

# **First no Choice, then Some Choice, and Finally Overload**

## *A Reasonable Data Management Evolution?*

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**Abstract:** Data management has moved in evolutionary ways in the education system in England. Although some might say that the current evolution has moved from a situation where there was no choice (20 and more years ago), to one where there was some choice (up to 20 years ago), to a position where there is now overload, this paper will argue that that is not the case when the position is viewed from certain perspectives. The paper will contend that data itself has changed little over a period of 20 years, but that data analyses, forms of data presentation, and access to data handling facilities have all changed a great deal. The paper argues that this has led to 'data complexity' rather than 'data overload'. Indeed, as the paper will show, when concerns about current national policies are considered, it is inevitable that the evolution will continue. It is argued that in this period of future evolution, 'smarter' systems will be needed if increasing numbers of facilities are to be used effectively and efficiently.

**Keywords:** Data management; data handling; data in schools; features of data systems; educational management and data; future of data systems

## **1. INTRODUCTION**

It is sometimes said that the educational system in England suffers from overload in terms of quantities of data available and in terms of provision for its access. Whether this is a recent phenomenon is one question that could be asked, but whether this is a phenomenon at all is another that is perhaps more important. If the questions are viewed from the perspective of what is available and accessible, then different answers will arise from those answered from a perspective concerned with those who use or access the data and data facilities. A review of facilities that are accessible (Passey, 2008) suggests a much greater level of potential than that described when users are asked about their levels of use (indicated, for example, in Kirkup et al., 2005).

So, there is clearly some truth in a statement about future wider potential of uses of data for curriculum management purposes, but the extent might well depend upon perspective. However, some forms of data have always been accessible to teachers and practitioners. There are basically, over a period of 20 or more years, three dimensions that have changed: one dimension is the flow of data within the educational system (more people have access to other people's sources of data than they had ten years ago, for instance); a second dimension is the ways in which data are analysed (added value analyses, and estimates of outcomes based on previous results have become accessible widely in the last ten years), and a third dimension is the ways that data are presented (they are accessible now in on-line format, with sophisticated graphical interfaces, which were not accessible ten years ago). So, a key question is not whether levels or forms of data have changed and evolved, but actually whether it is the ways in which they have been handled that have changed (at least, changed more than the levels and forms of data themselves). Indeed, this paper will argue that there are, in spite of claims that England has too much data, some forms of data that are still not accessible readily to teachers, and that potentially limit what practitioners can do to support young people in classrooms (which is surely where a main focus of intention of data uses should be). Current and emerging policy in England is calling for access to further forms of data, so the period of evolution is not yet at a standstill.

## 2. AN EVOLUTIONARY OVERVIEW

Is it possible to plot what has happened over time with regard to data, their flow, the ways in which they are analysed, and the ways they can be accessed? Have certain features and factors remained unchanged, and what sort of pattern of evolution has there been? It is certainly possible to identify three key phases at a fairly simplistic level.

Some twenty years ago and more, there was no real choice available. Data that was easily accessible was data generated locally (teacher marks, and teacher records), and that generated nationally (external test and examination results). The amount of flow of those data was likely to be limited; school records were retained, but the data were not necessarily shared even with teachers in the same school. Analysis of data was very localised, and numbers of grades were sometimes the most sophisticated measures used in schools as value indicators.

As Selwood (1995) indicates, a turning point arose with the advent of the inspection system (suddenly schools were interested in how others would and could judge them on the basis of certain data), and of school management information systems introduced to support local management of schools (allowing data to be held as records, retained over periods of time, and reviewed to indicate shifts or trends). Both features were coincident with the advent of the National Curriculum in 1989. A range of

measures to identify performance at a pupil level were developed at that time, some of them at a national level (the Standard Assessment Tasks - SATs), but others at a research level (such as those in the Centre for Educational Management - CEM, at Durham University).

By the year 2000, there was already a greater focus on school improvement, in part supported by the fact that data was more accessible to those concerned with both policy and local authority support. Ofsted (the inspection service) was in a position to chart measures and outcomes of performance, and the government department at that time was concerned with how to bring about school improvement using data (discussed in Coe, 2002). The concepts of school improvement and data feedback resulted in a range of forms of ways of reviewing data, fed back to schools to support positive development. Local authorities became interested in concepts of estimating future likely outcomes of pupils on the basis of prior results. The interest of schools in showing that their performance should account for background factors, including prior attainment and socio-economic groupings, was one element that fuelled the development of a range of measures referred to as 'added value'. This range of additional elements and analyses has led to what is sometimes referred to as 'overload'.

### **3. IS THE CURRENT STATE OF PLAY A MATTER OF OVERLOAD OR A LACK OF FOCUSED USE?**

So, having moved through perhaps three periods of evolution, what forms of data handling facilities now exist, and for whom? A wide range of possible systems is available to teachers, schools and policy makers. Is there good reason to have them all, or do they all do the same thing? What makes them different? Is it the types of data they focus on? Or is it how the facilities handle and analyse data? Or indeed, is the difference a matter of when data is used?

As a secondary school teacher or manager, or someone supporting a secondary school, a number of facilities might be suggested as data handling tools that could be of value. For the purposes of this paper a range of twelve of the most popular data handling facilities are considered (although it should be noted that other data handling tools exist that have not been included here, including the Pearson Phoenix, the RM Integris and the Bromcom school management information systems, the Essex Target Tracker, question level analysis facilities such as that provided by Alfiesoft.com, and bespoke school facilities that have often been created using spreadsheets). The twelve facilities selected here can be categorised according to source:

- Government department and agency facilities (Key to Success, Pupil Achievement Tracker, and RAISEonline, although an additional facility, Achievement and Attainment Tables, allowing schools to login and see their data due to be published in the form of a

spreadsheet of individual contextual value added scores and all coefficients used in calculations, and to calculate contextual value added analyses for groups additional to those given in RAISEonline, is not included).

- Commercial company facilities within a much wider school management information system (SIMS Assessment, Facility CMIS, and Edix Live).
- Commercial company facilities with a specific range of data handling functions (Cognitive Abilities Tests - CATs, 4Matrix, and Track to Success).
- Research and charitable status support groups (CEM, Fischer Family Trust - FFT, and Data Enabler Toolkit).

To review what these facilities offer, a first port of call might be to look at what is stated on provider web sites. The relevant provider describes each facility on-line as follows:

- Key to Success provides: “2007/08 Gifted and Talented Year 7-11 pupil data, 2007 KS3 e-results, 2007 KS2 e-results, 2007 KS3 e-results including 2007 question level data, 2007 KS2 validated e-results, 2006 KS1 PAT compatible files, 2007 KS2 e-results, KS3 PAT compatible files based on the data published in the 2006 Achievement and Attainment tables (these files contain the prior attainment and pupil characteristics data used in the Contextual Value Added, CVA, model), KS4 PAT compatible files based on the data published in the 2006 Achievement and Attainment tables (the import of these files into PAT will produce CVA, Contextual Value Added, analyses)” (Department for Children, Schools and Families - DCSF, n.d.).
- Pupil Achievement Tracker can be used by teachers to: “ask questions about the effectiveness of their classroom practice looking at graphical data on the progress made by their pupils; set pupil targets informed by the progress made by similar pupils nationally; and understand fully what pupils can achieve by the diagnostic analysis of test papers. Headteachers and senior managers can view recent performance against other similar schools to help set development priorities; ask questions about the achievement of different groups within the school; and review the success of different initiatives, particularly through the ability to group pupils and look at their achievement and progress. The Pupil Achievement Tracker includes all the national data and brings it to life on screen, but takes it into the classroom by adding: pupil target setting, allowing schools to set targets informed by the progress made by similar pupils nationally; question level analysis, bringing to life what pupils can achieve in National Curriculum and Optional Tests from Years 2 through to 9. The PAT fully incorporates the functionality of the 2003 QCA diagnostic software; analysis of value-added data by different cohorts within the school, including the ability to create groups of pupils” (DCSF, n.d.).

- RAISEonline: “aims to enable schools to analyse performance data in greater depth as part of the self-evaluation process, provide a common set of analyses for schools, Local authorities, inspectors and School Improvement Partners, better support teaching and learning. Features include reports and analysis covering the attainment and progress of pupils in Key Stage 1, 2, 3 & 4, with interactive features allowing exploration of hypotheses about pupil performance, contextual information about the school including comparisons to schools nationally, question level analysis, allowing schools to investigate the performance of pupils in specific curriculum areas, target Setting, supporting schools in the process of monitoring, challenging and supporting pupil performance, data management facility providing the ability to import and edit pupil level data and create school-defined fields and teaching groups” (Ofsted and Department for Education and Skills, n.d.).
- SIMS Assessment: “helps raise pupil achievement by giving school leaders, teachers, pupils and parents the information needed to make the right decisions about pupils’ learning ... gives you the freedom to focus on what really matters in your school ... can help you personalise learning for pupils and ease the burden of lesson planning and paperwork ... can ensure leadership teams focus on school improvement and target the issues that need addressing; whether that is to raise achievement, reduce administration or target truancy ... provides a means of recording a pupil’s marks, grades and other scores to meet the school’s day-to-day assessment needs and the statutory assessment requirements of the National Curriculum ... parents can be given online access to information about how their child is doing on a daily basis so they can provide better support at home” (Capita Children’s Services, 2007).
- Facility CMIS: “is the only totally integrated management information system available to schools. The program was specially designed to reduce paperwork by operating from a central data store. Data is entered once and is available immediately for all management functions, ensuring that the stored information is always up-to-date and accurate. Changes can be made through various associated programs so there are no delays or time lags. Whenever data is called up it is extracted from live figures and so produces an accurate picture of the school at the time it is needed” (Facility, 2005).
- Edix Live: “brings together all the information held in schools, local authorities and central government departments so that you can move from ad-hoc data to a knowledge based system” (Edix Live, 2007).
- CATs measure: “the three principal areas of reasoning - verbal, non-verbal and numerical - as well as an element of spatial ability, allowing you to test the full range within an entire class or year. CAT 3: provides indicators of outcomes at Key Stages 2, 3 and 4, including 29 GCSE and 24 Scottish Standard Grade subjects; identifies

individuals' strengths and weaknesses; standardised scores allow you to compare your pupils' results with the national average; results inform target-setting and the development of individual learning plans; a sound basis for year-on-year comparisons and a measure of the added value that your school creates for its pupils; generates information that helps you to build and maintain standards of achievement" (GL Assessment, 2007).

- 4Matrix allows: "schools to analyse the comparative performance of pupils across groups, providing the key measures of Within School Variation needed to support a school improvement strategy" (4Matrix, n.d.).
- Track to Success: "provides data management, online analysis, progress tracking solutions and consultancy to schools. In building a relationship with your school, Track To Success will become an essential partner in your drive for improvement" (Track to Success, 2007).
- CEM provides: "information by developing, producing and providing tests and questionnaires to be completed by students under standardised conditions. We analyse these and provide clear graphical feedback and comparisons with many hundreds of other schools and colleges. Data on pupil progress (value added) is provided when outcome measures become available. At each stage we try to measure what matters, be it attitudes, safety, relationships, learning and teaching processes etc." (CEM Centre, 2007).
- Fischer Family Trust: "Online reports are now available for Primary as well as Secondary schools (England & Wales) and can be accessed at FFT Online. Secondary schools have three main reports: (a) Subject value-added for KS4 and KS5, (b) Segmentation/Significant Areas Grid., (c) Estimates by categories of pupils. Primary schools have two main reports: (a) Significant Areas Grid, (b) Estimates by categories of pupils" (Fischer Family Trust, n.d.).
- Data Enabler Toolkit: "supports schools in making better use of examination data. The toolkit includes the Jesson framework tutorial with personalised results alongside FFT, Raise on-line and a range of resources" (Specialist Schools and Academies Trust, 2007).

A key question that might be asked (and which is not necessarily answered by the information provided on the web sites) is whether each of the facilities provides data (raw data that is not sourced from any other data base or bank) as an element of the facility, whether they source raw data from other places, whether they analyse raw data in particular ways, or whether they present analyses of raw or transformed data. Table 1 provides an overview of these levels of functionality for each of the twelve data handling facilities.

Source of data handling facility	Name of data handling facility	Whether raw data is provided	Whether raw data can be entered or sourced from elsewhere	Whether raw data is analysed within the system	Whether raw or transformed data is presented in non-tabular visual forms
Government department and agency	Key to Success	✓	✗	✗	✗
	Pupil Achievement Tracker (original)	✗	Manual transfer (copy and paste) or by import	✓	✓
	RAISEonline	✓	Transfer by import	✓	✓
Commercial company facilities within a wider school management information system	SIMS Assessment	✗	Input and transfer by imports, wizards, or copy and paste	✓	✓
	Facility CMIS	✗	Input and transfer by imports or copy and paste	✓	✓
	Edix Live	✗	Electronic transfer	✓	✓
Commercial company facilities with a specific range of data handling functions	CATs	✓	✗	✓	✓
	4Matrix	✗	Transfer by import routines or copy and paste	✓	✓
	Track to Success	✗	Transfer by import routines or copy and paste	✓	✓
Research and charity support facilities	CEM	✓	✗	✓	✓
	Fischer Family Trust	✓	✗	✓	✓
	Data Enabler Toolkit	✓	Manual transfer (copy and paste)	✓	✓

**Table 1:** Categorising data handling facilities according to a range of user features

(The author would like to acknowledge the kind support of key providers who checked features in Tables 1 and 2 so that they are, to the best of knowledge, correct at the time the paper was written, but may change as features are added in the future.)

It is clear from Table 1 that choice of data handling facilities can be a difficult task for users. Some users may well wish to select facilities according to specific features. However, without this form of tabular categorisation, making such a choice might well be a quite daunting task in itself. Indeed, selecting just on this basis could well mean that certain important features concerned with more precise or fundamental curriculum uses are overlooked.

To explore issues concerned with more precise curriculum use, it is necessary to look at a second form of categorisation of data management facilities. The categorisation used (described in Passey, 2007), distinguishes eight different forms of data facility. These relate to specific uses of the data, and are much more concerned with data analysis and presentation features:

- Background results (these are prior national attainment results in each subject at the end of each Key Stage, both test paper and teacher assessment results, and they may be presented in forms for teachers to compare results in their subject with those in other subjects).
- Estimated likely outcomes for the end of the next Key Stage (are statistically produced, based on different statistical calculations, on the basis of prior results).
- Target summaries (these are set by teachers, and indicate the results that pupils should aim for in the future).
- Target histories (show changes in targets that are set by teachers over time, so it is possible to see whether aspirations are shifting up, down, or remain unchanged over time).
- Teacher assessments (these are marks that are recorded by teachers in each subject, across a year, and these might be for behaviour, attendance, effort, or homework as well as subject attainment), rather than SAT records of teacher assessments of end of Key Stage attainment.
- Monitoring displays (these records allow teachers to see whether their assessments match an expected progression, between pupils' prior attainment results and the future targets that the teacher sets).
- Added value measures (these measures are calculated at the end of certain periods of time, to show how a pupil or pupil group has performed in comparison to an expectation, which would indicate whether an added value has been gained or not).
- Measures that inform classroom practice (are measures that show details about pupil learning approaches, that offer data that go beyond those provided by monitoring displays of comparative levels of subject attainment performance, to allow teachers to make decisions about learning approaches and choices in classrooms).

Table 2 shows whether each of the twelve selected data handling facilities analyses and displays these forms of curriculum features in a visual (which could be tabular or graphical) way (irrespective of whether the data is entered into or sourced by the facility). In some cases, it will be seen that differences arise because of specific forms of analyses that underlie certain features.



Source of data handling facility	Name of data handling facility	Background results	Estimated likely outcomes	Target summaries	Target histories	Teacher assessments	Monitoring displays	Added value measures	Measures informing classroom practice
Government department and agency	Key to Success	✓	✗	✗	✗	✗	✗	✗	✓ (Question level analyses of SATs and gifted and talented list)
	Pupil Achievement Tracker (original)	✓	✓ (Based on DCSF calculations)	✗	✗	✗	✗	✓ (Based on DCSF calculations)	✓
	RAISEonline	✓	✓ (Based on DCSF calculations)	✓	✗	✗	✓	✓ (Based on DCSF calculations)	✓ (Question level analyses of SATs)
Commercial company facilities within a wider school management information system	SIMS Assessment	✓	✓ (If calculated, entered or imported)	✓	✓	✓ (If entered or imported)	✓	✓	✓ (If calculated, entered or imported)
	Facility CMIS	✓	✓ (If entered or imported)	✓ (If entered or imported)	✓	✓ (If entered or imported)	✓	✓	✓ (If calculated, entered or imported)
	Edix Live	✓	✓ (If entered or imported)	✓ (If entered or imported)	✓	✓ (If entered or imported)	✓	✓ (Based on system calculations, and if imported)	✓ (Based on identification of common attributes)
Commercial company facilities with a specific range of data handling functions	CATs	✗	✓ (Based on CATs calculations)	✗	✗	✗	✗	✗	✓ (Based on CATs tests)
	4Matrix	✓	✓ (Based on WSV calculations)	✓	✗	✗	✗	✓ (Based on WSV calculations)	✗
	Track to Success	✓	✓ (If entered or imported, and based on system calculation for Years 7 and 8)	✓	✓	✓	✓	✓ (Based on system calculations for any year group and groups with common attributes at any time)	✗
Research and charity support facilities	CEM	✓	✓ (Based on CEM calculations)	✗	✗	✗	✗	✓ (Based on CEM calculations)	✓ (Based on CEM tests)
	Fischer Family Trust	✓	✓ (Based on FFT calculations)	✓	✗	✗	✗	✓ (Based on FFT calculations)	✗
	Data Enabler Toolkit	✓	✓ (Based on DCSF, FFT, and Jesson calculations)	✗	✗	✗	✗	✓ (Based on DCSF, FFT, and Jesson calculations)	✗

**Table 2:** User features identifiable within the range of data handling facilities

(Note on an abbreviation not previously used: WSV = within school variation)

It is clear from Table 2 that there is no single data handling facility that might provide all of the functionality that a teacher or school might want. Indeed, the array of different forms of underlying techniques (particularly those concerned with calculations for estimated likely outcomes and added value) may well be bewildering for some teachers and schools. Although web sites, for example, sometimes indicate differences, the implications for those differences are not necessarily discussed in places that can be easily accessed. Data Enabler Toolkit, in this respect, is a potentially useful

addition to the data handling facility armoury, as it offers a 'triangulation', allowing schools to compare estimated likely outcomes and added value measures on the basis of DCSF, FFT and Jesson analyses. The benefits and advantages of each can be seen and considered in the context of school need.

The analysis presented through Table 2 indicates that forms of data accessible to teachers are largely those that have been accessible in the past: national test and examination data; results from specific tests available from commercial or research groups; and teacher assessments. What the table shows is that the overload arises because of the differences that exist across the different forms of data handling facilities, and the differences that underpin the range of analytical techniques employed. It would be more correct to say that teachers and schools are confronted with 'data complexity' rather than with 'data overload'.

#### **4. EVOLUTION FROM THIS POINT IN TIME**

So, where does the evolution go from this point on? There are clearly a number of different features where evolution might move in the future. One feature would be concerned with the flow of data. This has been a major concern of the government agency focusing on technological infrastructure (and reported on by Becta, 2005; 2007). The issue of flow of data still remains an issue, for a wide range of reasons (including the fact that virtual learning environments are being seen as a potential 'solution' to this issue in the future, even though data flow through interoperability has not been implemented successfully to date by all providers of virtual learning environments). The direction of evolution of data flow, however, appears to be now more clearly identified, since Becta (2008) have stated that they: "are clear that [the Schools Interoperability Framework] SIF has proven potential to deliver a wide range of benefits at the front line and at local and national levels, and now recommends SIF as a preferred solution ... the expectation is that the SIF standard will be adopted by local authorities and system suppliers to meet specific local business needs over the next 18 months or so".

A second feature would be concerned with the forms of underlying analyses being used, and whether there will be greater rationalisation of these, or whether they will be widened further. It is certainly not clear at this time that rationalisation will happen, but there is a clear need to explain the analyses that exist in a way that teachers and schools can understand more, and as a consequence, make better informed choices. Although not an aspect for major discussion within this paper, it should be pointed out, for example, that with regard to just one of the data handling areas that schools have access to, value added measures, at least seven different measures currently exist: raw percentages of grades; unadjusted value added; contextual value added (adjusted by DCSF for a range of background factors); within school variation; CEM measures; FFT measures; and Jesson measures. There is no

known document to show clearly the distinctions between these, the benefits of each, and the ways they have or could be used to support specific school improvement needs.

A third feature would be concerned with forms of presentational access. There has been a great deal of development in this area over the past 8 years or so, and visual forms of presentation have been developed that now show traffic lighting, and the highlighting of exceptions or potential issues shown up in data sets. Presentational access is certainly an area where evolutionary developments could help a great deal more; the creation of a single portal, allowing access to key information, for example, would be a potential asset to teachers and schools. This aspect is also clearly related to the issue of what teachers or managers want or expect from a system. Many who guide schools indicate that a range of features of systems are not being used currently, and that this situation is coupled with requests from teachers or managers for information about how to get a system to offer a particular outcome (arising sometimes because of a lack of expertise in certain areas within a school, often from an information and communication technology perspective).

A fourth, and potentially important area of possible development, is concerned with a much finer grain of detail that allows different pupil groups to be considered more. A number of the measures which have been commonly used by teachers and schools to inform classroom practice (such as the use of CATs to identify whether a class has a larger number of concrete and visual learners, or abstract and textual learners, or the use of RAISEonline to look at the analysis of test data at a question subject topic level) is not yet built into a framework that meets the ways that teachers talk about or think about groups of learners or individual learners. Some new systems are being developed that attempt to provide ease of access to question level results (for example, an online system created and available from Alfiesoft.com, 2008). At the moment, data handling facilities do not allow the teacher or the school to look at the evidence that might help with questions such as: How can you find out how to help quiet pupils? How can you support those who do not have broadband at home? How can you help those who are in one-parent families? Basically, this form of evolution calls for different forms of raw data to be available, and different forms of analyses. So, rather than being concerned about data overload, we should perhaps be concerned about being 'smarter' with data.

## **5. DIRECTIONS AND POLICIES**

The analysis presented suggests that the next stages of evolution, to satisfy some of the issues and needs of the present, should focus on four main areas:

- A wider consideration should be given to benefits of data flow, involving key stakeholders, and enabling innovative approaches to be developed.
- A wider awareness of the underlying analyses and techniques used, described in terms of benefits and uses in different curriculum situations.
- A bringing together of facilities available at a level whereby teachers and schools can see the width, and how they can make informed choices.
- A diversification of access to additional raw data, to enable different analyses to be undertaken, so that teachers can explore questions about learner groups and potential ways to support them.

This form of evolutionary development would certainly seem to be consistent with features of current national educational policies in England. The concern identified within the last point in the list above, that there is a diversification of raw data to support a wider understanding at pupil group and individual level, is clearly apparent within policies such as that described in the Government White Paper focusing on personalised learning (DfES, 2005). This policy document stated that: “Central to personalised learning is schools’ use of data to provide structured feedback to pupils and their parents on progress. The National Strategies have helped over three quarters of secondary schools, last year with assessment for learning, but Ofsted tell us that assessment is still one of the weakest aspects of teaching. We will, therefore, redouble the support and challenge through the National Strategies, especially where there is danger of teachers underestimating the potential of pupils. We will also use the new School Improvement Partners to scrutinise the progress that different groups of pupils are making, so that success with some groups does not hide failure with others”. A second policy document, the Government e-strategy (DfES, 2005), stated that an e-strategy should seek: “to transform teaching, learning and help to improve outcomes for children and young people, through shared ideas, more exciting lessons and online help for professionals; to engage ‘hard to reach’ learners, with special needs support, more motivating ways of learning, and more choice about how and where to learn; to build an open accessible system, with more information and services online for parents and carers, children, young people, adult learners and employers; and more cross-organisation collaboration to improve personalised support and choice; and achieve greater efficiency and effectiveness, with online research, access to shared ideas and lesson plans, improved systems and processes in children’s services, shared procurement and easier administration”. Becta (2006) in their e-strategy delivery plan, stated that: “There is a clear and simple goal: that children’s services, schools, colleges, higher education and all learning providers should get the best out of the current and future technologies to improve the quality of learning and to help raise standards. We want all institutions and providers to regard using technology for learning as an essential but normal and integrated aspect of their teaching, learning,

assessment and management practice. We want all children and learners to harness technology to have more choice and chances to learn in a way that suits them, which leads to greater opportunities to learn inside and outside formal education”.

It is clear that the evolution of data management in education, through the use of data handling facilities, is not at an end. Indeed, some might say that it is at a mere beginning; in the past data have been focused for administrative purpose, and then for management purpose, but our current concerns are that data are focused on teacher purposes, yet policy demands that data are focused in the future on learner and carer purposes. To achieve these needs, it appears that we need to move away from perceptions of data overload, address issues of data complexity, and move towards planning for ‘data smartness’.

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