhD completion rate, etc)
PRFS	Yes. Research assessment is typically continuous (or annual) where metrics are used, or at intervals of several years
Excellence schemes – a hybrid of institutional and competitive funding: the German <i>Exzellenzstrategie</i> is the clearest example (though France has one too and Austria is planning one). It awards substantial institutional payments based on competitive application, where institutional strategy and emerging research strength and collaboration are rewarded based on criteria around scientific excellence. In short, this approach takes the shape of competitive funding, but fulfils aims typically more associated with institutional funding mechanisms.	Yes, in the sense that institutional plans, strategies or applications are assessed competitively, but the extent to which research as such is assessed may vary.

⁷ The USA are an exception, in that institutional funding is almost entirely provided at state-level and focused on teaching.

Figure 3: Funding mechanisms



Most countries opt for a combination of at least two of the various systems outlined above. This complicates the question of whether certain types of countries do certain types of things. Importantly, many countries have a diverse institutional landscape, consisting for example of universities, polytechnics or universities of applied sciences, and public research institutes. In countries with federal systems (e.g. Germany, USA, Switzerland), the national/federal and sub-national levels (e.g. Länder, states, cantons) are typically responsible for different types of institutions, so the assessment approaches and the funding systems they inform, as well as ‘ownership’ of those systems are distinct for various institutions. Where sectoral ministries (e.g. transport, environment, etc.) own specific research institutes, there are further separate funding and management arrangements in place.

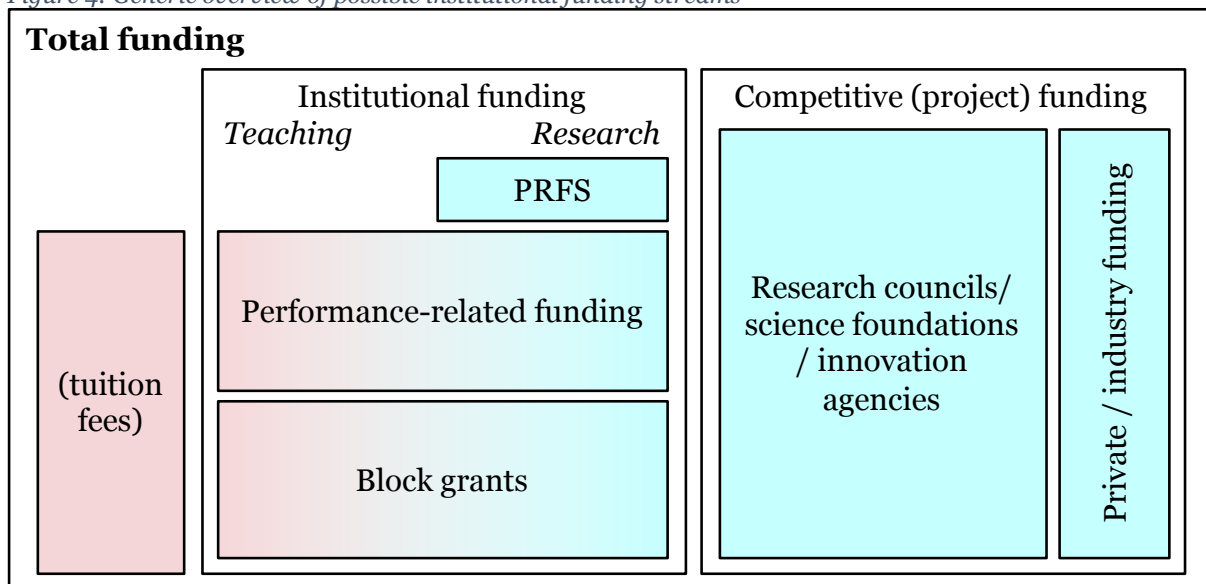
Even notwithstanding these additional factors adding complexity to the system, the presence of multiple funding mechanisms is common even for individual institution types. Based on our analysis, there are three different ways in which different mechanisms appear within the same national systems:

- Multiple mechanisms for individual institution types
 - This is common across most countries. A typical set up is that, for example, one portion of funding for universities is allocated via block grant based on performance contracts or input-indicators, and another via performance or ‘output’ indicators or a full PRFS
- Variations of the same mechanism (or set of mechanisms) for different institution types
 - Several German Länder and Swiss cantons have the same mechanisms to fund their universities and their polytechnics (*Fachhochschulen*) but use different weightings for the two respective institution types. Research-related indicators are for instance given a greater weight for universities
- Fully separate (sets of) mechanisms for different institution types
 - E.g. universities funded through input-indicator based formula and a PRFS, public research institutes funded through performance contracts. Switzerland is a clear example of a fully two-tier system: the federal technology institutes (ETHZ and EPFL) are funded by the federal level through performance contracts, the universities and *Fachhochschulen* via formula, jointly by individual cantons.

Some countries have clear separations between teaching and research, whilst many consider both in some funding mechanisms. The presence or absence of tuition fees may play a role in some cases to determine whether or not teaching is a fully separately financed endeavour. Figure 4 illustrates the various types of funding streams that institutions might have. Whilst the fundamental distinction

between institutional and competitive funding is constant everywhere, various ‘boxes’ (see Figure 4) may be present or absent in different countries, may also carry various weights and may entail stronger or weaker separations between teaching and research.

Figure 4: Generic overview of possible institutional funding streams



Finally, it is worth noting that there is a tendency for countries of common cultural blocks to have similar systems. This applies to the German-speaking countries and to the Nordics (Denmark was excluded from our selection of countries, for example, because its system is so similar to Norway’s). There is also a degree of similarity across the ‘anglosphere’, excluding the USA and Canada: more than most other countries, Australia New Zealand and Hong Kong (the latter not included in this study) have system components resembling the UK’s RAE/REF. These similarities are likely a result of deeper levels of long-term inter-country exchange and policy dialogue, and often also of similarities in the institutional landscape, which sometimes have deep common historical roots.

Table 7: Research funding mechanisms in use across 20 countries

Country	Block grants based on input indicators	Block grants based on performance contracts	Formula funding based on output (excl. research quality)	PRFS – Metrics only	PRFS – Peer review or mixed	Other mechanism
Australia	x	x	x			
Austria		x	x			
Belgium (FL)	x		x		x	
Canada	x					
China						x
Czech Republic					x	
Estonia				x		
Finland		x	x	x		
France	x					x

Country	Block grants based on input indicators	Block grants based on performance contracts	Formula funding based on output (excl. research quality)	PRFS – Metrics only	PRFS – Peer review or mixed	Other mechanism
Germany	x	x	x			x
Italy	x				x	
Netherlands	x	x				
New Zealand					x	
Norway	x		x	x		
Portugal	x				x	
Singapore						x
Sweden	x		x	x	(x)*	x
Switzerland	x	x				
UK					x	
USA	x		x			

* Used only for assessment of impact (2018 only so far) and separate funding stream for clinical research

3.2 The balance between assessment and funding

On the relationship between assessment and funding, there are a number of key findings worth listing here at the outset in brief, before we explain them in more detail below:

- There has been a growth in the use and significance of performance-related funding mechanisms in most countries since approximately the 1990s
- Institutional evaluations are also increasingly commonly practised over the past two decades. These are not necessarily tied to funding
- However, there is no evidence of a convergence towards regular and comprehensive national research assessment exercises as a means to allocate institutional funding
- More broadly, whilst performance-related funding mechanisms are increasingly used, allocation via the assessment of the quality of individual research outputs does not appear to play a growing role in the international landscape.

In most countries, there are two fundamental rationales that drive the institutional funding system choice: on one hand, there is a need to ensure long-term stability and a reliable funding stream. This applies in particular to institutions’ teaching missions, but research needs can also be considered here. On the other, there is a need for accountability and to incentivise good performance. The mix of funding approaches found in most countries derives fundamentally from these two needs, and typically results in a system consisting of more than one mechanism.

The need for increased accountability derives from the changing nature of universities themselves. Unlike the UK, where universities have traditionally had a royal charter and have been historically autonomous, most countries undertook major reforms (mostly in the 1990s) to grant their institutions increased levels of autonomy from the state, not least so that they are more readily able to secure funds competitively from a broader range of providers (including the private sector). Nevertheless, they remain in receipt of large amounts of public funding, so the new ‘arms-length’ set up required new means to ensure accountability and transparency. At the same time, there also needed to be ways for

government to ensure that institutions' activities could somehow be aligned to wider government science and innovation strategies and priorities.⁸

It is unsurprising therefore that we see a proliferation of various performance-based funding mechanisms across most countries over the past 20 years. Generally, the share of funding distributed through such mechanisms is still smaller than the share distributed through input indicator-based block grant funding, though performance contracts are an alternative form of ensuring accountability that were often introduced in response to increased institutional autonomy.⁹

PRFS are a particular type of performance-based funding mechanism in that they evaluate, ex-post, the quality of the actual research produced.¹⁰ As bibliometrics alone are widely regarded to be inappropriate to fulfil this task, such systems have usually resulted in complex assessment exercises involving peer review or mixed methods approaches (e.g. peer review informed by metrics, or metrics with additional peer review portions). Given their complexity, such exercises happen at intervals of several years.

There is a trend towards greater use of performance-related funding mechanisms. However, this does not appear to extend to PRFS as such. The Netherlands, Germany and France have all considered introducing a PRFS to distribute parts of institutional funding but decided against doing so. In the Netherlands this resulted in the Standard Evaluation Protocol (SEP), where institutions commit themselves to self-evaluate in accordance with strict standards, but un-attached to funding. In Germany, the *Exzellenzstrategie* presents an alternative approach, where additional institutional funding is provided via competitive application rather than through a PRFS. Australia used to have a PRFS: the ERA system was used to distribute part of the institutional funding, but whilst the ERA itself still exists as a tool for strategic intelligence, it is now no longer linked to funding. A small indicator-based component has instead been introduced to provide a degree of performance-based allocation.

The case of Australia is of interest in two ways: firstly, it highlights that there is by no means a uniform trend towards PRFS. But the fact that the ERA itself still exists as a strategic tool also illustrates the importance of institution and even micro-level research evaluation. Several countries have systems that ensure regular evaluations of research performing institutions, which can include evaluation of research produced (e.g. via bibliometrics or peer review). France and the Netherlands are among those countries where national institutional evaluation systems exist, but where these are not attached to funding. In Austria, institutional monitoring and self-evaluation is stipulated as an obligation in institutional performance contracts. In other words, it is a constituent part of the institutional funding mechanism, but the outcome of the evaluation does not determine funding as such. Germany and France also both have further mechanisms where institutional strategy and development is effectively used to competitively allocate payments to select universities for clusters of excellence.¹¹

Nevertheless, in the absence of a clear trend towards PRFS, and despite several countries' decisions to evaluate research at the institutional level without a direct link to funding, the use of performance measures has increased, as has the share of funding that is distributed in this way. As noted in the previous section, this often occurs by making a part of institutional funding dependent on a funding formula that uses output indicators not necessarily focused on the quality of research outputs themselves. In most cases, there is an indicator 'suite', with a certain percentage and weighting attached to each.

To provide just one example, the German state of North Rhine Westphalia allocates most of the institutional funding to its universities and polytechnics via performance contracts. But there is also a

⁸ In thematic terms this is typically done via special competitive funding instruments, but for broader factors such as researcher training, internationalisation or industry collaboration more generally, institutional funding also plays a role.

⁹ This of course does not include the additional shares of competitive funding, which vary substantially among the countries covered.

¹⁰ In the case of the UK, research impact and research environment are also part of the picture, though this is hardly practiced in other PRFS and is not a central element of the definition of a PRFS.

¹¹ For a more detailed overview of comparable (though often smaller) 'Excellence' schemes across Europe, see Pruvot EB, Claeys-Kulik AL & Estermann T (2015) 'Designing Strategies for Efficient Funding of Universities in Europe', EUA. Available: <https://eua.eu/downloads/publications/designing%20strategies%20for%20efficient%20funding%20of%20universities%20in%20europe%20define.pdf>

performance-related part: 23% of each institution’s basic grant is based on performance indicators, so that the amount for each institution is proportional to the whole budget the institution receives. There are different weightings to reflect differences in the importance of the teaching versus the research mission of universities and *Fachhochschulen* (polytechnics).

Table 8: Germany (NRW) – funding formula for universities and polytechnics

	Universities	Fachhochschulen
Graduates	50%	75%
Third party funding	40%	15%
Share of female professors	10%	10%

De Boer et al (2015)

The above example is an especially simple one. However, most systems that include approaches of this type typically opt for a manageable number of different indicators, so that performance can be measured, but that institutions are also able to comprehend what kind of performance is expected. Such approaches are common and their weight as a share of total performance-related funding has grown in many countries, often incrementally.

Radically new approaches (especially those allocated based on performance) tend not to replace funding streams previously based on non-competitive allocation measures. There are however some examples where a new performance-based mechanism is introduced to distribute an entirely new funding stream:

- For example, Sweden has a metrics-based PRFS, but it only distributes an institutional funding stream made available in addition to what was available on a non-competitive basis historically
- The German *Exzellenzstrategie* (formerly *Exzellenzinitiative*) follows a similar pattern: this competitive funding for institutions was a new addition to the research funding system.

It appears that the introduction of entirely new performance-related funding allocation mechanisms may be more politically feasible when attached to new funding streams, rather than when it replaces less performance-oriented systems.

3.3 Relationships between those running the assessment and those deploying the funding

Finally, it is worth briefly noting who exactly deploys the funding and who conducts the assessment. The funding itself almost invariably comes from the ministry of education, research or equivalent, potentially through a specialised agency. As a general rule, the more complex an assessment is, the more likely there is an intermediary organisation involved in running it.

Where formula-funding is used, using output indicators to allocate a share of institutional funds, these are in most cases set by the ministry (usually through some form of expert consultation) and deployed top-down. The same is true for various other funding approaches that do not involve research assessment as such: in Austria, for example, the ministry negotiates performance contracts directly with the institutions. However, for PRFS there is usually a specialised government agency involved in running the assessment.

For assessment exercises or systems not linked to funding, ‘bottom-up’ approaches are far more common, where stakeholders from the scientific community have ‘ownership’ of the assessment. In the case of the Netherlands, the SEP is effectively designed and owned by the HEIs themselves. In Germany and Austria, Science Councils with senior representatives from the academic world are involved in designing assessment mechanisms (e.g. the Research Rating in Germany) or reviewing and advising on institutional self-assessment (Austria).

4 Reviews and reforms

4.1 Review or evaluation of assessment processes

Reviews of assessment approaches or of science and innovation systems as a whole occur in almost all countries in some form. However, few do so at regular, pre-determined intervals. Whilst broad national research and innovation system reviews are out of scope of this study, reviews or evaluations of research assessment systems also occur in most countries and can be considered here.

Most often, these focus on research assessment systems that include performance and funding-related elements (though reviews of block-grant mechanisms and research assessment un-related to funding also occur). Austria, Belgium, the Czech Republic, Germany, New Zealand and Norway and the UK have all conducted reviews of their PRFS or other performance-related funding systems. Table 9 describes in brief the review activities that have taken place in the 20 countries covered.

Such reviews are typically conducted either by external organisations (evaluators) or by specific review commissions, which nevertheless retain a degree of independence from the system they are reviewing.

Stakeholder involvement in such reviews varies greatly, but typically does not extend outside the policy and research spheres: surveys of academics and input from institutional managers are common, but reviews of funding or assessment mechanisms themselves tend not to include business or third sector actors.

Table 9: Reviews and evaluations of assessment systems

Country	Review or evaluation of assessment systems
Australia	In preparation for the Excellence in Research for Australia (ERA) 2018 submission process, the Australian Research Council (ARC) undertook a range of consultation activities. Changes made to Research Block Grant (RBG) funding arrangements draws on recommendations set out in reviews of the Australian research system
Austria	It is part of the remit of the Austrian Science Council to periodically review the system of performance agreements (including self-evaluation), though there are no clear timelines or intervals for doing so.
Belgium (FL)	5-yearly starting 2018, by Ministry of Economic Affairs
Canada	The 'Indirect Cost Program' has been evaluated on several occasions, most recently the 10-year evaluation in 2014
China	China conducts extensive intelligence gathering but timing and methods are not always publicly available
Czech Republic	One-off: major study by Technopolis. From 2020, the RDI Council will review the exercise every 5 years
Estonia	Several one-off reviews in the past (some external); by Royal Swedish Academy, the Estonian Research and Development Council, and the University of Manchester
Finland	The Ministry of Education and Culture usually authorises reviews which are conducted by agencies, researchers and/or consulting firms etc. Inputs are provided by the major stakeholders from public and private and third sector through a variety of methods, such as queries, surveys, interviews and desk studies. The Academy of Finland conducts periodic reviews of the state of scientific research in Finland (there are many other reviews that take place semi-regularly, but they are more small-scale)
France	Annual survey of participants and stakeholders. No overall evaluation of the system as such.
Germany	No (Research Rating is the only assessment system and has not been reviewed since its creation)
Italy	The Italian government sets no requirement for the evaluation of the VQR. Prior to launching the latest VQR exercise, ANVUR ran a public consultation inviting the community to comment on the draft terms of the VQR. The response to consultation was collated and reviewed by a group of rectors. It has not yet been decided if a similar consultation will be launched in preparation for the next VQR

Country	Review or evaluation of assessment systems
Netherlands	SEP itself is evaluated at the end of each cycle (6 years) in close cooperation with universities and research institutes (they are essentially responsible for the SEP, which is a bottom-up exercise)
New Zealand	The PBRF is reviewed periodically by the Tertiary Education Committee, one coming up in 2019
Norway	One-off evaluation of the publication indicator in 2014 by external experts (Danish academics), who collected input from sector stakeholders for the study
Portugal	Each review round typically includes reflections on the overall procedure by the review panels. This takes place every 4 year approximately and is conducted by a coordination team consisting of a panel of 4 independent scientific experts
Singapore	n/a
Sweden	Financial implications reviewed as part of a study by the UKÄ in 2019 (hybrid between government agency and sector representational body). It found that the distribution of funding using the model was broadly in line with distribution of funding before it was adopted. New report in 2019 calls for a new quality assurance and evaluation system based on dialogue and trust, closer to the Dutch model or possibly with contracts between government and institutions
Switzerland	n/a
UK	The RAE 2008 and REF 2014 has been reviewed internally and externally and by means of open consultations. This process involved external evaluation with particular attention paid to new elements such as the introduction of impact. Consultation, review and evaluation processes often involve input from the academic community alongside experts in research evaluation, management and policy
USA	n/a

4.2 System change

Radical changes to funding and assessment systems are very rare. Major system overhauls have tended to coincide with major changes around the research-performing institutions themselves – most often in the shape of reforms granting institutions greater autonomy. This often marks the introduction of performance-related mechanisms. The Czech Republic is the only country in our selection where a radical system change has been implemented, following the discovery of multiple problematic aspects in the previous system.

Incremental changes are more common. Particularly changes to a funding formula, weightings for individual indicators, introduction of new indicators, or incremental changes (usually increases) in the share or performance-related aspects of the funding systems are quite common across most countries.

Table 10: Overview of system changes

Country	Extent of change in the research assessment processes
Australia	As of 2017, “research publication counts have been removed from the funding formulae along with HDR student load and the SRE funding moderators - Excellence in Research for Australia (ERA) ratings and transparent costing data”. (Australian Government, 2016) In short, research performance, as measured through ERA, is no longer used to inform funding allocations of the block grant and Australia no longer has a PBFS.
Austria	Minor: the performance contracts and self-evaluation responsibilities have remained largely constant, but the balance of funding dependent on these has changed over time.
Belgium (FL)	Minor: same system is in place, but the structure of the underlying formula has changed over time.
Canada	Minor: The Research Support Fund was first introduced in 2001 under the name, ‘Indirect Costs Program’. The budget frame has been revised regularly but there are no indications that the nature of the programme has changed.

Country	Extent of change in the research assessment processes
China	Major (although extent is uncertain): New programme 'Double first class' replaced two previous programmes 211 and 985 in 2017. The new programme has increased focus on disciplines, in practice, the outcome appears to be very similar.
Czech Republic	Major change taking place now: shift from a count-based system to a system with more qualitative considerations as well.
Estonia	Baseline funding (PRFS straight away) was introduced in 2004, since only minor changes to the weights of contractual research component.
Finland	Moderate change. In 2013 the Finnish system became more performance based, replacing largely input indicators (e.g. student numbers) with output indicators related more directly to research (e.g. internationalisation, research quality and research impact).
France	Major: HCERES's predecessor AERES was first set up in 2007 and replaced by HCERES in 2013/14. AERES' methodology was more summative, included grading and was intended to have consequences for funding.
Germany	No change, other than the creation of the Research Ranking.
Italy	VQR 2011-2014 reduced the number of publications to 2 per FTE. This change was proposed by ANVUR in response to the shorter coverage (4 years instead of 7 years).
Netherlands	Minor; components of the SEP have changed over time.
New Zealand	Minor: only small changes to weightings.
Norway	Relatively stable since introduction.
Portugal	Minor: adjustments to evaluation process.
Singapore	n/a
Sweden	Metrics-based model first used in 2009 but adjusted year-on-year. Somewhat bigger change in 2018 with introduction of impact element. Proposal for REF-style system drafted and then rejected in 2015.
Switzerland	n/a
UK	The UK system has seen incremental change since its introduction in the 1980s. The elements and weighting of the elements assessed has seen some significant change with the introduction of the assessment of research impact (non-academic impact) – outputs 65%, impact 20%, environment 15%. In REF 2021 the weighting for impact will increase to 25%. Measures to support equality diversity and inclusion were also introduced and remain prominent for REF2021. In exercises prior to 2021 institutions were able to select staff for submission to the exercise. REF 2021 will require all staff with significant responsibility for research to be returned.
USA	n/a

4.3 Challenges around system change

As shown, research assessment processes are commonly subject to review, and minor changes – often around individual indicators, weightings or other methodological details – are common and often result from such reviews. However, radical system changes are very rare.

While it is impossible to present a definitive typology of challenges, there is a strong impression across most countries we have studied that there are often conflicting interests around the system (including both its methodology and whether and to what extent it should be tied to funding). Across the great majority of countries considered for this study, compromises generally needed to be found between two or more of these groups:

- Researchers
- Research managers
- The policy sphere

- The political sphere (especially in federal systems, where the federal level and individual states may have conflicting interests, but disagreements between political 'left' and 'right' can also play a role)

The need to satisfy and find compromise between these different groups is likely a major explanatory factor behind the low occurrence of major system change or overhaul.

As noted in the previous section, fully new systems tend to be introduced as part of entirely new funding streams, rather than acting as a 'replacement' for old allocation mechanisms.

Appendix A Interview details

Table 11: Interviewees consulted for this study

Country	Name	Interviewee organisation	Position	Date
Australia	Sarah Howard	Australian Government ARC	Branch manager, Research Excellence branch	15/02/2019
Austria	Elmar Pichl	The Austrian Federal Ministry of Economy, Research and Science	Director of section IV Universities and polytechnics	14/02/2019
Austria	Antonio Loprieno	Science Council of Austria	Chairman	30/01/2019
Belgium (Flanders)	Gerard Cielen	KU Leuven	Research Policy Unit	06/02/2019
Belgium (Flanders)	Koenraad Debackere	KU Leuven & ECOOM	Research Coordination Office, University Administration and Central Services & KU Leuven Research & Development	06/02/2019
Canada	Dale Dempsey	Tri-Agency Institutional Programs (TIPS) Secretariat	Director of Programs	18/02/2019 + 05/03/2019
Canada	Dominique Bérubé	Social Sciences and Humanities Research Council of Canada (SHRCC)	Vice-president of Research Programs	18/02/2019
Canada	Louise-Michelle Verrier	Social Sciences and Humanities Research Council of Canada (SHRCC)	Corporate Planning and Reporting	05/03/2019
China	Sylvia Serger	University of Lund	Professor	14/02/2019
China	Yang Yun	National Centre for S&T Evaluation	Research Fellow/Director, International Cooperation Division	22/02/2019
Czech Republic	Petr Dvorak	Council for Research, Development and Innovation	Vice-chairman, responsible for research assessment	07/02/2019
Estonia	Siret Rutiku	Estonian Research Council	Head, Department of Research Funding	via email (01/02/2019- 14/02/2019)
Estonia	Rein Kaarli	Ministry of Education and Research	Research Policy Department	11/02/2019
Finland	Erja Heikkinen	Ministry of Education and Culture	Director, Division for Science Policy	via email (29/01/2019- 15/02/2019)
Finland	Tuomas Parkkari	Ministry of Education and Culture	Senior Ministerial Advisor, Department of Higher Education and Science Policy	via email (29/01/2019- 15/02/2019)

Country	Name	Interviewee organisation	Position	Date
Finland	Matti Kajaste	Ministry of Education and Culture	Counsellor of Education	via email (29/01/2019- 15/02/2019)
France	Pierre Glaudes	HCERES	Director, Department of Research Evaluation	Via Email (11/02/2019)
France	Pascal Marty	HCERES	Scientific Advisor, Department for Research Evaluation	14/02/2019
Germany	Jan-Christoph Rogge	BMBF	Directorate 411 - Higher education legislation, Excellence strategy, DFG, Futurium	28/01/2019
Germany	Rainer Lange	German Council for Science and Humanities	Head of Research Division	06/02/2019
Italy	Marco Malgarini & Sandro Momigliano	ANVUR	Research Evaluation Area / President	30/01/2019
Netherlands	Han van Yperen	The Association of Universities in the Netherlands (VSNU)	Policy Advisor	12/02/2019
Netherlands	Elke van Cassel	The Association of Universities in the Netherlands (VSNU)	Policy Advisor	12/02/2019
Netherlands	Martijn Poel	Ministry of Education, Culture and Science	Senior Policy Official	11/02/2019
New Zealand	Sharon Beattie	Tertiary Education Committee	Senior Advisor for the PBRF Quality Evaluation	via email (24/01/2019- 08/02/2019)
Norway	Johs Kolltveit	Research Council Norway	Special advisor, Department for Research Institute Policy and Public-Private Research Coordination	11/02/2019
Norway	Vidar Røeggen	Universities Norway (UHR)	Senior Advisor, National Board of Scholarly Publishing (UHR Publishing)	04/02/2019
Portugal	Isabel Vitorino	Foundation for Science and Technology	Director, Department for R&D Units	via email (28/01/2019- 05/05/2019)
Portugal	Luís Fortes	Foundation for Science and Technology	Science and Technology Manager, Institutions Support Department (DAI)	via email (28/01/2019- 05/05/2019)
Singapore	Ang Mei Wei	Ministry of Education	Senior Manager, Academic Research Division	Fact-checking only (21/02/2019)
Sweden	Lars Olof Mikaelsson	Ministry of Education	Secretary of the government inquiry into the future governance of HEIs (2018-19)	13/02/2019

Country	Name	Interviewee organisation	Position	Date
Switzerland	Marco Scruzzi	SBFI	Head of Unit, 'Higher Education Policy'	Via Email (10/02/2019-12/02/2019)
Switzerland	Nicole Schaad	SBFI	Head of Unit, 'National Research'	Via Email (24/01/2019-08/02/2019)
UK	n/a (direct support from Research England)	n/a (direct support from Research England)	n/a (direct support from Research England)	n/a (direct support from Research England)
USA	Irwin Feller	Penn State College of Liberal Arts	Professor Emeritus of Economics	14/02/2019

Appendix B Data collection template

The following template was used to collect information of each of the 20 countries covered in this study.

International landscape study Country/system template

[Country name]

1. Headline facts			
1.1 Country: [name]	1.2 Population: [rounded to mil.]	1.3 GERD/GDP: [%]	1.4 GERD/GDP rank (/20): [Rank out of 20]
1.5 Overview of RPO landscape	[How many RPOs does the country have? What main different types? E.g. universities, research institutes, Polys, etc? are there regional/federal 'ownership divisions?]		
1.6 Brief summary/ system description	[Max 100 words: what are the types of funding systems in place, does the mix have a headline purpose or 'gestalt'?)		

2. Funding system overview	
2.1 What are the main funding system components?	2.2 Is there a PRFS (definition: JRC/Hicks)? [Yes/No]
	[Please consider institutional funding, of which block grants, and of which PRFS (& any other major bits), and main sources of project funding. For each, note in broad terms how the allocation is determined, i.e. contracts, strategies, political whim, PRFS, etc]
2.3 Shares of funding allocated through the main mechanisms	[For the 'groups' above, please give % of funding allocated via each]
[Boxology: please illustrate via a basic diagram]	

3. Assessment-based system components	
PRFS	3.1 Approach [Please give a full account of what the system looks like: periodicity, methods, unit of assessment (individual department, institution?), etc.]

	3.2 Funding formula	[Please go into as much detail as feasible: at minimum, we should get the equivalent of the REF's Quality/Impact/Environment weightings. Please ensure you include ALL aspects of the PRFS, not only publication-related ones (so impact, PhD students, anything else that determined funding!)]
3.3 Rationale for PRFS		[If available, please explain any evident rationales for why the PRFS was implemented, or its stated aims. For other system components (see below) there may not be an evident rationale/aim in the same way, but if there is a stated reason for other conditional funding mechanisms, please also state]
Other Conditional funding	3.4 Approach	
	3.5 Funding formula or allocation key	[As above: delve as far as possible into how the funding approach actually related to money]
3.6 Other assessment activities	[Are there national (albeit field- or institution-specific) research assessment exercises? If so, please describe these briefly and what they are for. Consider only aspects that do not have direct funding implications]	

4. History & effects

4.1 Do current performance- or assessment-based components have predecessors?	[If available, please include information on: how did it work? Effects: Any evaluations / what effects identified? Review process: How was it reformed, what rationale? Please include dates (years) when older systems were in place!]
4.2 Are there any known effects of current or former performance- or assessment-based components	

5. Ownership, review & evaluation

5.1 Which organisation 'owns' and runs (if different) the performance- and assessment-related elements of the funding system?	[If several organisations are involved, please state who does what, please consider PRFS as well as other performance or assessment-related components]
5.2 What review and evaluation procedures have been conducted on the performance and assessment related elements of the system?	<ul style="list-style-type: none"> • One-off or periodic? • Internal or external (and by who specifically?) • Do reviews/evaluations have a stated aim?
5.3 Which stakeholders/ organisations had input into review/ evaluation activities?	[Please list different groups that were consulted. If we can say anything about the extent of input, please do.]

6. Additional points of interest	
[Please add any further matters of potential interest here, i.e. anything unique or potentially helpful for Research England that does not neatly fit into the other template sections]	

7. Sources	
7.1 Public documents of interest	
7.2 Interviewees	

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