



National Audit Office

MEASURING UP

HOW GOOD ARE THE GOVERNMENT'S
DATA SYSTEMS FOR MONITORING PERFORMANCE
AGAINST PUBLIC SERVICE AGREEMENTS?

JUNE 2010

Comprehensive Spending Review 2007 covering the period 2008-2011

**Review of the data systems for Public Service
Agreement 4 led by the Department for
Business, Innovation and Skills:**

*‘Promote world class science and innovation
in the UK’*

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Contents

Summary	4
Findings and conclusions for individual data systems	8
Indicator 4.1: Percentage UK share of citations in leading scientific journals	9
Indicator 4.2: Amount of income generated by UK Higher Education Institutions and Public Sector Research Establishments through research, consultancy and licensing of intellectual property	11
Indicator 4.3: Percentage of UK businesses with 10+ employees that are “innovation active”	12
Indicator 4.4: The number of students who qualify with PhDs in Science Technology, Engineering and Mathematics (STEM) at UK Higher Education Institutes (HEIs)	13
Indicator 4.5: Number of young people in England taking A levels in mathematics, physics, chemistry and biological sciences	14
Indicator 4.6: UK R&D intensity in the 6 most R&D intensive industries, relative to other G7 economies	16

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Summary

Introduction

1. This report summarises the results of our examination of the data systems used by the Government in 2009 to monitor and report on progress against PSA 4 “Promote world class science and innovation in the UK”.

The PSA and the Departments

2. PSAs are at the centre of Government’s performance measurement system. They are usually three year agreements, set during the spending review process and negotiated between Departments and the Treasury. They set the objectives for the priority areas of Government’s work.
3. This PSA is led by the Department for Business, Innovation and Skills (the Department). The Department was formed on 5 June 2009 following the merger of the Department for Business Enterprise and Regulatory Reform (BERR) and the Department for Innovation, Universities and Skills (DIUS). This PSA was previously led by DIUS.
4. Data for the measurement of this PSA is provided by, amongst others, the Higher Education Statistics Agency¹, the Office for National Statistics, the Department for Children, Schools and Families and the Organisation for Economic Co-operation and Development. Each PSA has a Senior Responsible Officer who is responsible for maintaining a sound system of control across Departmental boundaries that supports the achievement of the PSA. The underlying data systems are an important element in this framework of control.
5. The most recent public statement provided by the Department on progress against this PSA was in the 2009 Autumn Performance Report².

The purpose and scope of this review

6. The Government invited the Comptroller and Auditor General to validate the data systems used by Government to monitor and report its performance. During the period September 2009 to January 2010, the National Audit Office (NAO) carried out an examination of the data systems for all the indicators used to report performance against this PSA. This involved a detailed review of the processes and controls governing:

¹ Set up in 1993 by agreement between the relevant government departments, the higher education funding councils and the universities and colleges to provide a system of data collection, analysis and dissemination in relation to higher education in the UK.

² Published December 2009 – URN 09/P36 available from www.bis.gov.uk

- The match between the indicators selected to measure performance and the PSA. The indicators should address all key elements of performance referred to in the PSA;
 - The match between indicators and their data systems. The data system should produce data that allows the Department to accurately measure the relevant element of performance;
 - For each indicator, the selection, collection, processing and analysis of data. Control procedures should mitigate all known significant risks to data reliability. In addition, system processes and controls should be adequately documented to support consistent application over time; and
 - The reporting of results. Outturn data should be presented fairly for all key aspects of performance referred to in the target. Any significant limitations should be disclosed and the implications for interpreting progress explained.
7. Our conclusions are summarised in the form of traffic lights (see Figure 1). The ratings are based on the extent to which Departments have:
- (i) put in place and operated internal controls over the data systems that are effective and proportionate to the risks involved; and
 - (ii) explained clearly any limitations in the quality of its data systems to Parliament and the public
8. The remaining sections of this report provide an overview of the results of our assessment, followed by a brief description of the findings and conclusions for each individual data system. Our assessment does not provide a conclusion on the accuracy of the outturn figures included in the Department’s public performance statements. This is because the existence of sound data systems reduces but does not eliminate the possibility of error in reported data.

Figure 1: Key to traffic light ratings

Rating	Meaning ...
GREEN (fit for purpose)	The data system is fit for the purpose of measuring and reporting performance against the indicator
GREEN (disclosure)	The data system is appropriate for the indicator and the Department has explained fully the implications of limitations that cannot be cost-effectively controlled
AMBER (Systems)	Broadly appropriate, but needs strengthening to ensure that remaining risks are adequately controlled
AMBER (Disclosure)	Broadly appropriate, but includes limitations that cannot be cost-effectively controlled; the Department should explain the implications of these

RED (Systems)	The data system is not fit for the purpose of measuring and reporting performance against the indicator
RED (Not established)	The Department has not yet put in place a system to measure performance against the indicator

Overview

9. The Science and Innovation Investment Framework 2004-14 reflects the long term nature of the Government's science and innovation policy objectives. The focus of this PSA however, is on the progress that will be made over the CSR07 period (2008-2011) towards the longer term ambition of world-class science and innovation in the UK.
10. This PSA is supported by six indicators. For this PSA, we have concluded that the indicators selected to measure progress are consistent with the scope of the PSA and afford a reasonable view of progress. However, it is unclear whether the indicator set measures clearly the Department's own impact on promoting science and innovation.
11. At the time of our review, governance arrangements around the control framework were being revised following the creation of the Department in June 2009. The range of governance processes in place over PSAs included:
 - Departmental management board monitoring of PSA performance on a regular basis;
 - PSA programme board led by a senior responsible officer, responsible for risk management on individual PSA indicators with a remit to escalate risks to the management board; and
 - responsibility for data quality residing in the PSA sponsor directorate with a named data owner responsible for data compilation for each indicator, supported by analysts.
12. Overall quality assurance is the responsibility of the sponsor Directorate. While the Department has underlying quality and training measures in place there is no standardised quality control methodology applied across directorates. Quality control processes are generally undertaken by individual data owners and their team, who complete checks on their respective indicator. However in a number of cases reliance is placed on the controls in operation by other government bodies, which are not always reviewed regularly for adequacy.
13. The Department has procedural documentation and manuals in place documenting processes used to quality assure and calculate data, however in some cases procedures for identifying and assessing risks to data reliability, controls, and other processes involved in measuring targets were not always documented. Additionally although a high level risk register is in place for the PSA, there were some instances

where risks were discussed more informally, for example, with a contractor involved, and not documented.

14. The Department’s internal audit unit undertook a scoping exercise in 2008-09 with regards to the Science and Innovation PSA which found that despite all significant parts of the delivery system being represented at a senior level on the PSA Board, the delivery plan was incomplete and more work was needed to identify the expected impact of key actions for each indicator and to strengthen success measures. Key risks had been identified but mitigating actions needed to be implemented.
15. Where these issues have a specific impact on individual indicators, we explore them further in the next section of this report.
16. Figure 2 summarises our assessment of the data systems.

Figure 2: Summary of assessments for indicator data systems

No	Indicator	Rating
1	Percentage UK share of citations in leading scientific journals	GREEN (Fit for purpose)
2	Amount of income generated by UK HEIs and PSREs through research, consultancy and licensing of intellectual property	GREEN (Fit for purpose)
3	Percentage of UK businesses with 10+ employees that are “innovation active”	GREEN (Fit for purpose)
4	The number of students who qualify with PhDs in Science Technology, Engineering and Mathematics (STEM) at UK Higher Education Institutes (HEIs)	GREEN (Fit for purpose)
5	Number of young people in England taking A levels in mathematics, physics, chemistry and biological sciences	AMBER (Systems)
6	UK R&D intensity in the 6 most R&D intensive industries, relative to other G7 economies	GREEN (Fit for purpose)

17. Our main conclusions on the PSA are:

- there is a good match between the indicators and the data being used to monitor their progress;
- the Department has made adequate disclosure of the inherent weaknesses in the data it is using. There is however scope for the Department to be more explicit about weaknesses within its Departmental Annual Reports and Autumn Performance Reports;

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- the Department is undertaking appropriate work in order to strengthen those systems that we have previously rated at amber and improve the quality of data; and
 - where previous validation work has indicated areas of improvement the Department has carried out further work to quantify the impact of weaknesses or implemented improved methodologies.

18. We recommend that the Department:

- carries out risk assessments on the supply of external data it uses to ensure third parties have adequate controls in place. This would also serve to identify where changes in data sets may impact on data quality; and
- ensures evidence is available for all data controls and processes which are in place.

Assessment of indicator set

19. In undertaking the validation we read the documentation associated with the PSA, including the Delivery Agreement and considered whether the indicators selected to measure progress are consistent with the scope of this PSA.

20. We conclude that the indicators selected afford a reasonable view of progress against this PSA. However the indicators that make up the PSA do not adequately measure the priority actions set out in the Delivery Strategy³ and although the PSA indicators are not explicitly stated as measures of the priority actions the Department could consider better alignment of the indicators and priorities.

Findings and conclusions for individual data systems

21. The following sections summarise the results of the NAO's examination of each data system.

³ PSA Delivery Agreement 4, HM Treasury October 2007

Indicator 1

Percentage UK share of citations in leading scientific journals

Conclusion: Green (Fit for purpose)

22. The data system involved is relevant and appropriate to measure progress against this indicator. The indicator is relatively simple, and the risks to the data system low.
23. We do not consider there to be any significant risks which have implications for the quality of the data reported. However, the Department should disclose its reliance on the reputation alone of the database to assess the risk of inaccuracy of data. There are minor improvements to documentation that could be made.

Characteristics of the data system

24. Thomson Reuters scientific journal database is used by the Department's contractor to calculate the percentage of UK citations. The database indexes over 8,000 journals in 35 languages. Leading scientific journals are defined by the wider scientific community and are generally accepted as those journals having the most 'impact factor', that is those containing original research articles which are cited most often by peer scientists. Despite a very large number of scientific journals, the concentration of scientific information is skewed to a minority of journals that publish the majority of the articles and receive the majority of the citations. These include, for example, journals such as *Nature*, *Science* and *Proceedings of the National Academy of Sciences of the USA*.
25. The Department considers Thomson Reuters scientific journal database to be a reputable data source and that it can rely on the accuracy of the data provided. It is the only source of data available to the Department to measure progress against this indicator.

Findings

26. The data system is clearly relevant to the indicator.
27. The system is robust and reliable. The Department perceives the risk of inaccuracy in the Thomson Reuters scientific journal database to be low; although this judgment is based on reputation as the most accurate data source for journal citations rather than active identification of risks to the reliability of the data. The Department should ensure the risk assessment is documented and that controls operated by the contractor are verified.
28. The Department has ongoing discussions with its contractor regarding data accuracy issues and actively scrutinises the results produced by the contractor. The system produces comparable results and the Department has worked closely with the contractor to ensure consistency of reporting over time.

29. The measurement of the indicator is clearly presented in the 2009 DIUS Departmental Annual Report and 2009 BIS Autumn Performance Report and the Department's view of the quality of the data stream is also reported.

Indicator 2

Amount of income generated by UK Higher Education Institutions and Public Sector Research Establishments through research, consultancy and licensing of intellectual property

Conclusion: Green (Fit For Purpose)

30. The data systems involved are relevant and appropriate to measure progress against this indicator. We do not consider there to be any risks which have implications for the quality of the data reported.

Characteristics of the data system

31. Information from the Higher Education – Business and Community Interaction (HE-BCI) survey and the survey of Public Sector Research Establishments (PSRE) is aggregated to determine income from business (research and consultancy) and income from licensing intellectual property.

32. The HE-BCI survey of higher education institutions is carried out by the Higher Education Statistics Agency (HESA) and the PSRE survey is carried out on behalf of the Department by an independent contractor.

Findings

33. The HE-BCI data system is well established and the Department regards HESA as a reliable organisation with solid experience in this field. Data processing and analysis in this case are very simple and do not include any qualitative data. HESA has adequate processes in place to control the quality of its data analysis, and these are appropriately documented. The Department also maintains a good overview of data quality issues through its presence on the HE-BCI Stakeholder group.

34. With regards to the PSRE survey a review of the data is undertaken by the contractor and reviewed by the Department, including year on year variance analysis and agreement of income figures to statutory accounts where possible. Under a memorandum of understanding the Department also scrutinises the results produced by the contractor and the data processing through spot checks on the contractor and regular meetings to ensure reliability, although the regular meetings are informal and are not minuted.

35. In relation to the HE-BCI survey there has been no assessment of specification risk since the indicator was established. The Department has undertaken an assessment of specification risks for the PSRE survey indicator.

36. The PSRE survey does not get a full response rate (around 90 per cent). Although this is very high, the results are grossed up to take account of non respondents based on returns from similar organisations.

37. The consistency of questions within the surveys ensures comparability with prior year data and the reporting of this indicator is clear.

Indicator 3

Percentage of UK businesses with 10+ employees that are “innovation active”

Conclusion: Green (Fit for purpose)

- 38. The data system involved is relevant and appropriate to measure progress against this indicator.
- 39. We do not consider there to be any risks which have implications for the quality of the data reported.

Characteristics of the data system

- 40. The UK Community Innovation Survey is a survey run by the Office for National Statistics (ONS) on behalf of the Department. The survey collects data on the innovation characteristics of UK firms that are deemed to be ‘innovation active’ following guidelines set out in the Organisation for Economic Cooperation and Development’s Oslo manual. The data includes measures of innovation-related expenditure, rates of innovation and factors which have either encouraged or hindered innovation. As similar surveys are being conducted in other EU member states using the same methodology it will be possible to benchmark the performance of UK firms against that of their EU competitors.
- 41. Firms that have innovation characteristics are counted and presented as a percentage of all firms. The target response rate is 50 per cent and the methodology used for sampling was considered by NAO statisticians and deemed robust as part of previous NAO validation work.

Findings

- 42. The Department has an agreement with the ONS with respect to carrying out the survey. The agreement also specifies the minimum response rate the Department is willing to accept. Where this is not met, the ONS have procedures to follow up non response items to meet the Department’s requirements.
- 43. The Department receives raw data from ONS. This is then processed and analysed by the Department, mostly by means of checking survey responses to a pre designed check list which will indicate whether or not the company should be classified as innovation active.
- 44. The data stream is robust and well defined to measure against this indicator. The survey itself has been refined over time to improve clarity for respondents. The survey has been conducted more frequently for the last two iterations, now being carried out every two years rather than every four years. This will ensure the Indicator is more easily measured against between Comprehensive Spending Reviews.

Indicator 4

The number of students who qualify with PhDs in Science Technology, Engineering and Mathematics (STEM) at UK Higher Education Institutes (HEIs)

Conclusion: Green (Fit for purpose)

45. The data system involved is relevant and appropriate to measure progress against this indicator.
46. The data system is simple and does not involve any complex analysis which means that there are limited risks involved.
47. We do not consider there to be any risks which have implications for the quality of the data reported.

Characteristics of the data system

48. The Higher Education Statistics Agency's (HESA) Student Record is used to count the number of students qualifying with PhDs in STEM subjects.
49. The Student Record is collected in respect of all students registered in the reporting institution who follow courses that lead to the award of a qualification or institutional credit.

Findings

50. This is an established data system and the Department obtains its assurance from the risk assessment and controls operated by the HESA, the Department does not have a separate risk register.
51. The HESA has developed extensive quality assurance procedures and runs a range of validation checks against all submissions including five per cent of records being subjected to random check. Any anomalies are investigated by the HESA.
52. The Department checks the variables it uses by checking for anomalous changes year-on-year and levels of missing values (if any).
53. The HESA is experienced in data processing and analysis and this data system does not require complex measures or complicated statistical calculations.

Indicator 5

Number of young people in England taking A levels in mathematics, physics, chemistry and biological sciences

Conclusion: AMBER (Systems)

54. We have concluded that the data system underlying this indicator is broadly appropriate, but needs strengthening to ensure that responsibilities for quality assurance and reporting data quality are clarified between the relevant Departments.

Characteristics of the data system

55. This indicator is defined under the National Indicator Set (NIS 85) and it is a National Statistic. Data underlying the School and College Key Stage 5 Achievement and Attainment Tables (AATs) is used to measure this indicator and these tables are published annually by the Department for Children, Schools and Families.

56. Awarding bodies (which set and mark the examinations) provide information on the numbers of A level entries for each subject included in the indicator, which are analysed by a contractor and reported on in the Key Stage 5 AATs. The Qualifications and Curriculum Authority (Ofqual from 1 April 2010) has responsibility for ensuring that standards in the examinations remain consistent from year to year.

57. The Department for Children, Schools and Families has an agreement in place with the contractor setting out the process by which data should be assessed for robustness and the quality control procedures which should be applied to ensure that the data is accurate.

58. As an additional quality control check the Department for Children, Schools and Families recalculates the AATs from the data provided by the awarding bodies to ensure that information reported within the tables is accurate. This process is documented and overseen by the Department's Data Services Group, any issues and inconsistencies are discussed with the contractor prior to the publication of the AATs and the indicator. The Department monitors the contractor's risk register and has also identified the risks to data quality on its own risk register.

Findings

59. NIS 85 is strictly concerned with the physical sciences i.e. Physics, Mathematics and Chemistry. However, the Government aims to achieve year on year increases in the numbers of young people taking A levels in the physical sciences without adversely affecting the number taking Biology A level so the overall indicator is appropriate. All A level data is collected using the same methodology by the awarding bodies and measured against the national pupil database.

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60. The Department for Children, Schools and Families has established robust arrangements to ensure the examination results data for the AATs are appropriately collected, processed, analysed and reported. In particular, the Department recalculates the AATs from the raw data and compares results with the contractor's, investigating and resolving any discrepancies prior to the calculation of the indicator. Schools are also given the opportunity to challenge the results reported in the provisional AATs, prior to both the AATs and indicator being published.
61. However, the reporting process for this indicator is not well defined. The indicator is reported by the Department for Business, Innovation and Skills, the lead Department for this PSA, but it does not undertake any further quality assurance work itself and made no reference to data quality in the BIS 2009 Autumn Performance Report.

Indicator 6

UK R&D intensity in the 6 most R&D intensive industries, relative to other G7 economies

Conclusion: Green (Fit for purpose)

62. The data system involved is relevant and appropriate to measure progress against this indicator.
63. Performance against this indicator is determined by using data from reliable sources with minimal analysis or processing. We do not consider there to be any risks which have implications for the quality of the data reported.

Characteristics of the data system

64. The six most R&D intensive industries (Aerospace, Electronics, Office machinery and computers, Pharmaceutical, Instruments and Services) are those used in the main science and technology indicators by the Organisation for Economic Co-operation and Development (OECD) and enable international comparison.
65. Research and Development is defined as “Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications”.
66. Survey data from the OECD regarding R&D is published for the US, Japan, France and Germany. The Department compares this G7 data to that obtained from the Office of National Statistics (ONS) Business Enterprise Research and Development (BERD) survey, which measures R&D in the UK. The measure is estimated using a standardised survey methodology based on international guidelines published by the OECD in the Frascati manual⁴.

Findings

67. The Department considers the data to be good quality since all data is supplied by national Statistics Offices and revisions to country data tend to be minor.
68. Both data streams are robust, well defined and allow the Department to fully measure against the indicator.

⁴ An internationally recognised methodology for collecting and using R&D statistics, it includes definitions of basic concepts, data collection guidelines, and classifications for compiling statistics.