A practical example of companies, public sector and universities collaboration in unlocking the economic potential of big data

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Bio:

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Abstract

This paper discuss the results of a one-day open-innovation-oriented big data hackthon organised by the Big Innovation Centre, an open-innovation oriented London think-thank. The event involved the London local authority Camden Council, and many of the Big Innovation Centre's partners, including universities, public bodies, and companies such as Barclays Bank, EDF Energy, GlaxoSmithKline and Google.

The event brought together innovation specialists from different sectors, thought leaders from Camden Council, data engineers, programmers and data analysts, to examine Camden Council's data and find solutions for specific problems faced by the council in social housing, healthcare and street presence teams management.

The results of this public-private, cross-industries hackthon prove that an open innovation platform where people with different skills and insights work collaboratively is an effective way of unlocking the potential of (unknown) datasets. The teams were able to develop several workable tools for Camden council to build upon. These included: (1) a web-based simulation tool to better target social housing repairs; (2) a tool to demonstrate the performance of the Street Cleanliness teams; (3) an application for the Street Presence teams to carry to identify infringements to venues' licencing; (4) the identification of key health issues that Camden council's health services will need to be prepared to address in the next 10-15 years.

The event also showed that a collaborative, open innovation environment is a great learning opportunity for deriving sensible policy recommendations. These include recommendations on data quality standards as well as on what local authorities need to do to break the data silos. The results of the event also suggest relevant practical ways forward in setting a big-data-friendly regulatory regime that simultaneously allows data sharing across public and private sectors while addressing privacy concerns.

1. Introduction: The big data opportunity

Data is growing at an ever-explosive rate and is measured now in petabytes (PB), exabytes (EB) and zettabytes (ZB). The amount of data worldwide is estimated to have more than double between 2010 and 2012, from 1.2 ZB to 2.8 ZB, and is expected to be about 14 times bigger by 2020, reaching 40 ZB (EMC[2] 2013).

Businesses, public bodies and other organisations are dealing with fast growing amounts of structured and unstructured data, both quantitative and qualitative. Not surprisingly, the interest in big data is recent but growing exponentially. Take, for example, the trend in the web searches for 'big data'. As Figure 1 shows, web searches started to pick up as late as mid-2011 and have sky-rocked since then. This fast growing interest in big data around the world is a manifestation that both companies and public organisations are starting to realise that the insights locked in these vast amounts of data are an asset.

Figure 1: The growing interest in big data: weekly web searches
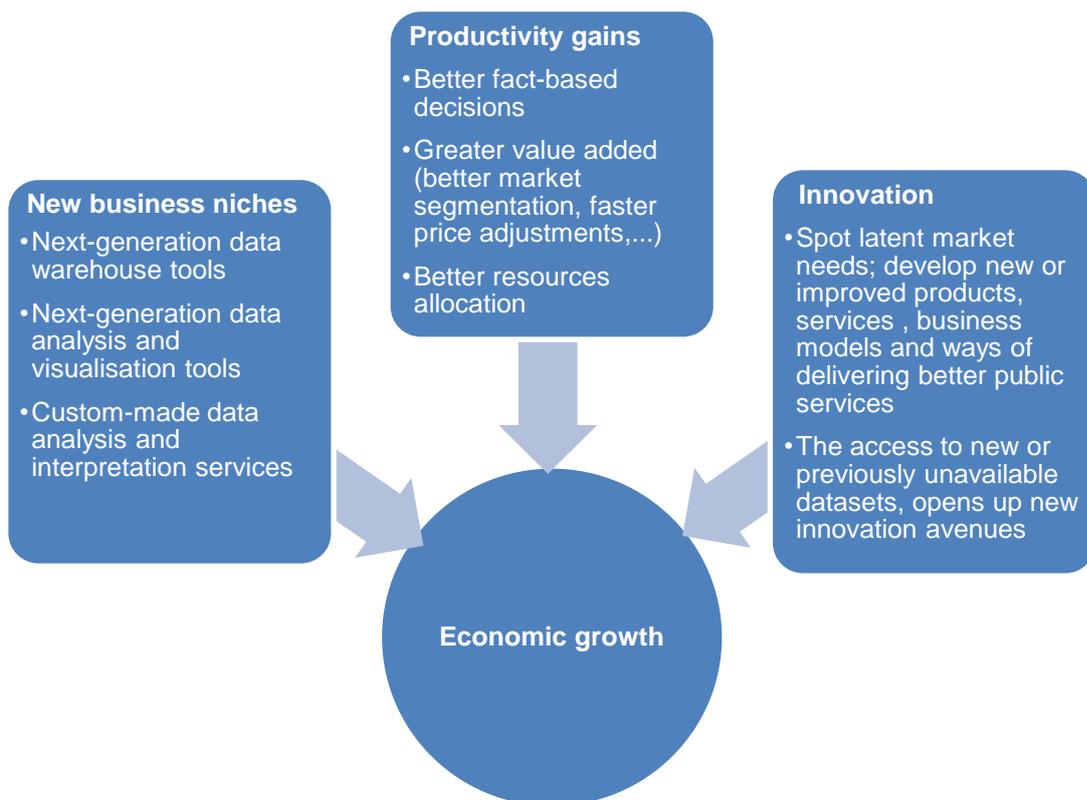**(1 January 2004 to 18 May 2013)**
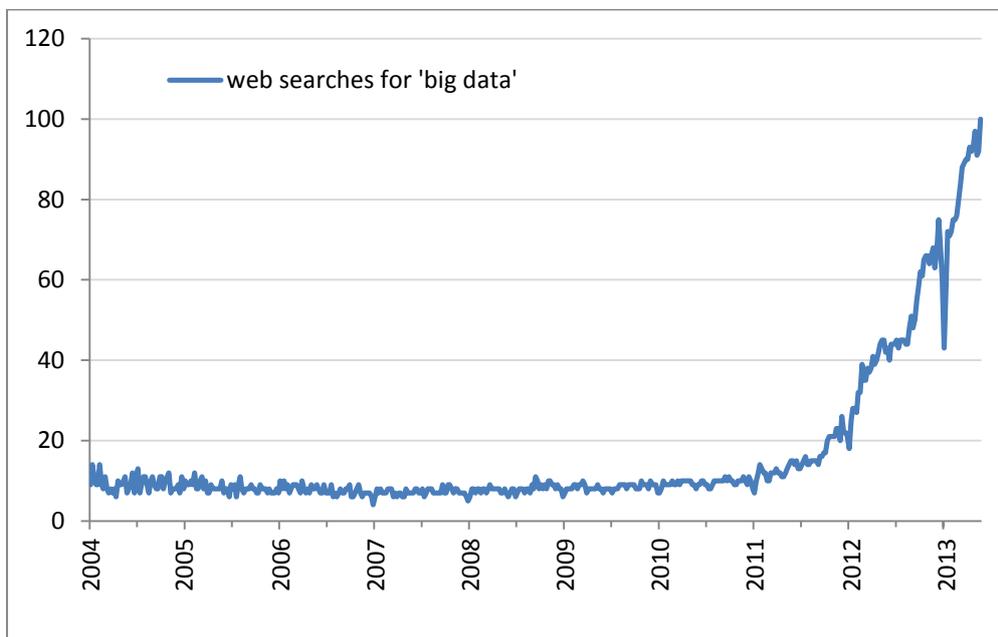
Source: Google trends
Note: The values represent the number of weekly web searches for the key word 'big data', relative to the highest number of observed searches for this key word over this time period. The values are presented in a normalised 0-100 scale. The highest number of web searches for 'big data' occurred in the week of 18 May 2013, which resulted in a normalised value equal to 100.

At the Big Innovation Centre we consider that the knowledge extracted from these vast amounts of data creates unprecedented economic opportunities, ranging from disrupting the way we do usual things to creating completely new product and service markets, new business models, and new and more efficient ways of delivering public services. Because the highly transformative power of the knowledge extracted from big data spans all industries, private and public sectors alike, we at the Big Innovation Centre consider big data a new general purposes technology; the second phase of the digital revolution.[1]

Conceptually, the economic opportunities brought about by big data can be grouped in three categories, as depicted in Figure 2: new business niches, productivity gains and innovation (for a detailed discussion on the economic opportunities of big data, see Sousa 2013).

Figure 2: Types of economic opportunities created by big data

Productivity gains
- Better fact-based decisions
- Greater value added (better market segmentation, faster price adjustments,...)
- Better resources allocation

New business niches
- Next-generation data warehouse tools
- Next-generation data analysis and visualisation tools
- Custom-made data analysis and interpretation services

Innovation
- Spot latent market needs; develop new or improved products, services , business models and ways of delivering better public services
- The access to new or previously unavailable datasets, opens up new innovation avenues

Economic growth

Source: Author's construction based on Sousa (2013).

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[1] This was also recently acknowledged by Stephan Shakespeare in Shakespeare (May 2013).

2. State-of-the-art: Open innovation as the way forward in exploiting the big data opportunity

All these economic opportunities are better exploited within an open innovation ecosystem where companies of different industries, public authorities, universities and other organisations come together to share and combine data and insights to address common challenges. Only by sharing, combining and opening data (once privacy, confidentiality and security are safeguarded), across industries and across private and public sectors, one can extract the greatest economic potential of big data. Undoubtedly, this is better accomplished in a collaborative, open innovation ecosystem where all the parts involved benefit from the cross-fertilisation of ideas and data (Andersen and Wong 2013; Wong 2012).

Embracing open innovation to break the data silos and exploiting the economic potential of big data requires an innovation paradigm shift. Admittedly, we are still in an early stage of this shift. The research, both theoretical and empirical, on how to make the most of big data[2] shows that for this paradigm shift to materialise we need to close three data-related gaps:

- Firstly, the real-world examples of the economic benefits extracted from big data tend to come from private sector, within-silo data analyses. Few examples are available of value created via combining and sharing data across companies of different industries and across public and private sectors. As Einav and Levin (2013) the greatest potential of big data resides in sharing and combining data across industries across private and public sectors;

- Second, most public bodies are likely lagging behind the private sector in making use of their own data. Public bodies have done little to reach out for insights and expertise on how to make the most of their own data. To be fair, there are a few good examples of public-led big data exploitation experiments (which will discussed below), but these are the exceptions rather than the rule;

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[2] Some recent examples include: Einav and Levin (2013), OECD (2013), WEF (2013), Willetts (2013), Mandel (2012), and MGI (2011).

- Thirdly, the examples available so far show that, despite some recent progress, both private companies and public bodies are still largely unaware of the role that open innovation can play in extracting value from big data.

3. The challenge: Can open innovation unlock the value of local authorities' big data?

Local authorities collect large amounts of data as part of their day-to-day activities and they have been doing so for quite a long time. Most of this data is quite unique because of its granularity, time spam, and variety of subjects covered. Examples include micro-level (individual-, household-, or small businesses-level) data on social care, healthcare, social housing, schools, street cleaning services and street presence uniformed teams (namely, parking enforcement and parking patrolling). This data has been largely under-utilised by both public authorities and, due to limited and restricted access, by private sector and universities, who could look at this data from a different perspective and uncover new opportunities.

3.1 Inspiring examples

Interestingly, some forward-looking local authorities across the UK and abroad are starting to look at this data as an asset that can be leveraged to bring down costs and deliver improved and innovative services to tax payers. One approach has been open local authorities' data to the public and hope that researchers, companies, and universities will explore these datasets in ways that end up helping local authorities to deliver better services. Manchester, New York, Chicago, San Francisco, and Philadelphia are examples of cities around the world that have embraced or are about to embrace an open data agenda. Some concrete outcomes have already come into light. For example, using the data made available by the city of New York, Ho (2012) found that restaurants hygiene grades had little consistency over time and suggested improvements for the city's hygiene inspection services. In Chicago, software developers have built on the city's open data to develop applications that show, for example, the status of requests to fix potholes or which streets have been cleaned after a snow.[3]

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[3] These examples were found in an article published on *The Economist* (US edition) on 27th April 2013 titled "By the numbers: Citites are finding useful ways of handling a torrent of data"

Local authorities across the UK and abroad are also learning how to use open innovation to build on the data they have available to develop new and better services. In the UK, Manchester is one of the earliest examples. As part of the Manchester open data agenda, a project partially funded by the European Community's ICT Policy Support Programme, in November 2012 Manchester city council organised a big data hackathon to explore the potential of the data made available by the city council and other public partners. According to the statement of the event,[4] several workable tools emerged from this experience including: (1) a visualisation tool that allows users to plot different council's datasets on a map (e.g., location of road traffic accidents and speed cameras); (2) an application that allows people to find their nearest bus stop and to learn about the next bus; and (3) an application to find the nearest public toilet and details about it as, for example, the opening times.

In the US, New York is another good example. By looking at its historic data and crossing data from different departments, New York City was able to pinpoint for example: (1) the houses with greatest probability of a catastrophic fire; (2) what businesses are more likely to be cigarettes smugglers and, as such, should be targeted by the cigarette-tax city's inspectors; or (3) what restaurants are more likely to be dumping grease down a manhole and thereby should be targeted by the restaurant inspectors.[5]

Although these are inspiring examples, the review shows that they are more the exception than the rule (Einav and Levin 2013). This is particularly true in the UK. In fact, as Lucy Watt and Quentin Jones noted in a *The Guardian* article the 26th of April 2013,[6] UK councils seem to be increasingly keen on embracing open innovation and open data as a way of addressing local problems while coping with budget cuts. However, only few have put it into practice so far.

(http://www.economist.com/news/united-states/21576694-cities-are-finding-useful-ways-handling-torrent-data-numbers)

[4] Available at: http://www.manchester.gov.uk/news/article/6484/inaugural_manchester_hackathon_h...

[5] These examples were provided in an article by Gillian Tett in an *Financial Times* article on 1 April 2013 (http://www.ft.com/cms/s/2/a284331a-9751-11e2-a77c-00144feabdc0.html#axzz2VG2hD0lV)

[6] Available at: http://www.guardian.co.uk/local-government-network/2013/apr/26/councils-hack-day-geek-squad-problem-solving

3.2 The case of Camden council, London, UK

Camden council in central London is one of these rare cases. A forward-looking leadership recognised that the council has both the need to address challenges in a more cost-effective way and an opportunity to do so by making a better use of the data they have available..

Recognising that this will be difficult to do by itself,[7] Camden council teamed up with the Big Innovation Centre, a London-based open innovation hub that brings together large companies from different industries, universities and several public bodies. By bringing together a unique cross-industry, private-public network, the Big Innovation Centre offered the sort of diversified pool of insights and skills that the Council was looking for in order to learn how to make the most of its data using open innovation methods.

Rather than adopting a holistic approach towards a comprehensive open data agenda (similar to that adopted by Manchester city), the Big Innovation Centre and Camden council followed a hands-on bottom-up approach. The approach was to start with a few practical problems and open the council-level datasets that could help to address these problems. The lessons learnt from opening up and experimenting with a small number of datasets from different departments within the council could, then, be used to put together a more comprehensive council-level open data and data exploitation agenda.

For about five months, The Big Innovation Centre and Camden council worked together to put in place an open innovation-based big data practical experiment seeking to achieve four objectives:

- Firstly, deliver practical tools that allow Camden Council to make a more efficient use of its data and deliver great value for money to the local taxpayers;

- Secondly, identify opportunities for developing innovative services across public organisations and private companies and also across different industries;

- Thirdly, identify obstacles and problems in using, combining and sharing public and private data;

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[7] This was acknowledged publicly by the Camden council's Councillor Theo Blackwell in a comment posted to his Blog on the 13th of May 2013 (available at: http://theoblackwell.blogspot.co.uk/2013/05/camden-hosts-hackday-to-use-data-for.html)

- Fourthly, obtain insights on how to set sensible policy recommendations to influence a big data-friendly policy agenda.

4. Methodology

The big data practical experiment co-organised by the Big Innovation Centre and Camden Council followed a 5-step methodology, as systematised in Figure 3 and detailed below.

Figure 3: Methodology for an open innovation-based big data practical experiment

Step 1:	Define the practical questions
Step 2:	Get the data ready
Step 3:	Find the right mix of skills
Step 4:	Find a trusteed broker
Step 5:	Choose the open innovation tool

Source: Author's construction

Step 1: Define the practical questions

The first step was to define a small set of practical questions able to meet three criteria:

- Deliver better and more cost-effective services to the local taxpayers;

- Be answered by exploring council-level data, possibly combined with other data sources;

- Be similar or complementary to questions faced by some of the Big Innovation Centre's partners, with a view at stimulating their participation in this practical experiment.

The combination of these three criteria resulted in the following three practical questions:

- What is the profile of Camden's future patients – what will they be treated for and how?

- How can the council target the repairs budget most effectively to deliver maximum benefit to the households (e.g., lower energy costs, greater energy efficiency, better ventilation, or a combination of these)?

- How can the teams better target their efforts to reduce crime and anti-social behaviour?

Step 2: Get the data ready

The second step was to select the data available in different departments of the council that could be of interest to any of these questions. One major issue in getting the council data open to the public was to make sure that it was properly de-identified.

It was also our goal to search for other datasets outside the council that could be combined with the council's data to answer these questions. Some of these datasets could be publically available. Others could be private but possible to be made available for the day, once properly de-identified.

Step 3: Find the right mix of skills

The third step was to guarantee that we would have the right mix of skills for exploring the data, which should include: innovation specialists from different industries, thought leaders from Camden Council, data engineers, programmers and data analysts.

In order to accomplish this we relied on the network of companies, universities and public bodies that are partners of the Big Innovation Centre. Many partners responded favourably and enthusiastically so it was quite easy to find the right amount and combination of skills by relying primarily on the partners of the Big Innovation Centre. Nevertheless, we reached out for people outside this network that was interested in participating. Because we had more registrations than places available, among those registrations from outside the Big Innovation Centre's network we selected only those able to fill the skills gaps.

Step 4: Find a trusteed broker

Having a trusted broker behind an open innovation-based big data practical experiment is important for two reasons. First, skilled people are more likely to be willing to work collaboratively, share ideas and insights if they trust that their ideas and insights will not be misused. Second, organisations, both public and private, are easily prone to bring data to an open innovation practical event if they are sure that this data will be used for good only. In this case the Big Innovation Centre was the trusted broker that helped to make this event possible.

Step 5: Choose the open innovation tool

Among the open innovation tools appropriate for big data exploitation, a hackthon was considered the way to go because it is well suited to kicking off a big data experiment aiming at exploring data largely unknown.

Big Innovation Centre-style big data hackthons, although sharing some features with other hackthons are unique in several ways. Like other hack days, Big Innovation Centre-style hackthons are events in which programmers, data scientists, data analysts and innovation specialists work collaboratively to address one or a few real-world challenges in a short time period, usually one or two days. Big Innovation Centre-style hack days differ from most similar events in, at least three ways:

- Firstly, they pool data, expertise, and skills from a full range of organisations, mostly our partners. They include: (1) companies from a variety of industries; (2) world-class universities; and (3) public authorities, including local authorities which team up with us on a project-by-project basis;

- Secondly, as the leading organiser, the Big Innovation Centre uses its convening capacity to provide a trusted and neutral broker;

- Thirdly, our hack days are also policy-driven learning experiences. The Big Innovation Centre uses these experiences as a way of identifying practical obstacles in opening, using, sharing, and combining private and public data in order to set sensible and evidence-based policy recommendations.

For this join event with Camden council we put in place a Big Innovation Centre-style big data hack day with the following features:

- An one-day event held at Google London Campus on the 10th of May 2013;

- It was an open, collaborative, cross-sectorial environment that pooled expertise, skills and insights from three types of organisations, mostly Big Innovation Centre's partners:

    o Universities, including University of Oxford and University College of London;

    o Companies: Barclays Bank, EDF Energy, GlaxoSmithKline and Experian;

    o Public organisations: Intellectual Property Office and, of course, Camden council;

- An eclectic group of about 75 people (selected from a pool of 130 registrations) with very diversified skills: programmers, data analysts, data scientists, thoughtful leaders, policy makers, entrepreneurs, and graduate students;

- Out of the 13 teams formed on the day, 5 worked on the Health problem, 3 on the social housing problem, and 5 on the street presence problem;

- The data made available on the day came from two sources: (1) publically available data with different levels of geographical desegregation within the council; (2) data made available by the council on the day. The data made available from the council included: (1) housing stock condition and repairs data for about 33,000 properties; (2) Camden-wide prescription and illness data; (3) data on ambulance call-outs broken down to ward level by category; (4) crime data at the street level by type of crime; and (5) incidents in parks and open spaces at ward level. The publically available data included (1) demographic and socio-economic census data by post-code sector and (2) housing energy efficiency at the council level.

Figure 4: The Big Innovation Centre and Camden council hackthon on 10th of May 2013

5. Lessons learnt

The major struggle with local authorities' data is not as much the size of the datasets. Rather, the real struggle is dealing with thousands of small datasets suffering from systems legacy problems.

The results of the co-organised Big Innovation Centre and Camden Council big data hackthon demonstrated that an open innovation ecosystem is an effective way to better understand the issues around these disjointed bits of data an finding ways forward in unlocking their economic potential. The event also showed that a collaborative, open innovation environment is a great learning opportunity for policy purposes. The lessons learnt from this collaborative big data practical experience can be grouped in 3 categories: (1) prove of concept, (2) what is needed to break the data silos and (3) legal and regulatory hurdles.

5.1 Prove of concept

The Big Innovation Centre and Camden council hackthon proved that the concept of open innovation and collaborative work is a good way forward in unlocking the potential of big data. It also proved that a hackthon is an effective tool to explore data that outsiders had never got access to. This is demonstrated by the results of the event, which can be summarised as follows:

- Companies and entrepreneurs found it useful to:

  o Identify the sort of data collected by councils;

  o Explore potential new economic opportunities coming from crossing the council data with corporate data;

- Camden council staff considered the event a great learning experience because they:

  o Got new insights about the usefulness of the data they gather on a regular basis;

  o Learnt about diagnostic and analytic tools they were not aware of;

  o Got a practical understanding of what data quality issues caused greatest difficulties to the data exploitation and collected practical suggestions on realistic ways of fixing them (more on this below);

  o Developed new conceptual ways of addressing the practical problems the teams were confronted with. This was possible because each team included delegates form companies that work on similar problems regularly. Their experience and insights where crucial to frame the problems, develop practical ways of approaching them and suggest different courses of action when the analysis hit a roadblock;

- In just one day, the delegates were able to develop several workable tools for the Camden to build upon. These included:

  o A web-based simulation tool for social housing to identify the houses with greatest savings on their energy bills through low-investment repairs (lower than £10,000/year);

**Figure 5: Social housing simulation tool**

- A data model to identify the wards where the street presence teams should focus to deliver higher services quality without increasing the workload beyond realistic levels;

Figure 6: Data model to identify the wards that street presence teams should target
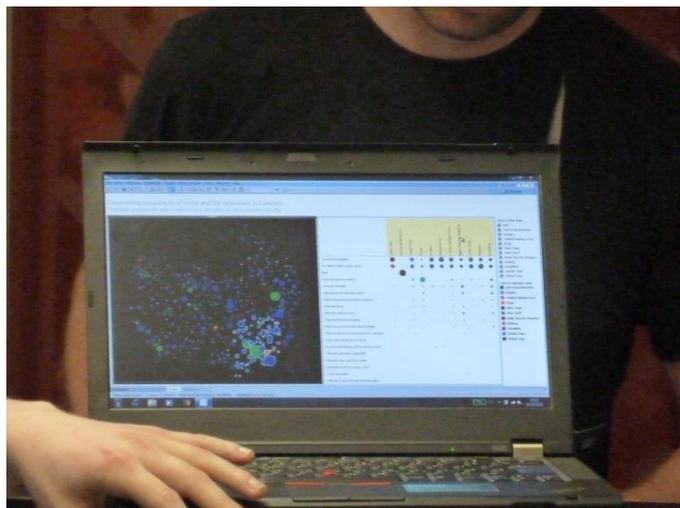
- A tool to demonstrate the performance of the Street Cleanliness teams;

**Figure 7: Performance tool for the street cleanliness teams**
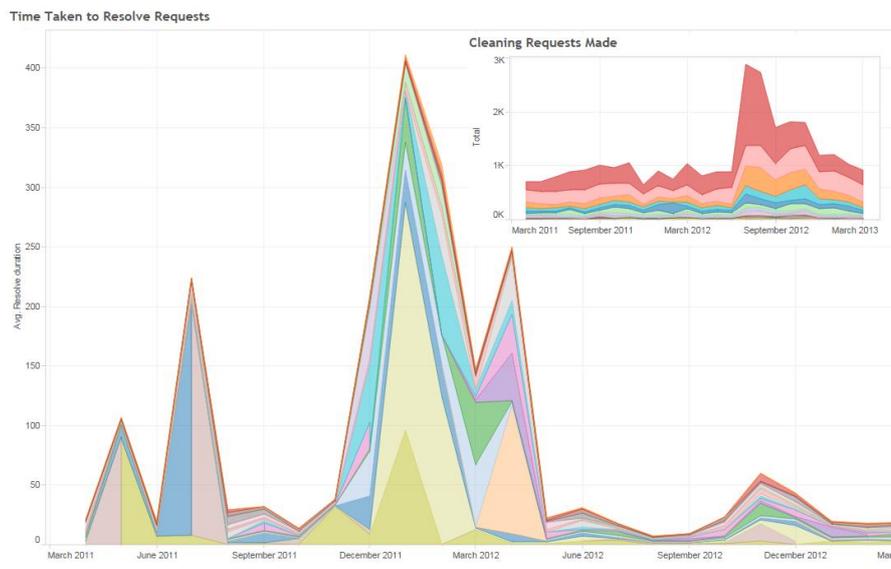
- A demo application for the Street Presence Teams to carry to identify infringements concerning the licencing held by a venue

Figure 8: Application for the identification of venues' licencing infringements

- Identify the key health issues that Camden council's health services will need to be prepared to address in the next 10-15 years.

Figure 9: Identifying the key health concerns in 10-15 years time
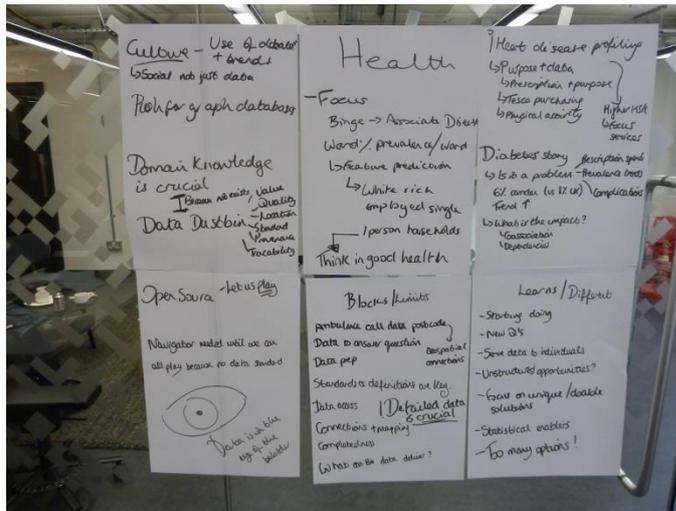
5.2 What is needed to break the data silos

Similarly to any local authority in the world (and many companies), Camden council's legacy systems of collecting and storing data, many of them several years old, created serious challenges to big data analysis. Historically, the council data has been kept in separated and incompatible files, across departments but also within the same department. Also, in many cases data sets were incomplete and missing key variables as, for example, time range.

The hackthon showed that to break the data silos Camden council will have to:

- Identify connectors among datasets and made them available via lookup tools. For example, in order to link datasets at the street level (latitude and longitude), 6-digit postcodes, 4-digit postcodes, postcode sectors, wards, and council level, it is necessary to make available an user-friendly lookup tool that allow users to easily aggregate lower-level data into higher an compatible geographical levels;

- Conduct some data audit and data exploitation to assess the quality and completeness of the datasets. There are several toolsets appropriate for that, e.g., Tableau;

- Ensure the completeness of newly collected data and fill missing key data in current datasets (whenever possible and cost-effective). Basic examples are:

- o Include the appropriate geographical locator (e.g., street address for crime data, postcode, postcode sector, wards,…) in future data records; fill the missing geographical identifier for those datasets where this is cost-effective;

  - o Include the time range in future data records; fill the missing time range for those datasets where this is cost-effective;

- Store the data in standardised format files as, for example, relational databases and web-based access services;

5.3 Legal and regulatory hurdles

To release data for the day proved to be a very hard task and more so for private companies than for Camden council. From the council's side, we were able to release some data, properly de-identified, but not all data the council has available that could directly or indirectly be useful to answer the questions raised on the day. However, this data was only made temporarily available. People had access to the data on a temporary data cloud and the data was deleted at the end of the day. Also every delegate signed an IPR disclosure where they committed themselves to delete the data from their own computers before leaving the room.

The Big Innovation Centre's corporate partners run into even greater internal legal hurdles and were unable to bring along any of their own data to combine with Camden's data.

6. Conclusions and policy recommendations

The Big Innovation Centre and Camden Council hackthon showed that both companies and citizens are very keen on having access to UK council's data. This is a great opportunity that local authorities cannot afford to lose. This is a win-win situation for all. Local authorities win because they are be able to find more cost-effective ways of delivering usual services as well as developing new services. Local tax payers win because they receive greater value for money. Companies and entrepreneurs win because they are able to develop new and better services to their customers by exploring the rich local-level granular data.

For all these across-the-board benefits to materialise, policymakers need to address several issues. Below we stress out most prominent actions that both local-level and national-level policymakers must take.

6.1. Recommendations for local-level policymakers

Policymakers at local level must:

- Open local public data. The benefits we can reap from data are only as great as the amount, quality, and richness of the data that general public, entrepreneurs and companies can get access to;

- Push for an open data and open innovation culture among the councils' staff. Councils' data tend to be closed in departmental silos and each department tend to see its datasets as 'sacred cows'. Councils need to empower an advocate to break these departmental silos. This is a hard task since many civil servants are resistant to this collaborative mentality. This might require, like in the case of New York,[8] that council leaders make open data and departmental silos breaking an explicit priority;

- Work with other local authorities and also with the central government in setting forward common standards on (1) data anonymisation, (2) data quality and (3) data release formats. The recently published Shakespeare review created the right momentum for this to be done, by calling for the UK to define a National Core Reference Dataset of all public-sourced data (Shakespeare 2013). But as the author recognises, what is missing now is to define how such Reference Dataset should look like. The best way of accomplishing this is by learning from experiences like this big data hackthon with Camden Council.

6.2. Recommendations for national-level policymakers

Policymakers at national level must:

- Open up data across all public bodies, particularly publicly funded data. The UK has some of the world's best and most complete public datasets in, for example, health, demographics, agriculture and meteorology (Willetts 2013). For the UK economy to reap

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[8] http://www.ft.com/cms/s/2/a284331a-9751-11e2-a77c-00144feabdc0.html#ixzz2VG6zVGKk

the benefits of these and other important public datasets the most innovative and creative companies and entrepreneurs have to have full access to this data. Only then companies and entrepreneurs can build on the opportunities of public data to develop new marketable products, services and organisational methods, thereby promoting economic growth and job creation;

- 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:

  o Investing in broadband capacity, 4G wireless networks and data storage capacity;

  o Coordinating the electromagnetic spectrum and ensuring hardware and software compatibility;

  o Ensuring digital networks are safe and secure;

- Adjust the education policy to 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:

  o The next generation of data scientists and data analysts;

  o 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;

- Put in place a big-data-friendly legal and regulatory framework for using, combining, and sharing data without compromising privacy, safety, and intellectual property rights. This is not a straightforward task. The lessons learnt from a recent debate on the topic organised by the Big Innovation Centre[9] coupled with the lessons learnt from this hackthon suggest some possible ways forward. These include:

  o Explore whether the UK should build on the Creative Commons legal infrastructure to develop a Privacy Commons;

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[9] See, for example, the conclusions of the debate co-organised by the Big Innovation Centre and the Economic and Social Research Centre as part of the Big Data Week 2013 event at: http://us4.campaign-archive2.com/?u=f48c74d9cc73a25267a7bc364&id=2ef911193d

- Explore whether the UK should adopt an 'opt-in unless you opt-out' approach to personal data disclosure;

- Ensure that the regulatory framework for big data avoids loopholes, is easy to understand and easy to comply with.

- Support the development of new platforms that allow merging and combining data sets from companies, universities and public bodies without putting privacy at risk. These platforms are crucial to carry out trusted big data 'test-bed' experiments. The greatest economic potential of big data comes from cross-linking data from different organisations, public and private. But this can only be accomplished within a secure environment where companies, entrepreneurs, academics and public organisations can share and experiment with public and private data without fear of losing commercial advantage or breaking the law. Like other practical experiments with big data, trusted 'test-beds' are also effective ways to learn how a fit-for-purpose legal and regulatory regime for big data should look like.

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