Department for Business Innovation & Skills

RESEARCH COUNCILS IMPACT REPORTS 2012

Descriptive analysis of trends using metrics

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Contents

Executive Summary

This report reviews evidence of trends in a selection of inputs, outputs and outcomes contained in the quantitative element of the Impact Reports returned by Research Councils in 2012.

The Impact Reports demonstrate the contribution made by Research Councils to economic growth and social welfare through their activities. This report considers only some of the areas of influence of Research Councils that can be quantified. While being partial, the quantitative evidence on which this report builds provides trends analysis that may inform future policy development.

Total income drawn by public and non-public sources by all seven Research Councils fell at an annualised rate of 3.4% in real terms from 2009 to 2012. Non-BIS income fell at a similar rate to BIS income (3.2% in real terms). Non-BIS income is however a very small proportion (5%) of the total.

Despite reductions in total income, expenditure on Research Grants and Post-graduate Support has been maintained or increased, expenditure in other categories like sponsored institutes and subscriptions to international facilities has fallen.

The total headcount of Principal Investigators, Research Leaders in sponsored institutes and Research Fellowships has fallen by 500 since 2009, reaching 9,500 in 2011/12. This is a reflection of various policies for example grant demand management that has the effect of increasing the size of research teams and reducing the number of research proposals. As a result, the number of visible heads is lower but the total number of researchers funded may be larger.

Total publication counts have grown at a yearly rate of 9% since 2009, reaching an estimated 35,000 in 2012. This is a little slower than the growth rate of 12% prevailing between 2007 and 2012 but still healthy. Total counts of patents and spinouts fluctuate rather than accumulate over time, but fluctuations are small and therefore growth in the cumulative counts is stable.

Total PhD starter counts fell from 6,200 in 2009 to 5,200 in 2012. This reflects partially a move to increased concentration of funding (post-graduate support) among the best and brightest, as pledged by Councils in their Delivery Reports.

With finishing rates for these students standing at 87% in 2012, Research Councils are currently delivering to the economy 5,000 PhDs a year, of which an average of 20% find employment in the private sector within 6 months of finishing.

Overall the quantitative evidence suggests that in times of financial restraint the Research Councils are managing a reallocation of resources to concentrate funding among the best and brightest researchers and students to ensure sustained excellence and a smooth exchange of knowledge.

Introduction

This report summarises performance data from the seven Research Councils collected through their annual Impact Reports and provides a contextualised view of how this data can be interpreted and used to help identify trends and monitor developments. This report focuses exclusively on the quantitative element of the performance metrics which refer to recent activities outputs rather than the wider economic and social impacts of past investments in research. These wider impacts of past investments are best captured through the wealth of case studies referenced in the Impact Reports.

The New Metrics Framework is the quantitative element of the Department for Business, Innovation and Skills (BIS) Impact Reporting for Research Councils. It provides a quantified approach to monitoring trends through a broad set of metrics, none of which is sufficient on its own to capture performance, but which together give a timely picture of some of the activities and investments funded by Research Councils in the previous year.

The Research Councils use multiple approaches to assess the achievements of science and research investments[1]. Trends over time can point to useful avenues of investigation that have the potential to inform policy.

In what follows it is important to bear in mind that:

1. Metrics will necessarily leave out areas of progress and impact that cannot be quantified across all Councils; the analysis is therefore partial.

2. Metrics indicate the current state of affairs but not causes or reasons for changes. The analysis is therefore a static assessment of positions at different points in time.

3. Metrics do not capture detail on process or describe how research discoveries improve social welfare. These processes take long periods of time to mature and some are described in case study evidence published by the Councils in their reports.

Appendices A and B show the structure of the New Metrics Framework[2] across three categories of metrics: inputs, outputs and outcomes. The list of metrics also covers various dimensions of activity including expenditure, human capital, technology and knowledge exchange. Ideally all dimensions would be represented in all categories, e.g. human capital inputs (researchers), outputs (finishing students) and outcomes (destinations of finishing students). The differences in the nature of research across Councils and associated differences in approaches to data collection prevent such complete accounting.

Although Councils are given the same definitions for metrics, variations in institutional organisation, data collection and measurement mean that each Council can only provide a "best fit" of the concept required. Aggregations of activities across Councils should be viewed with that point in mind.

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[1] http://www.rcuk.ac.uk/documents/publications/EconImpactNote.pdf
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32482/11-1071-economic-impact-reporting-framework-interim-report-2010-returns.pdf

Recent developments in Research Council information management such as Gateway to Research[3], and common data definitions, point to a future of increased and improved common reporting. In the interim the New Metrics Framework provides an overview of trends in some activities even though not all metrics are relevant for all Councils in all years. The New Metrics Framework can be regarded as a Research Council counterpart to performance data collected by the Funding Councils for monitoring research performance among their funding units. This Framework in particular is a partial correspondent to HEFCE's Higher Education Business and Community Interactions Survey (HE-BCI)[4], which collects data on collaborative and commercial activity across Higher Education Institutions. As such the development of this framework contributes to the goal of developing closer monitoring systems for the two sides of the dual funding system.

The UK Science and Research System

The UK Science and Research (S&R) System is organised as a dual system of financial support to research performed in Universities and other publicly funded Research Institutions. The allocations booklet published in every spending review gives a full overview of how the system is organised and managed[5].

There are two main, but not exclusive, channels for funding research publicly in the UK:

- A block grant allocated to Higher Education Institutions by the Funding Councils of England, Scotland, Wales and the Department for Employment and Learning of Northern Ireland on the basis of past research performance. The next evaluation exercise for funds allocation will be the Research Excellence Framework in 2013/4.

- Research grants and other research support allocated by the seven Research Councils to research teams on the basis of research proposals submitted by teams and evaluated on excellence by peer review.

The seven Research Councils and a link to their Impact Reports 2012 are:

Arts and Humanities Research Council (AHRC); [6]
Biotechnology and Biological Sciences Research Council (BBSRC); [7]
Engineering and Physical Sciences Research Council (EPSRC); [8]
Economic and Social Research Council (ESRC); [9]
Medical Research Council (MRC);[10]
Natural Environment Research Council (NERC);[11]

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[3] http://www.rcuk.ac.uk/research/Pages/gtr.aspx
[4] http://www.hefce.ac.uk/whatwedo/kes/measureke/hebci/
[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32478/10-1356-allocation-of-science-and-research-funding-2011-2015.pdf
[6] http://www.ahrc.ac.uk/News-and-Events/Publications/Documents/AHRC%20Impact%20Report%202012.pdf
[7] http://bbsrc.ac.uk/web/FILES/Reviews/impact-report-2012.pdf
[8] http://www.epsrc.ac.uk/SiteCollectionDocuments/Publications/corporate/ResearchPerformanceAndEconomicImpactReport2011-2012.pdf
[9] http://www.esrc.ac.uk/_images/RPEI_report_2012_tcm8-24783.pdf
[10] http://www.mrc.ac.uk/Utilities/Documentrecord/index.htm?d=MRC008981
[11] http://www.nerc.ac.uk/about/perform/documents/impactreport2012.pdf

Science and Technology Facilities Council (STFC).[12]

Research Councils manage funding for UK research through coordinating and funding particular disciplines, areas of research or strategic priorities, whilst also supporting postgraduate and doctoral training. Whereas all Research Councils fund research grants, only some of them (BBSRC, MRC, NERC and STFC) sponsor public sector research institutes, providing these institutes with facilities and paying the salaries of researchers. Moreover, some Research Councils support UK membership and participation in international research ventures by managing international subscriptions. Finally, the Research Councils together manage the larger and cross-disciplinary elements of UK research capital infrastructure, mainly though not exclusively through the STFC.

The joint remit is therefore much broader than the individual remit of each Research Council. The umbrella organisation RCUK coordinates work across the seven Councils in areas where cooperation results in a better outcome than the sum of uncoordinated individual action[13]. Capital infrastructure is a good example of synergic benefits at RCUK level.

The Policy Context

The allocations booklet from the Comprehensive Spending Review 2010[14] and the Government's Innovation and Research Strategy 2011[15] provide an overview of economic and social reasons for public investment in S&R. Investments in the national research base provide the problem-solving capacity and high level skills required to sustain a knowledge driven economy and are key to building and maintaining long term economic growth.

Whilst not all investment in Research and Development (R&D) ought to be or indeed is public, there are areas of fundamental discovery that due to risk, uncertainty or coordination failures would not take place unless the public sector takes the lead in providing them directly. Once market failures are tackled successfully using public resources it is sometimes easier for the private sector to carry R&D investments forward, often mediated through some indirect incentives such as R&D Tax Credit. The Research Councils' Impact Reports include a wide range of examples of impact on the private sector.

Moreover, as also illustrated through the Research Councils' Impact Reports, one of the more prolific areas of problem solving need is public policy implementation and delivery. In these cases the private sector has limited scope for capturing the full value of benefit, which can nevertheless be substantial for society.

The many reasons for public investment in S&R underpin recent Government decisions, from a ring-fenced, flat cash settlement at £4.6bn per year in the last Comprehensive Spending Review, to subsequent new commitments in science capital, amounting to £915m worth of new research capital investment.

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[12] http://www.stfc.ac.uk/resources/pdf/STFCImpactReport2012lowres.pdf
[13] http://www.rcuk.ac.uk
[14] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32478/10-1356-allocation-of-science-and-research-funding-2011-2015.pdf
[15] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32450/11-1387-innovation-and-research-strategy-for-growth.pdf

These investments in the research base have thus far been matched with international reputation and remarkably good performance in times of fierce competition. The UK continues to rank second to the US in international rankings of research excellence and efficiency, attracts more foreign direct investment for research than other comparable European countries and remains a net beneficiary in the global competition for talent[16].

Inputs

The seven Research Councils together manage the "forward-looking" element of the dual funding system for S&R prevailing in the UK. Each Council has a disciplinary UK-wide remit assigned by Royal Charter and whilst they all collaborate in multiple cross-council activities, their areas of influence overlap only partially. This partial overlap is important because Councils do not serve identical markets and differences in the activities and investments funded may well reflect autonomous discipline features rather than relative worth or efficiency. Research in one discipline may require: larger or smaller teams; different specific equipment; and/or different travel arrangements from another discipline. As a result, investment patterns across categories of spend and the resulting outputs will differ for reasons intrinsic to the disciplinary nature of the research funded by each Council.

Income

Total nominal income for all Research Councils peaked in 2009 at £3.65bn and has since fallen by 2.9 % year on year to £3.45bn in 2012. In real terms this is a fall of 3.4% a year from £3.60bn to £3.36bn.

Figure 1 shows total nominal income and the relative size of each Council in the total. It is apparent that the fall in total income is relatively evenly distributed across the seven Councils keeping the relative income of each stable over the past five years.

Figure 1 also shows a line of black triangles measured on the right hand side, capturing reported income that does not come from BIS. Sources of Non-BIS income differ by Council and by year, but as indicated in Impact Reports, it can be from other Government Departments, foreign research institutions and non-public investments from private or not-for-profit organisations. External income excludes receipts from the sale of IP[17], cross Council transfers and the contributions of collaborating organisations on research grants. Non-BIS income has also fallen since 2009 at an annualised rate of 3.2% in real terms.

Figure 1 shows that non-BIS income is a relatively small proportion of the total direct income to Research Councils, accounting for 5% of the total on average over the last 5 years. This overall proportion is comparable to external income for Universities as captured in the Higher Education Business and Community Interaction Survey[18]. Figure

[16] International Comparative Performance of the UK Research Base 2011 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32489/11-p123-international-comparative-performance-uk-research-base-2011.pdf)

[17] Research Councils do not undertake commercial activity directly but rather through affiliated technology transfer companies, e.g. Babraham Bioscience Technologies or MRC Technology

[18] Note however that HE-BCI external income for Universities includes Research Council income, IP and cross-university transfers while external income as defined for Research Councils in Figure 1 excludes cross-Council transfers and IP.

1A shows non-BIS income for individual Councils indicating this has remained broadly stable or fallen slightly in the last 2 years.

**Figure 1: Total Income by Research Council (left axis)
Non-BIS Income (right axis)**

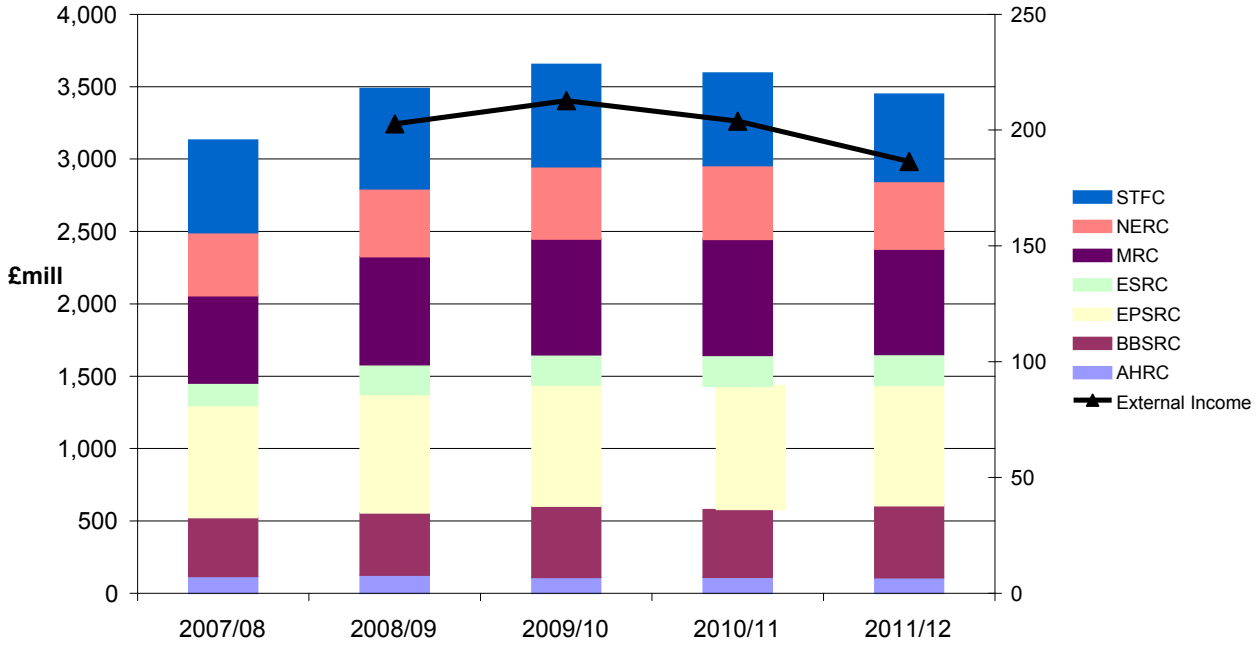

Figure 1: Total income, public and otherwise, for each Council. Height in £mill on left indicates each Council and the whole bar is the total. Right hand side axis for non-BIS income, excluding cross-council transfers, income from IP and contributions of collaborating organisations on research grants. STFC did not report external income in 2007/8.

Figure 1A: Non-BIS Income by Research Council

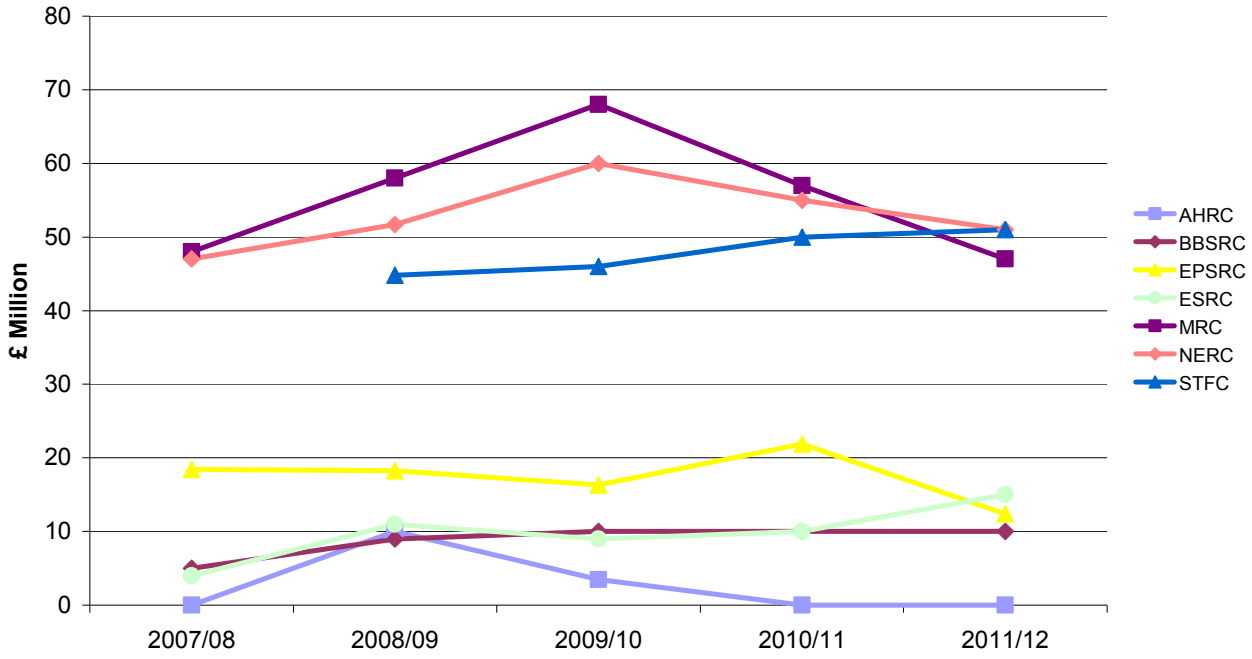

Figure 1A Non-BIS income by Council, excludes cross-council transfers, IP and contributions of collaborating organisations on research grants.

Whilst limited in magnitude, the trend in falling overall co-investment from non-BIS sources at the very least indicates that lower investment from BIS is not being met with higher investment elsewhere. Alternatively, this is evidence that the BIS investment in Research Councils is not crowding out other sources of income.

Expenditure

Because of non-overlapping disciplinary remits, categories of spend vary significantly across Research Councils. In addition to differing needs across disciplines, some Councils sponsor research institutes directly (notably BBSRC, MRC and NERC) and some Councils pay for UK international subscriptions to cross-national research facilities (notably but not exclusively STFC). Because of this, it is difficult to categorise areas of spend in such a way that an overview of the whole system can be given.

For the purpose of providing some quantitative split of areas of spend, Research Councils provide approximate expenditure on Research Grants and Fellows, Post Graduate funds (no distinction across types) and Other expenditure (covering sponsored institutes and/or subscriptions and/or other types of expenditure[19]). Figure 2 illustrates the diversity of expenditure across Councils in the year of the peak (2009/10) just before the 2010 Comprehensive Spending Review took effect; and the most recent year. The horizontal

[19] The Annual Accounts in the respective Council Annual Reports provide detail of this "other" category.

axes measures Post Graduate support, the vertical axis measures Other expenditure and the size of the bubble represents expenditure on Research Grants.

For the purposes of categorising expenditure Figure 2 shows:

1. Expenditure on Research Grants is proportional to total income, with larger Councils displaying larger bubbles. BBSRC and EPSRC spend a large proportion of their funds (two thirds) on Research Grants.

2. The bulk of EPSRC's non-research grant expenditure is on Post-Graduate support. This is readily explained by the breadth of the EPSRC portfolio which requires a significant investment in doctoral training to provide highly skilled people in key areas of the economy.

3. The existence of sponsored institutes and facilities explains why MRC, NERC and STFC respectively are bunched together with a large proportion of Other expenditure. The relative position of the BBSRC is because they have fewer sponsored institutes which are embedded under research and capital grants, thus not counting towards Other expenditure as in the other Councils.

4. Between 2009 and 2011:

    - The sizes of the bubbles have not changed noticeably over the last two years. This indicates that larger proportions of the more modest total incomes (see Figure 1) are being dedicated to Research Grants for all Councils. This explanation is consistent with a fall in the proportions going to the "Other" categories, particularly for those Councils where "Other" was sizeable.

    - EPSRC reduced slightly its expenditure on Post Graduate support while BBSRC and MRC increased it slightly.

    - Little change in the distribution of expenditure can be observed for ESRC – the bubbles overlap.

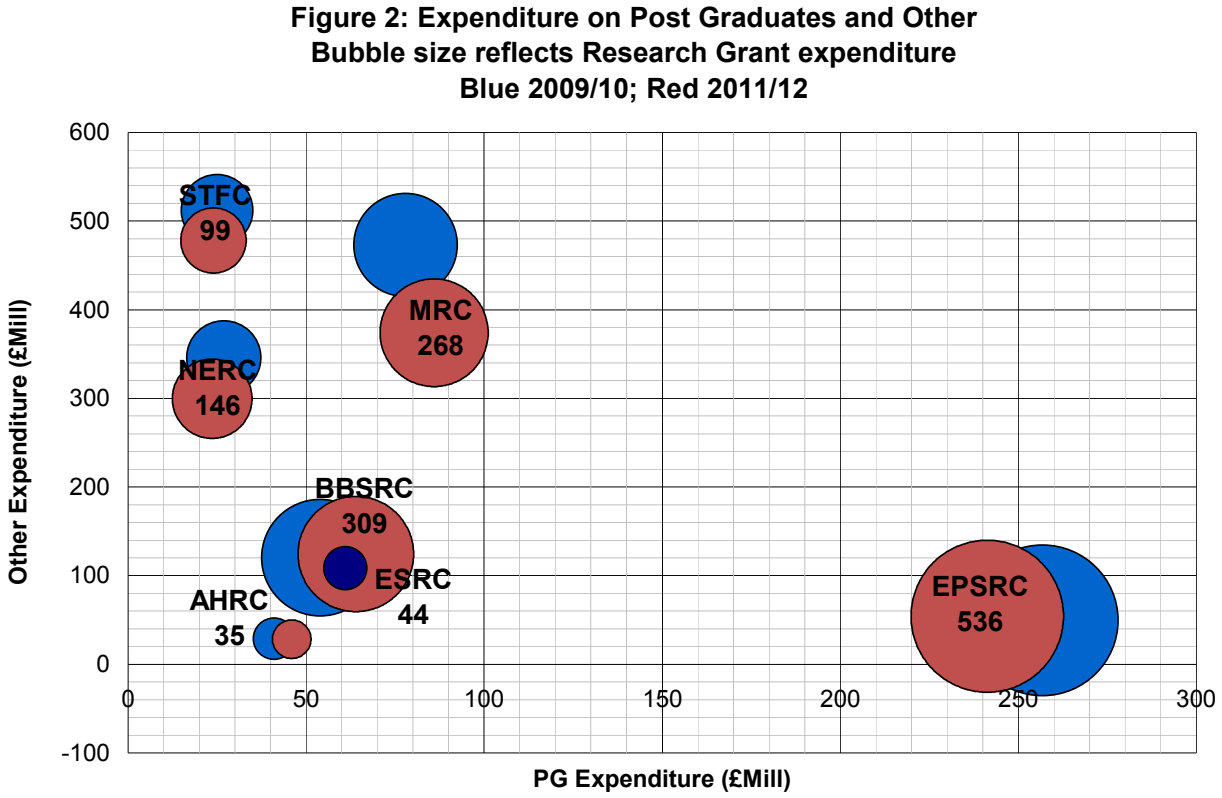

Figure 2: Expenditure by category. Bubble size represents the Research Grant category of expenditure, with numbers reflecting £mill of Research Grants in 2011/12. Horizontal position measures PG expenditure, vertical position measures Other expenditure. ESRC bubble in dark blue, previous year overlaps with current so not visible

Figure 2 illustrates that while the stream of funding managed by the Research Councils as a group may be stable at around £4.6bn, it is not however static. This can be readily seen by noting that the size of the bubbles does not change from one year to the other but the position of the bubbles is noticeably different. These figures reflect changes pledged in Delivery Plans and subsequently implemented by the Research Councils. Details of these changes and any efficiency savings delivered and re-invested are provided in their published Annual Reports and their Impact Reports.

Human Capital

Researchers are one of the main resources that Research Councils fund to obtain excellent research. Human capital can be seen as an input to or an output of the research base, but to the extent to which it is people who generate new knowledge, the New Metrics Framework considers funded researchers as an input.

Research Councils fund researchers in a variety of ways. Research Grants are submitted in the name of a so called “Principal Investigator” (PI). The PI is rarely the only recipient of the grant but the person who accepts responsibility for the delivery of the proposal on behalf of the research team. Therefore the total number of PIs gives an indication of

breadth of support over time but represents an underestimate of the total number of researchers funded by Research Councils.[20]

Figure 3: Principal Investigators and Fellows
Bubble size reflects Research Council Income
Blue 2009/10; Red 2011/12

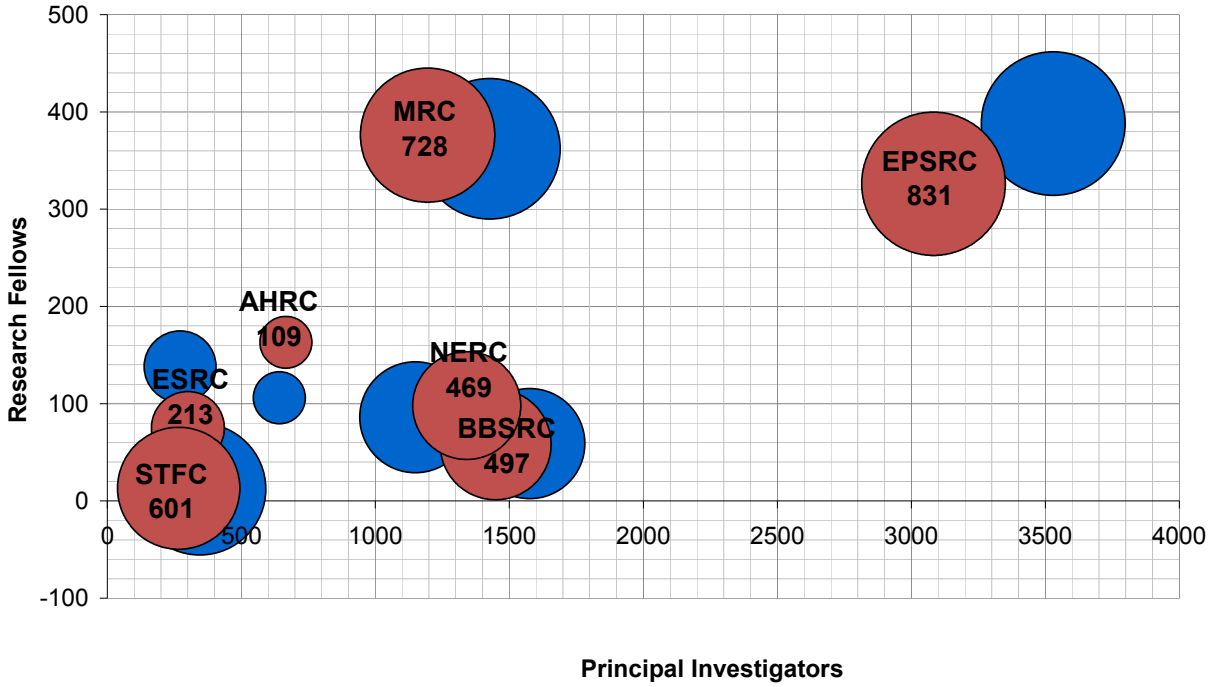

Figure 3: Human capital inputs. Bubble size represents Research Council Income with numbers reflecting income in 2011/12. Horizontal position measures number of PI's, vertical position measures number of Research Fellows.

Whereas PIs and other researchers funded by research grants are often funded partially rather than full time, Research Fellowships are a class of grants that fund a researcher fully for a period of time so that they can dedicate themselves to the pursuit of knowledge, either for specialisation, developing a research career or for changing research direction. Research leaders in sponsored institutes, for those Councils that have them, may not fit into either category. Below, where appropriate, research leaders are added to the count of PI's because they also lead research teams, rather than working individually as Research Fellows.

Figure 3 shows that the number of funded PIs (and research leaders where applicable) has fallen overall - most red bubbles are to the left of the blues - but for some Councils, notably AHRC, MRC and NERC, there has been an increase in the number of funded Research Fellows - red bubbles up from the blues.

Despite an overall fall in the absolute number of PIs and Research Fellows accounted for each year, it is notable that together they still funded nearly 9,500 researchers in 2011/12.

[20] Some Council's have begun to have only one application per department to manage demand,. This can easily have the effect of inducing larger teams under a single grant/PI.

Since PIs and research leaders in sponsored institutes lead teams of unknown size, the actual count of human capital input is higher than the headcount of 9,500. Note however that the fall in numbers leading the research may reflect a growing trend towards funding larger and longer programmes and projects, and therefore not necessarily a loss of human capital input.

Fewer funded PIs need not result in reduced research excellence and/or productivity, provided adequate support and facilities are provided and dedicated funds are concentrated towards the more prolific and successful researchers. The evidence presented below regarding the direct outputs of the research base potentially supports this view of substitution alongside the intensive margin where budget restraint has had the effect of concentrating fewer resources among the more excellent parts of the research base.

Outputs

The New Metrics Framework in the Appendices acknowledges a multiplicity of outputs from investments in the research base that can be quantified, not all of which apply to every Research Council in every single year. This report highlights only the knowledge, skilled people and business opportunities that are directly generated as a result of research funding. The Impact Reports provide additional case study evidence of outputs that are more difficult to quantify systematically.

New Knowledge

The new theories, ideas and methods produced and developed by funded researchers have the potential to markedly improve the lives of citizens. New knowledge is vital in providing the solutions to many of the problems facing the economy, environment and society.

Whilst it is impossible to accurately quantify the total amount of new knowledge that research creates in any one year, publications are a primary repository of this knowledge. Therefore the numbers of publications attributable to Research Council's funding provide a good proxy for knowledge generation. Although researchers publish in a variety of different formats, including books, monographs, and digital media, common reporting of different types of publication outputs is still experimental. This leaves peer-reviewed publications as the metric of choice for approximating the volume of new knowledge generated by research funding.

Figure 4 illustrates the number of Refereed Publications recorded by each Research Council (measured by the left axis) and the total number of Refereed Publications (measured by the right axis). AHRC and BBSRC have recently changed the way in which publication data is collected and have thus been excluded, however, together these two Councils are estimated to add around 5,000 refereed publications to the level accounted for by others.

**Figure 4: Publication counts for 5 Research Councils (left axis)
Total (right axis, AHRC and BBSRC not included)**

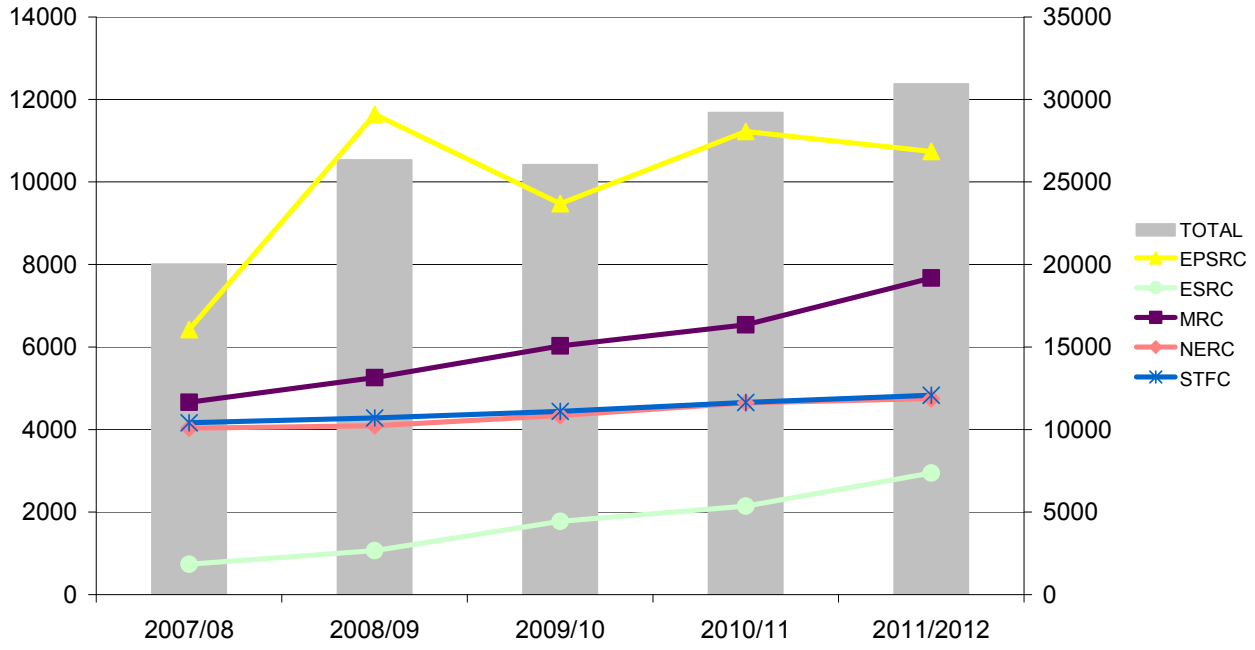

Figure 4: Publication counts for those Councils that reported it over time (exclude AHRC and BBSRC). Left axis shows counts per individual Council line, right axis shows counts for the sum of all five. Missing data for STFC in 2011/12 has been extrapolated using the annualised growth rate over the previous four years.

For the five Research Councils in Figure 4[21], publication counts have increased at a rate of 12% per annum in the five years to 2011/12 and by 9% per annum over the last three years alone, reaching 31,000 publications in 2011/12. It is clearly established that there are lags between the funding of research and the publication of findings and thus the attribution of publications in one year to funding in that same year is inaccurate at best.

Considering trends over the last five years for illustration without annual attribution shows that while income increased at an annualised rate of 2.4% in real terms, as noted above, publication counts increased at a 12% rate year on year for the five Councils considered over the five years from 2007/8.

In broad terms, the slower growth in publications in the last three years, at 9%, indicates a predictable trend response to lower inputs with slower growing outputs. This observed response in trends can be taken as early indication that Research Councils are concentrating scarcer resources on excellent research. However due to lags in publication counts following income changes, it is early to make a definite assessment of future publication growth.

[21] Missing data for STFC in 2011/12 has been extrapolated using the annualised growth rate over the previous four years.

**Figure 5: PhD starters by Research Council (left axis)
EPSRC and Total (right axis)**

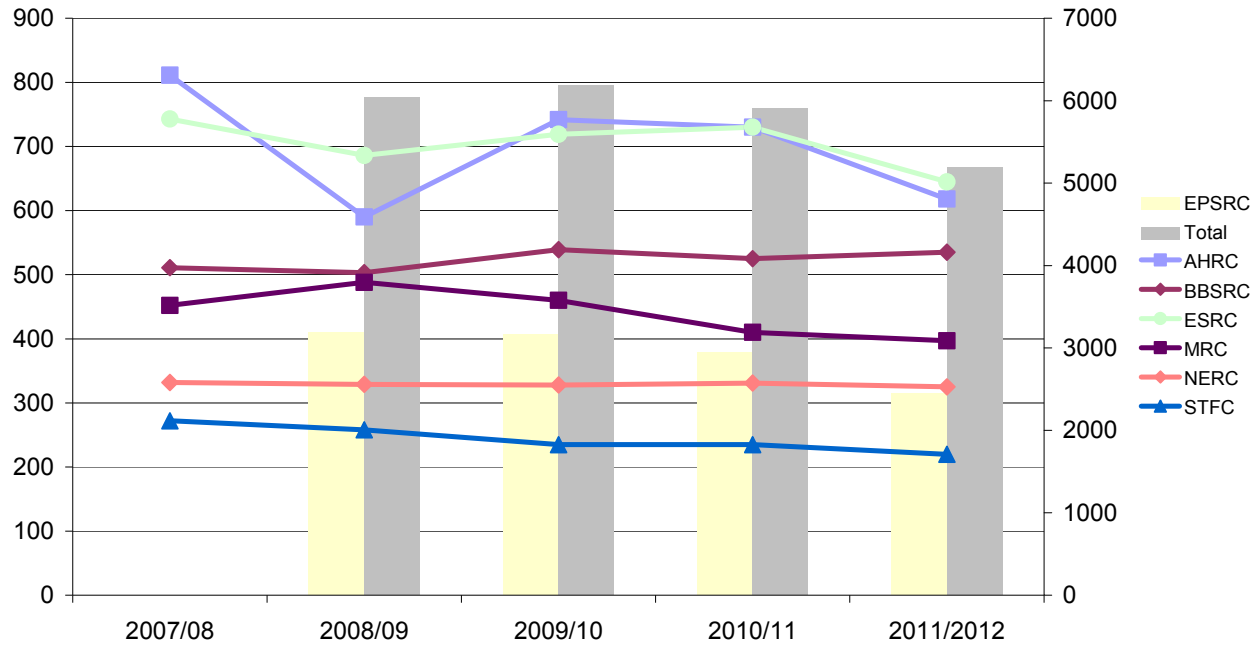

Figure 5: PhD starter counts. EPSRC starts at 3,200 in 2008/9 which is much higher than all other Councils therefore displayed as yellow bar together with total counts (grey bar) on right axis. All other Councils on left hand axis.

Human Capital

Besides using their time and skills to generate new knowledge, many funded researchers will perform the dual role of teaching students, developing the skills and knowledge of future generations of workers. Consequently human resources can constitute both an input and an output of the national science and research system. In this report funded researchers are regarded as an input; the flow of students and learners out of the science and research system are counted as an output.

Figure 5 shows the numbers of new PhD students supported by each Research Council and the total number supported by Research Councils over the past 5 years. The left axis measures the headcount at individual Research Councils excluding EPSRC; the right axis measures EPSRC and the total across all seven Research Councils. Restricting the count to newcomers avoids double-counting and provides an indication of the potential annual flow of highly skilled workers that will add to the national stock upon graduation.

The total number of PhD starters funded directly by Research Councils has fallen by 8% per year since 2009/10 from 6,200 to 5,200 in 2011/12. This decline demonstrates a continual downward trend in PhD starters following its peak in 2009/10.

For some Research Councils this development is the result of an increase in studentships funded through Centres for Doctoral Training and other similar models. Alternatively other falls in the PhD count, including the sharp drop experienced by EPSRC, can be explained by an increase in focus on the quality of PhD training courses, prioritising and protecting support for the best students. The pattern observed for postgraduate starters thus reflects a concentration of scarce resources among the best and brightest.

Figure 6: Intellectual Property and Spinouts (left axis)
Patent Applications (right axis)

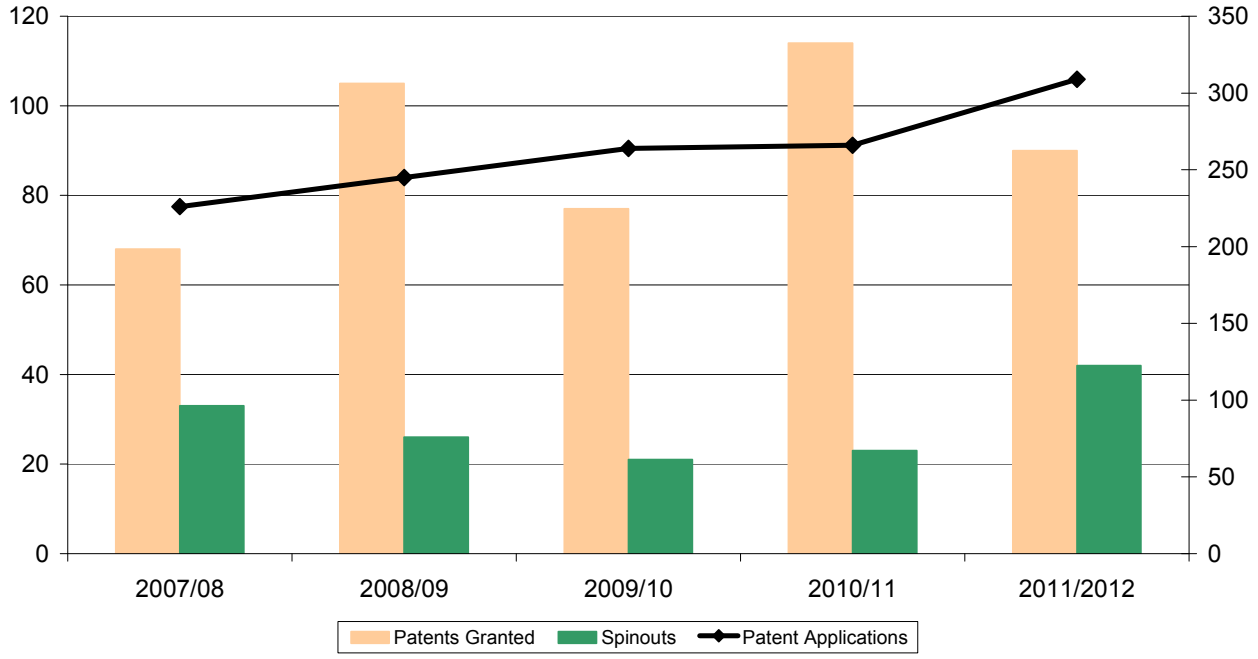

Figure 6: Patents granted and spinout companies attributable to Research Council funding counted on the left axis. Patent applications filed on the right axis.

An indication of the potential stock of highly skilled workers can be inferred from finishing rates. Research Council finishing rates express the proportion of funded doctoral students submitting their thesis within four years of commencement of support. High rates of completion have been maintained across Research Councils, reaching on average 87%. Combining starting headcounts and finishing rates suggests that approximately 5,000 PhD graduates a year are currently being delivered by Research Councils to the economy, with associated benefits in the labour market.

Intellectual Property and Spinouts

The transfer of new postgraduates into employment and the transfer of technological knowledge from academia to the private sector are among the most immediate channels for the research base to generate impact. Commercialisation activity, as captured by patenting and licensing and the creation of new businesses are a minority activity among academic researchers[22], and are generally led by the research institutions themselves, rather than directly by the Research Councils. However these indicators often attract a great deal of attention because they demonstrate direct links between generation and potential use of knowledge and underpin the market for technological problem solving. Other problem solving activities are captured through consultancy and collaborative research services; see for example the Higher Education Business and Community Interactions Survey[4].

[22] See Figure 10 in http://www.cbr.cam.ac.uk/pdf/AcademicSurveyReport.pdf

Figure 7: Percentage of annual PhD graduates working in the Private Sector within 6 months of completing DLHE

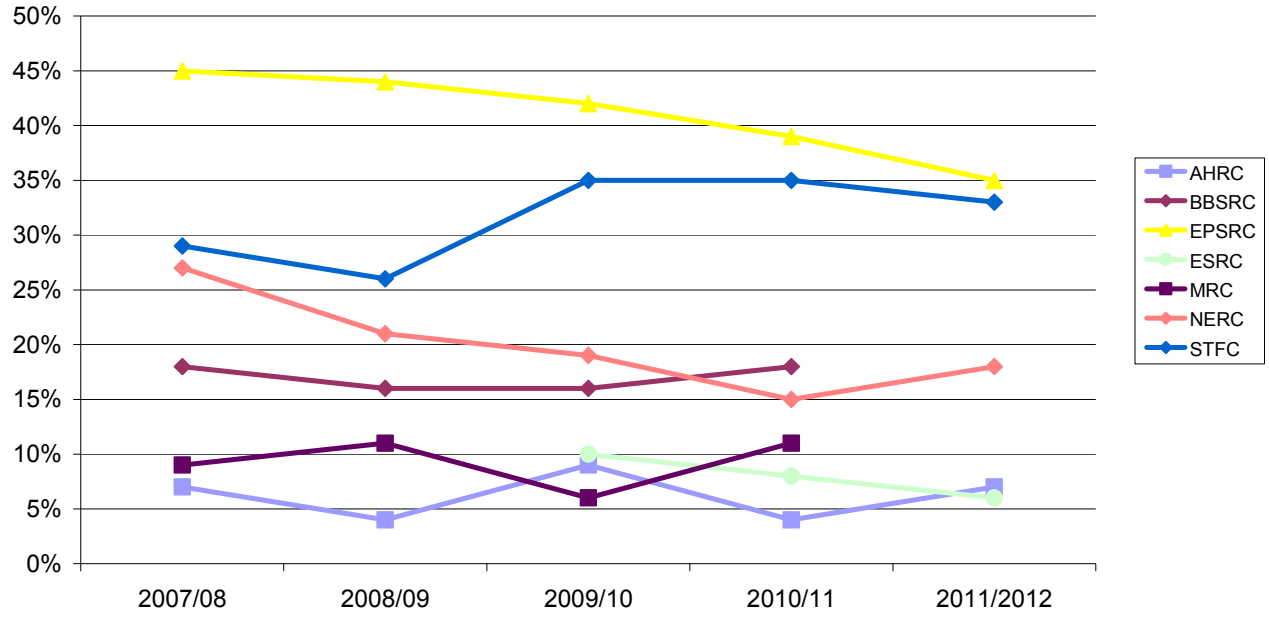

Figure 7: Destinations of PhD cohort leaving HE in each year. Percentage of each Research Council's cohort for whom destinations are known. Other destinations listed in text.

Not all Councils have returns on all technology transfer metrics in every year and thus contributions to totals do not come from the same units in every year. This makes it difficult to make aggregate or trend assessments because patents granted and spinout counts fluctuate for reasons outside the control of the Council (legal and IP requirements). Patent applications display a clear upward trend but not all applications result in granted patents in every year.

Figure 6 displays total counts of spinouts and patents granted with a scale on the left axis and patent applications as measured on the right axis. Despite financial restraint these trends have remained either static or have increased in recent years.

Outcomes

The outcomes and impacts of investments in Science and Research are substantial, as demonstrated in the Impact Reports, but they often take years to accrue, draw on compounded funding and are difficult to quantify and attribute. Since this report focuses on metrics to identify trends, many economic and social outcomes are excluded because they cannot be systematically assessed over time. Nevertheless such outcomes are well-covered in the Impact Reports.

Human Capital

Employment outcomes for new PhD graduates are a potentially useful indicator which is consistent over time and across funders, and relevant to monitoring progress of investments by Councils in the research base.

Destinations of PhD students six months after graduation are collected through the Longitudinal Destinations of Leavers of Higher Education survey (DLHE). The destinations covered are Universities, the wider Public Sector, the Third Sector, the Private Sector, unknown, other destinations and unemployed. The most frequent initial destination is the University sector, with an average of 50% of PhD graduates gaining employment in Universities. These graduates become inputs into the science and innovation system.

The private sector is the second most frequent destination for funded PhD graduates with an average of 20% of funded new PhD graduates transferring to this sector over the five years observed. Figure 7 depicts the proportion of the total funded PhD graduates in each Research Council working in the private sector six months after graduation. As illustrated in the Outputs section, Research Councils deliver a steady flow of completed PhDs to the economy. Fluctuations in destinations may reflect preferences in the finishing cohort but they also reflect changing conditions in the labour market for PhDs. This data does not provide detail on the causes for these fluctuations.

Whilst EPSRC funded PhDs have the highest rate of private sector transfer out of all the Councils, they have seen a decline in the proportion transferring to the private sector in recent times. This may reflect the current employment situation in the key sectors that employ PhD graduates in engineering and physical science. For example, according to STFC, 71% of their funded graduates employed in the private sector work in financial or business services reflecting the strong demand from these sectors for the high-level computing, modelling, quantitative and transferable skills that are developed through an STFC PhD.

Finally whilst it is common for PhDs to remain in academia immediately after finishing, it is also likely that a significant number of PhD graduates transfer to the private sector later on in their professional career (after a stint as a post-doctoral researcher).

Ending statement

This report has reviewed the evidence of trends in a selection of inputs, outputs and outcomes contained in the quantitative element of the Impact Reports returned by Research Councils in 2012.

In as far as quantifiable activity is illustrated by these metrics they demonstrate various features of the system of research funding managed by Research Councils.

- The time series views demonstrate recent changes in the overall funding with a reduction in the total but little difference in the relative allocations to each Council over time.
- The cross-sectional views demonstrate the breadth of coverage of the Research Councils. Each Council covers complementary but non-overlapping areas of research funding activity.
- The evidence suggests that in response to reductions in income drawn from both public and external sources the Research Councils have been managing funds so as to maintain or increase investment in research grants and post-graduate support.
- The evidence also suggests that Research Councils are concentrating the scarcer resources among the more excellent researchers and students.

Department for Business Innovation & Skills

Appendix A: New Metrics Framework

INPUTS	OUTPUTS	OUTCOMES
Structure of Income and Expenditure Income from BIS and by source Expenditure by category: Research Grants, Post Graduate Support and Other	**Knowledge Generation** Bibliometrics Other publication outputs Co-authorship with industry and abroad	**Public Policy** Where available account for instances of policy influence – possibly illustrate with case studies
Human Capital (Input) Principal Investigators and Research Leaders in Sponsored Institutes Research Fellows	**Human Capital (Flow and Stock)** Students supported Finishing Rates	**Human Capital (Stock)** Destinations of leavers Placements in user organisations
Other Inputs Income contributed by non-BIS entities	**Commercialisation** IP activity IP income	**Impact Case Studies** Examples of how past research is improving the life of citizens in the present.

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Appendix B: List of Metrics

NEW METRICS FRAMEWORK –BIS

CATEGORY / METRIC	UNITS	DEFINITION
Income and Expenditure		
Total Funds Available	£m	Total funding available to the research council - Sum of Grant in Aid and Leverage
Budget Allocation	£m	Research council Grant-in-Aid
Leverage	£m	Funding other than Grant-in-Aid. Sum of components below
of which Private	£m	Funding Leveraged from the Private Sector
of which from other Research Councils	£m	Funding Leveraged from other research councils
of which from other source	£m	Funding received from all other sources.
of which Private	%	As a percentage of Total Funds Available
of which Other Research Councils	%	As a percentage of Total Funds Available
of which Other	%	As a percentage of Total Funds Available
Total Expenditure		
of which Research Grants	£m	Accounts Expenditure on Responsive Mode Grants
of which Postgraduate Awards	£m	Accounts Expenditure on Postgraduate Student Support
of which Other components	£m	Residual Expenditure on other components as Total funding minus two above
of which Responsive Mode Grant	%	As a percentage of Total Funds Available
of which Postgraduate Awards	%	As a percentage of Total Funds Available
of which Other components	%	As a percentage of Total Funds Available
Human Capital		
Principal Investigators	#	Total number of principal investigators directly supported on DATE
Research Leaders in Sponsored Institutes	#	Total number of research leaders in sponsored institutes where applicable on DATE
Research Fellowships	#	Total number of Research Fellowships on DATE
Knowledge Generation		
Number of Grants assessed for reporting	#	Number of grants assessed to which the outputs reported refer
Refereed Publications	#	Number of papers published in peer reviewed journals
Non Refereed Publications	#	Publications OTHER THAN those included under Refereed Publications
Co-authorship of refereed publications - International	#	
Co-authorship of refereed publications - Industry	#	
Human Capital		
Number of PhD Students Supported	#	Number of NEW PhD students supported on DATE
Finishing Rates	%	Percentage of PhD students submitting within 4 years of commencement of support (for example row 2007/08 refers to students who began in 2003/04)
Commercialisation Activities		

NEW METRICS FRAMEWORK –BIS

CATEGORY / METRIC	UNITS	DEFINITION
Patents applications	#	Patent Applications to RC investments
Patents granted	#	Patents Granted to RC investments
Spinouts/new businesses created	#	Number of new spinouts created from RC investments
Income from IP activity	£m	Income from IP including areas such as licence income and receipts from sales of shares in RC funded companies.
Human Capital		
Destinations of leavers		Total Number of leavers from Doctoral Programmes in this academic year (DLHE)
Of which University	%	
Of which Wider Public Sector	%	
Of which Third Sector	%	
Of which Private Sector	%	
Of which Unknown or Other	%	
Of which Unemployed	%	
Placements in user organisations	#	Count instances of funded placements in user organisations
Public Policy		
Instances of influence		Examples of influence in policy
Value/changes induced		Examples of measured impact

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