

February 2013



How should the government approach the big data challenge?

Realising economic opportunities and building an enterprising state

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The Big Innovation Centre is an initiative of The Work Foundation and Lancaster University. Launched in September 2011, it brings together a range of companies, trusts, universities and public bodies to research and propose practical reforms with the ambition of making the UK a global open innovation hub as part of the urgent task of rebalancing and growing the UK economy, and with the vision of building a world-class innovation and investment ecosystem by 2025. For further details, please visit www.biginnovationcentre.com.

Executive summary

This paper is a contribution prepared by the Big Innovation Centre to the Shakespeare Review, an independent review commissioned by the Data Strategy Board for the Department for Business, Innovation & Skills.

The volume and detail of information captured by governments and companies, the rise of multimedia, social media, and ‘the internet of things’¹ are all fuelling an exponential growth in the amount of data available. Much of this is unstructured, real-time data, both quantitative and qualitative, that does not fit into traditional, structured, relational data warehouses. Much of this data, both structured and unstructured, is generated and captured by public organisations and is paid for by public funds.

Opening up these massive and mixed public datasets is a crucial condition for unlocking the economic potential of big data. However, for the UK to succeed in securing the economic benefits of these vast amounts of data, several other policy issues need to be addressed.

What can policymakers do to make sure that the UK economy takes full advantage of these publicly funded vast amounts of data? How can we unlock the value of private data through action on public data? What would deliver protocols that would enable the greatest exploitation of these vast quantities of data, both public and private? These are the questions addressed in this paper.

What the government must do – the big data policy agenda for an enterprising state

In answering these questions this paper identified the following set of actions the government must take to address the big data challenges:

1. **The government must aim at making the UK a global leader in custom-made big data analysis**, a new and fast-growing category of professional and business services (PBS). This means that the government must create the conditions for the UK economy to capitalise on three of its important competitive advantages:
 - Global leadership in other PBS services such as, for example, financial and insurance services;
 - World-class universities;
 - Ability to attract and retain talented and innovative people.
2. **The government must open up data**, particularly publicly funded data where the UK

¹ By ‘the internet of things’ the Big Innovation Centre means the ability of devices and machines to communicate with one another without human guidance.

has a worldwide competitive advantage – the UK has some of the best datasets in, for example, health, demographics, agriculture and meteorology.

3. **The UK government must create the digital network infrastructures** needed for the collection, storage, integration and use of large and complex sets of data. This includes:
 - Investing in broadband capacity, 4G wireless networks and data storage capacity;
 - Coordinating the electromagnetic spectrum and ensuring hardware and software compatibility;
 - Ensuring that digital networks are safe and secure.

4. **The UK government must adjust the education policy** and work together with schools, universities, and employers to deliver the next-generation data scientists and data analysts, as well as data-savvy mid-level professionals able to interpret and use the results of data analysis.

5. **The UK government must put in place a legal and regulatory framework** that creates the right incentives for the UK economy to extract the economic potential of big data. This requires:
 - Delivering standards on data quality and release formats;
 - Delivering technical and security protocols for using, sharing and combining private and public data while addressing privacy and security concerns;
 - Supporting big data ‘test beds’ as a bottom-up strategy to determine the set of meaningful and feasible quality standards and technical and security protocols.

1. What we mean by big data

From a technological point of view, big data means a collection of large, complex, and diverse sets of data. Because of its size and diversity, big data is difficult to work with using traditional databases, statistics, and visualisation software tools. Therefore, from a technological perspective, big data poses three major challenges: (1) how to collect these vast and diversified quantities of data, (2) how to store them and (3) how to integrate them, whenever meaningful.

From an economic point of view, the knowledge extracted from big data is in itself an economic asset; a factor of production alongside labour, capital, and technology. Making use of vast quantities of data opens up enormous economic opportunities ranging from smoothing the way we do old things to creating completely new products, services and organisational methods. Because the knowledge that comes out from big data impacts nearly every part of the economy, we at the Big Innovation Centre describe it as a new general purpose technology. Thus, from an economic perspective, the three main big challenges posed by big data are: (1) how to analyse these vast and quite often unstructured quantities of data, both quantitative and qualitative, (2) how to interpret the analysis results, extracting knowledge from them and (3) how to turn this knowledge into value added.

At the Big Innovation Centre we are concerned primarily with the economic definition of big data, and not as much with its technological definition. The Big Innovation Centre focuses mainly on how to make the most of big data, both private and public, while creating economic growth and jobs in the process.

2. Economic opportunities of big data: Why big data is important for the UK economy

Broadly speaking, the economic opportunities brought about by big data can be grouped in three main categories: new business niches, productivity gains and innovation.

New business niches

Big data opens several data-related business niches. One is the next-generation data warehouse tools. The amounts of data that we are generating today are so vast that it is physically impossible to store it all. For example, according to some estimates² healthcare providers discard about 90 percent of the data they generate. A second data-related business niche is the next-generation data analysis and visualisation tools, able to analyse large amounts of structured and unstructured data, both quantitative and qualitative.

A third important business niche is the custom-made data analysis and data interpretation industry. Capturing the value of data requires the right skills mix, which involves highly specialised analytical skills but also mid-level data interpretation capacities. Although many companies and organisations will develop in-house analytical and interpretation capacity, many others will prefer to look outside for specialised and custom-made data analysis and interpretation services.

Given that the highly transformative power of big data spans all industries and economic sectors, custom-made data analysis and interpretation services will soon become a new and important category of professional business services (PBS).

The UK must aim at being a global leader in this new and growing industry by capitalising on some of its important competitive advantages, especially:

- Its global leadership in other PBS³, e.g. financial services;
- Its ability to attract and retain talented and innovative people.

However, to become a world leader in this industry the UK must address several major data-related challenges. These challenges are discussed in the last section of this paper.

² See McKinsey Global Institute (June 2011) *Big data: The next frontier for innovation, productivity and competition*.

³ For a discussion on the role of professional and business services in the UK economy, see Department for Business Innovation & Skills (March 2010) *Professional and Business Services: A 2020 Vision for Growth*, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/15696/professional-business-services-2020-vision-for-growth.pdf

Productivity gains

Another way through which big data causes economic growth is by raising productivity. This can happen in several ways. Here we mention only three:

- First, the knowledge extracted from big data helps leaders make better fact-based decisions and minimise risks, which ultimately improves the organisation's overall performance and thereby its overall productivity;
- Second, big data allows organisations to add more value to its products and services by, for example, better segmenting and targeting consumers, or by adjusting prices more quickly in response to market changes;
- Third, organisations able to apply insights from data are more agile in allocating and redeploying resources to capture, for example, first-mover advantages in specific markets.

Innovation

Big data also creates important innovation opportunities in at least two ways:

- First, big data enables organisations, both companies and public sector, to spot latent market needs. This means that:
 - UK companies must build on these opportunities and develop new products and services, the enhancement of existing ones, and the invention of new business models;
 - The UK government must find new forms of public service delivery to meet these needs.
- Second, the access to new or previously proprietary datasets, public and private, opens up new innovation avenues. For instance:
 - Pharmaceutical companies might be able to develop disruptive new drugs by gaining access to the patterns of behaviour showed by the internet browsing records of persons with specific health conditions;
 - Gaining access to the individual-level medical records from the National Health Service (NHS), while securing identity protection, will most likely prompt new waves of innovation in the way healthcare is provided;
 - Access to the NHS data can support the development of healthcare-related personal monitoring services;
 - Using technologies associated with the 'internet of things', healthcare providers can develop healthcare information technology services to monitor chronically ill patients in their home environment. The analysis of the resulting data can be used to monitor behaviour-prescription adherence (determining if patients are actually doing what was prescribed) as well as to develop improved drugs and

treatments.

These are just a few examples.

As David Willetts points out in his recent report⁴, big data is one of the UK's eight great technologies and part of this is because the UK has some of the world's best and most complete public datasets in healthcare, demographics, agriculture and environment.

What the UK needs now is to find ways of exploring the potential of this public data to develop new marketable products, services and organisational methods, thereby promoting economic growth and job creation. For that the UK government must:

- Open up public data, particularly publicly funded data. Clearly, the economic potential of these and other important public datasets can only be fully exploited if the most innovative and creative entrepreneurs have full access to data;
- Find creative ways of tackling privacy, security, and intellectual property concerns while allowing the exploitation of the full economic potential of big data.

⁴ Willetts, D. (January 2013) *Eight Great Technologies*, Policy Exchange.

3. The enterprising state

A focus on open data in isolation might result in missed opportunities. Opening up public data is a crucial first step. However, policymakers must, at the same time, address several other challenges if they want to create the right conditions for the UK economy to capture the full potential of big data. Four particular issues stand out for the government to focus on.

- First, the enterprising state must ensure that the right digital infrastructure is in place. Building effective and reliable digital networks is a precondition for making full use of big data. This includes:
 - Securing investment in broadband capacity, 4G wireless networks and in data storage capacity;
 - Ensuring compatibility among parts of the infrastructure network, which requires coordinating the electromagnetic spectrum, ensuring hardware and software are compatible;
 - Making networks safe and secure.

There is an opportunity to integrate the necessary investment in digital infrastructure in the ambitious UK government's National Infrastructure Plan, first announced by the British Prime Minister David Cameron in 2011 and moved up the agenda in 2012.

- Second, the enterprising state must tackle the potential skills mismatch. Making the most of big data calls for a labour force able to analyse, interpret and put the insights extracted from data to work. The UK education policy must make the necessary adjustments to deliver:
 - The next generation of data scientists and data analysts;
 - Data-savvy mid-level professionals able to interpret and make meaningful use of the data analysis results.

A failure to adapt to these skill requirements will limit the UK's ability to capture the full potential of big data. It can also raise structural unemployment in the UK. This presents a significant challenge to the government, but also to schools, universities, and employers.

- Third, the enterprising state must put in place a legal and regulatory framework for data. This framework must address two quite often conflicting objectives:
 - Ensuring that companies have the right incentives to fully exploit the potential of big data;

- Providing the necessary safeguards to address privacy, safety, and intellectual property rights concerns about big data.

There is currently little clarity about the rules and procedures concerning access to public data as well as regarding sharing data among companies. There is also a degree of uncertainty about whether such rules will change in the future. This confusion and uncertainty make it harder for companies, particularly smaller companies, to make valuable use of big data.

The enterprising state must provide a clear, stable and consensual framework for using and protecting data. This is accomplished by:

- Delivering standards on data quality and release formats;
- Delivering technical and security protocols for using, sharing and combining private and public data. This includes delivering protocols in terms of, for example, data anonymisation and level of data aggregation.

These standards and protocols must set the rules and procedures that allow combining public and private data in ways that protect privacy, security and intellectual property rights while ensuring access to as much of the information encompassed in big data as possible.

- Fourth, the enterprising state must support big data 'test beds'. Developing meaningful quality standards and technical and security protocols is not a straightforward task, to say nothing about re-shaping the whole legal and regulatory framework for data. An effective approach is to learn from practical experiments with data. Big data 'test beds' are special spaces where companies, entrepreneurs, academics and public organisations can share and experiment with public and private data in a secure environment, without fear of losing commercial advantage or breaking the law. Big data 'test beds' are meant to:
 - Emphasise both the opportunities and barriers resulting from sharing and combining data from public and private sources;
 - Shed light on how the UK should change its data rules and regulations in order to make the most of sharing and combining private and public data while protecting the privacy of citizens and providing data security.

In addition to some government support, putting big data 'test beds' in place requires a trusted broker to host them. The Big Innovation Centre, by bringing together companies, universities, and public agencies is well positioned to play this role.

Acknowledgements

This report is a publication from the Big Innovation Centre, an initiative from The Work Foundation and Lancaster University. The content of this report reflects the opinions of its authors and not necessarily the views of the Big Innovation Centre or its supporters. The Big Innovation Centre is supported by the following companies, public bodies, universities and private trusts.



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