Emerging analysis

Using real-time indicators for economic decision-making in government

Lessons from the Covid-19 crisis in the UK

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Key messages

Government can act rapidly and flexibly to develop innovative alternatives to slower, traditional statistics, with considerable impact at times of emergency.

However, necessary data skills and infrastructure cannot be acquired overnight, and require continuous investment and improvement prior to the outbreak of crises.

Setting up infrastructure (joint servers and platforms) and clarifying data-sharing processes are necessary to enable civil servants to rapidly develop and share real-time indicators (RTIs).

Longer-term efforts are also necessary to better understand the statistical quality and predictive power of RTIs, since these are activities that are rapidly deprioritised in emergency settings.

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Contents

Acronyms

BEIS	Department for Business, Energy and Industrial Strategy
CHAPS	Clearing House Automated Payment System
DWP	Department for Work and Pensions
GDP	gross domestic product
GDS	Government Digital Service
GSS	Government Statistical Service
HMRC	Her Majesty's Revenue and Customs
IT	information technologies
NHS	National Health Service
ONS	Office for National Statistics
PMI	purchasing managers' index
RTI	real-time indicator
VAT	value-added tax

1 Introduction

When the UK went into lockdown in mid-March 2020, government was faced with the dual challenge of managing the impact of closing down large parts of the economy and responding effectively to the pandemic. Policy-makers needed to make rapid decisions regarding, on the one hand, the extent of restrictions on movement and economic activity to limit the spread of the virus, and on the other, the amount of support that would be provided to individuals and businesses affected by the crisis. Traditional, official statistics, such as gross domestic product (GDP) or unemployment, which get released on a monthly basis and with a lag, could not be relied upon to monitor the situation and guide policy decisions.

In response, teams of data scientists and statisticians pivoted to develop alternative indicators, leading to an unprecedented amount of innovation in how statistics and data were used in government. This ranged from monitoring sewage water for signs of Covid-19 infection to the Office for National Statistics (ONS) developing a new range of ‘faster indicators’ of economic activity using online job vacancies and data on debit and credit card expenditure from the Clearing House Automated Payment System (CHAPS).

The ONS received generally positive reviews for its performance during the crisis (The Economist, 2022), in contrast to the 2008 financial crisis when policy-makers did not realise the extent of the recession until subsequent revisions to GDP estimates were made. Partly in response to this, the Independent Review of UK Economic Statistics (HM Treasury, 2016) recommended improvements to the use of administrative data and alternative indicators as well as to data science capability to exploit both the extra granularity and the timeliness of new data sources.

This paper reviews the elements that contributed to successes in using real-time data during the pandemic as well as the challenges faced during this period, with a view to distilling some lessons for future use in government. Section 2 provides an overview of real-time indicators (RTIs) and how they were used in the UK during the Covid-19 crisis. The next sections analyse the factors that underpinned the successes (or lack thereof) in using such indicators: section 3 addresses skills, section 4 infrastructure, and section 5 legal frameworks and processes. Section 6 concludes with a summary of

the main lessons for governments that hope to make greater use of RTIs.

Box 1 Independent review of UK economic statistics

The UK government commissioned in 2015 a review of UK economic statistics (HM Treasury, 2016), led by Sir Charles Bean, a former Deputy Governor of the Bank of England. The review was conducted several years after considerable upheaval at the ONS due to its relocation from London to Newport (Wales) in 2007, which led to an important loss of expert staff. The terms of reference of the review were as follows:

- Assess the UK's future statistics needs, in particular relating to the challenges of measuring the modern economy
- assess the effectiveness of the ONS in delivering those statistics, including the extent to which the ONS makes use of relevant data and emerging data science techniques
- while fully protecting the independence of the UK national statistics, consider whether the current governance framework best supports the production of world-class economic statistics

The review advised 24 'recommended actions', of which the following were most relevant to the development of RTIs and data science techniques:

- **Recommended Action 10**: Remove obstacles to the greater use of public sector administrative data for statistical purposes, including through changes to the associated legal framework, while ensuring appropriate ethical safeguards are in place and privacy is protected.
- **Recommended Action 11**: Exploit new methods for collecting data and explore the scope for using information gathered by private sector entities in the production of economic statistics, nowcasting and one-off studies of emerging measurement issues.
- **Recommended Action 12**: Ensure ONS's technology and data systems are capable of supporting the flexible exploitation of very large data sets.
- **Recommended Action 13**: Build ONS's capacity to clean, match and analyse very large datasets, including through the recruitment of a cadre of data scientists.
- **Recommended Action 14**: Establish a new centre for the development and application of data science techniques to the production of economic statistics.

2 Real-time indicators

2.1 What are RTIs?

RTIs are data that are updated with a high frequency and can provide early insights on changes where traditional statistics are not yet available. Their frequency can range from seconds or minutes to daily, weekly or monthly – although in practice, daily data is the highest frequency that is likely to be needed for most policy-making.

RTIs can come from many sources and possibilities have exploded in the digital age. The World Bank's 2021 *World Development Report* (World Bank, 2021) provides a useful taxonomy of the types of data that are now available, based on whether their collection is intended for public or private use, and on how 'modern' the data collection techniques are. The most striking development in this area is the expansion of possibilities beyond data explicitly collected for measurement (e.g. surveys) to data collected incidentally about agents' behaviour, which has become easier than ever before to collect and analyse. This includes public data resulting from increasing government digitalisation (e.g. administrative tax data or medical records) or from new private digital services (e.g. Google searches or social media behaviour).

Table 1 Examples of data types based on original intent and collection methods

Data collection and tools	Public intent data	Private intent data
Traditional	Census; national accounts; household surveys; enterprise surveys; labour force surveys; surveys of personal finance; administrative records	Any survey conducted by private entities, including public opinion surveys deployed by private entities; administrative data from company financial accounts
New	Location data from satellite imaging; digital identification; facial recognition from public cameras;	Just-in-time digital data on individual behaviour/choices from digital platforms in the private sector

	public procurement data from e-government platforms	

Source: World Bank, *World Development Report 2021*

Alternative 'early' economic indicators such as IHS Markit's purchasing managers' index (PMI) have existed for a long time, although in the case of PMIs, they were based on surveys. Researchers have also exploited the opportunities of newly available 'big data', such as the Billion Price Project (Cavallo and Rigobon, 2008). Meanwhile, the combination of huge datasets and increased processing power has made machine-learning algorithms more readily available for nowcasting. Examples range from the Organisation for Economic Co-operation and Development's (OECD) weekly GDP tracker, which uses Google Trends data (OECD, n.d.; Woloszko, 2020), to the International Monetary Fund's (IMF) combination of both traditional data (e.g. vehicle sales, PMIs) and non-traditional data (e.g. night-time lights, nitrogen dioxide emissions) (Barhoumi et al., 2022).

2.2 Uses of RTIs

RTIs, when chosen with care for their relevance and timeliness, can offer valuable early insights, especially at times of rapid change. They can also focus on a particular sub-sector for which traditional data does not offer sufficient granularity. During the Covid-19 pandemic, many UK government data scientists turned to these sources to get early insights into the economic and social impact of government-imposed restrictions, providing policy-makers with a much greater understanding of the situation than during the 2008 financial crisis.

However, they can suffer from volatility inherent to high-frequency data and in many cases do not possess enough historic data to allow assessment of their predictive power (although in practice, crises can create structural breaks and affect the ability to forecast). It is also worth remembering that RTIs can complement, but not replace, traditional statistics gathered by national statistical institutes (NSIs) that are generally subject to more scrutiny, testing and quality assurance.

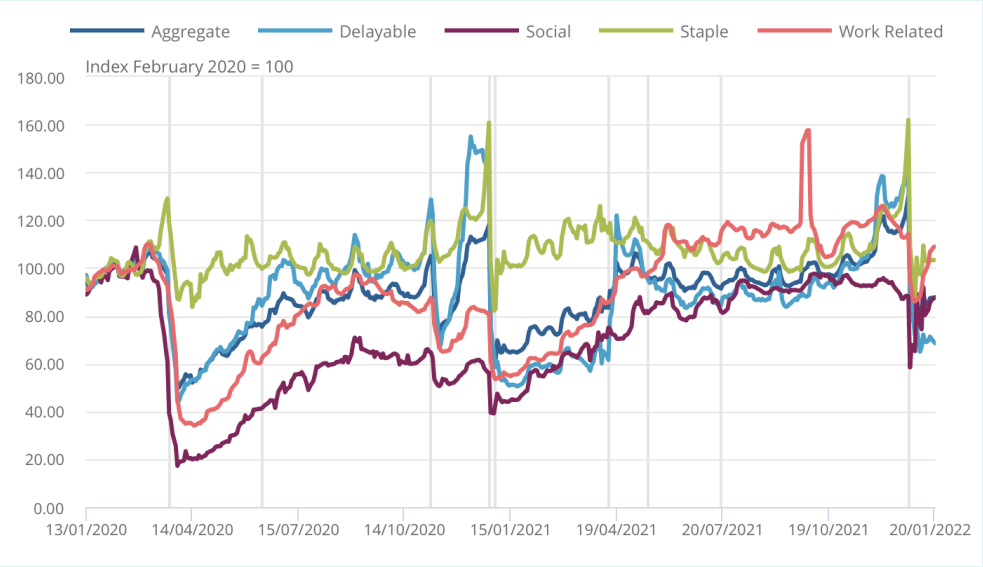
Box 2 Examples of RTIs developed during the Covid-19 pandemic

ONS faster indicators

The ONS Data Science Campus started working on experimental, faster indicators prior to the pandemic (Nolan, 2019) with measures

based on value-added tax (VAT) returns and shipping and road traffic data that have been published monthly by the ONS since April 2019. However, soon after the first lockdown was announced, publication was conducted on a weekly basis, and new data was added to the publication. Some new data was collected by the ONS via the new Business Impacts of Covid-19 Survey (BICS) (ONS, 2022a) and the Opinion and Lifestyles Survey (OPN) (ONS, 2022b), the latter which was also moved to a weekly frequency. Other data came from external suppliers, including card spending data from the Bank of England's CHAPS (Bank of England, 2021), online job vacancy counts from job vacancy aggregator Adzuna (ONS, 2021) and restaurant table bookings from Open Table (OpenTable, 2022). For example, in the chart below, card-spending data gave policy-makers real-time insights into how consumer spending on social activities collapsed during the pandemic, while spending on essentials ('staple') remained strong.

Aggregate CHAPS-based indicator of credit and debit card purchases, non-seasonally adjusted, nominal prices



Source: ONS, Economic activity and social change in the UK, real-time indicators: 27 January 2022 (https://www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/economicactivityandsocialchangeintheukrealtimeindicators/27january2022)

BEIS RTIs

The Department for Business, Energy and Industrial Strategy (BEIS) created its Advanced Analytics team to collect RTIs to track the impact of the pandemic on the economy (Duquemin, 2021). Some of these were based on open data such as Google Trends or Google Mobility; others were commercial, such as online job vacancy data from Burning Glass (Rosenfeld, 2020), footfall data from Springboard

or construction data from Glenigan (Glenigan, 2020); others were derived from official-sensitive data. Given the purpose was to provide additional insights to government, data was shared securely with other government departments using a data dashboard.

The RTIs developed during the Covid-19 pandemic fed into a range of policy decisions, from the micro to macro levels. For instance, at the micro level, the Department for Work and Pensions (DWP) shared data on unpaid carers with the National Health Service (NHS) to speed up their vaccination (Tarry, 2021) while Her Majesty's Revenue and Customs (HMRC) used administrative data to determine eligibility for government support of self-employed workers (Kwiatkowska, 2020). On a local level, Hackney Council linked several internal and external datasets to identify households most vulnerable to Covid-19 and government restrictions (CDEI, 2020). On a macro level, the ONS and in-house RTIs gave HM Treasury and BEIS insights into the scale of the macroeconomic impact, as well as the sectors and geographical areas most likely to need government support (as illustrated in Box 2), leading to the 'furlough' scheme, the Coronavirus Business Interruption Loan Scheme (CBILS), the Bounce-Back Loan Scheme (BBLS) (HM Treasury, 2020) and 'Eat Out to Help Out' (HMRC, 2020) to support workers and businesses in impacted sectors.

Table 2 provides, for economic data, an illustrative (and certainly non-exhaustive) mapping of how government officials can proxy economic variables using RTIs.

Table 2 Examples of RTI proxies for traditional economic indicators

Objective	Traditional indicator	RTI proxy	Source
Economic output	GDP (including sub-components and surveys feeding into it)	Consumer card spending	Private
		VAT returns	Public
		New company incorporations, company dissolutions	Public
		Google trends data on keywords (e.g. 'unemployment benefits', 'mortgage', 'food bank')	Private
		Footfall in high streets, retail parks and shopping centres	Private
		Restaurant bookings	Private
		Text in news articles (including keyword search, sentiment analysis, topic modelling	Private

		or more advanced machine learning)	
Labour markets	Unemployment	Potential redundancy notifications from employers	Public
		Applications for unemployment benefits	Public
	Job vacancies	Online job vacancies	Private
Inflation	Official inflation statistics	Supermarket scanner data	Private
		Web-scraped price data	Private
Trade	Exports, imports	Customs data	Public
		Telecommunications/GPS app data on movement in ports, airport cargo terminals, railway freight terminals	Private
		Ship visits to ports	Private
		Container shipping orders	Private
	International passenger survey	Real-time flight data	Private
Impact of Covid-19 restrictions on mobility		Movement data (telecommunications/GPS app data)	Private
		Google Mobility, Apple Mobility, Citymapper	Private
		Footfall data	Private
		Share of job vacancies mentioning remote working	Private
		Utility bills: offices vs homes	Private

Source: Author

Using RTIs requires officials to choose data sources carefully, which entails several trade-offs:

- An RTI may be an imperfect proxy for the official statistic it aims to complement; officials must prioritise indicators based on their relevance. For instance, consumer card spending on restaurants can be a good proxy of the impact of restrictions on hospitality, but only if disaggregated between in-person and online, given the rapid expansion of delivery services.
- Relatedly, officials must assess how much weight to give to different indicators: even if they are seemingly relevant, different

indicators may give different answers, and there is typically little information on the predictive power of RTIs deployed in emergency, especially since many of them will not have sufficient historic data to run robust statistical models on long-term relationships (even without accounting for the fact that past correlations may break down during crises).

- Officials can also be overwhelmed by the sheer number of different indicators that are now available; their time is limited, and creating data ingestion and reporting pipelines is time-consuming. Equally, ministers' attention spans are limited. Officials have to decide which data to collect and report on to get the greatest 'bang for their buck' – especially when considering that government priorities can shift rapidly.
- Naturally, some datasets are more accessible than others. This can be due to technical factors (IT restrictions/firewalls, significant preprocessing or cleaning needed), legal restrictions, or cost (for private data – although there is also an increasing amount of open data available). Weighing these against the value of data can be daunting and hard to assess, especially during crises.
- Interpreting RTIs also requires weighing the need for faster indicators against the inherent volatility of shorter-term data – it can often be tempting to overreact to short-term spikes driven by one-off events. Smoothing the data and investigating unusual patterns can guard against such issues, but this inevitably means reducing the timeliness of the indicators.
- RTIs may be affected by data collection and cleaning issues that affect the results, with corrections only applied further down the line. For instance, a change to an online job vacancy website may affect the ability of a web-scraping company's algorithm to detect duplicate vacancies (a job vacancy posted on multiple websites, or posted repeatedly to improve visibility). Data revisions occur with national statistics, and inevitably also affect RTIs.
- More generally (and as with all data), officials need to appropriately caveat advice to ministers based on RTIs to avoid a false sense of certainty, and remind them that they are a complement, rather than a substitute, to traditional official statistics, which undergo more thorough statistical testing and are typically based on more robust theoretical foundations.
- As with all novel datasets and statistical methods (which tend to underlie RTIs), officials must consider issues around data ethics (for example, potential breaches of privacy). The Centre for Applied Data Ethics (UK Statistics Authority, no date) is an important body in this space, continually developing and refining data ethics guidance.

In short, RTIs are complementary indicators to slower, traditional statistics, and can deliver considerable impact when government has to make decisions in the face of a rapidly changing situation. With the

increasing digitalisation of government and society, the ‘menu’ of RTIs from which to choose has grown considerably. However, government officials must proceed with some caution, despite the speed at which these RTIs sometimes need to be developed, to avoid pitfalls inherent to such indicators.

3 Skills

3.1 A prior build-up of data science expertise

The increased availability and use of RTIs during the pandemic required digital and data science skills that did not develop overnight (see Box 3 below). The early 2010s saw the first increase in recruitment of professionals with greater digital skills through the Government Digital Service (GDS). Subsequently, the Independent Review of Economic Statistics (HM Treasury, 2016) provided further impetus for the development of a significant cohort of data scientists in government.

This included the creation of new institutions and teams, and the recruitment of professionals with the right skillset. In particular, the creation of the ONS Data Science Campus in 2017 (Data Science Campus, n.d.-a) was crucial in experimenting with new techniques and datasets that subsequently fed into the creation of its faster indicator series. In parallel, other government departments expanded their own teams of data scientists. BEIS, for instance, had already expanded its central data science team by the start of the pandemic, allowing it to rapidly spin out its Advanced Analytics team to develop RTIs. The creation of a specific Digital, Data, Technology and Cyber Fast Stream (Civil Service Fast Stream, no date) will also undoubtedly increase opportunities for data scientists across government.

It also meant upskilling the existing cadre of analysts in government, especially members of the Government Statistical Service (GSS), the Government Operational Research Service (GORS) and the Government Economic Service (GES). For instance, a new master's programme in Data Analytics for Government (Data Science Campus, no date c) was created for civil servants, as well as other schemes such as the Data Science Accelerator programme (Central Digital and Data Office et al., 2021), Reproducible Analytical Pipeline (RAP) champions (GSS, no date), the Civil Service Data Challenge (*Civil Service Data Challenge*, no date), or the Data Science Graduate Programme (Data Science Campus, no date b).

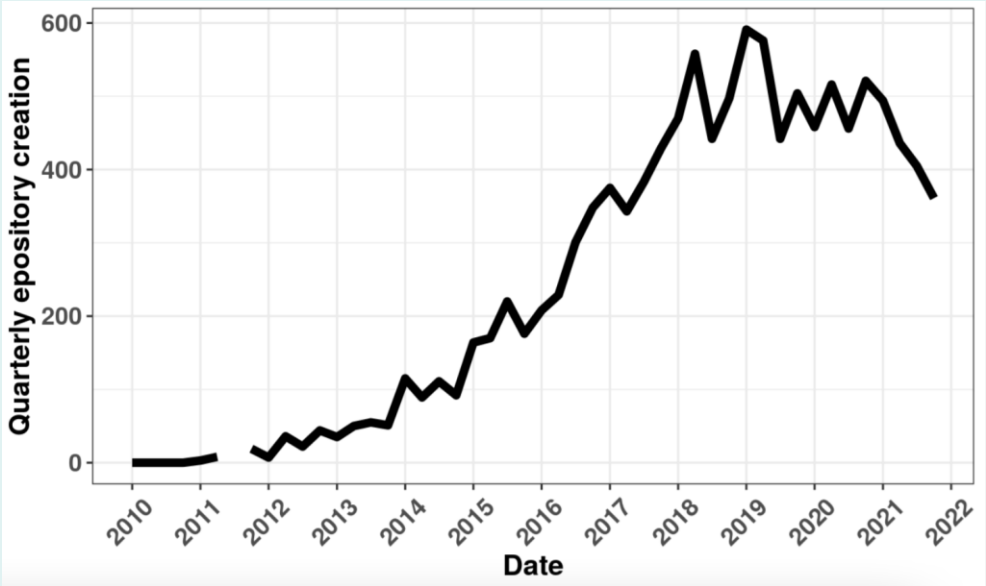
Box 3 Building digital capacity: insights from Github data

Github, a platform for online collaboration, is a common tool for modern IT and data science work – alongside competitor platforms Gitlab and Bitbucket. Analysing (open) Github data can offer some

insights into the adoption of modern software engineering ways of working. That said, this data is far from complete as many teams either use competitors to Github, or make their projects private for security reasons (meaning this does not appear in open data). In particular, data science projects using sensitive government data are unlikely to appear in these statistics.

This data suggests that the greatest phase of expansion in new public repositories by the UK government was from 2014 to 2018. The subsequent plateau and slight drop likely reveal a system that has reached greater maturity, in which efforts are possibly more focused on maintaining existing products relative to creating new ones. It may also suggest a move to make more projects private.

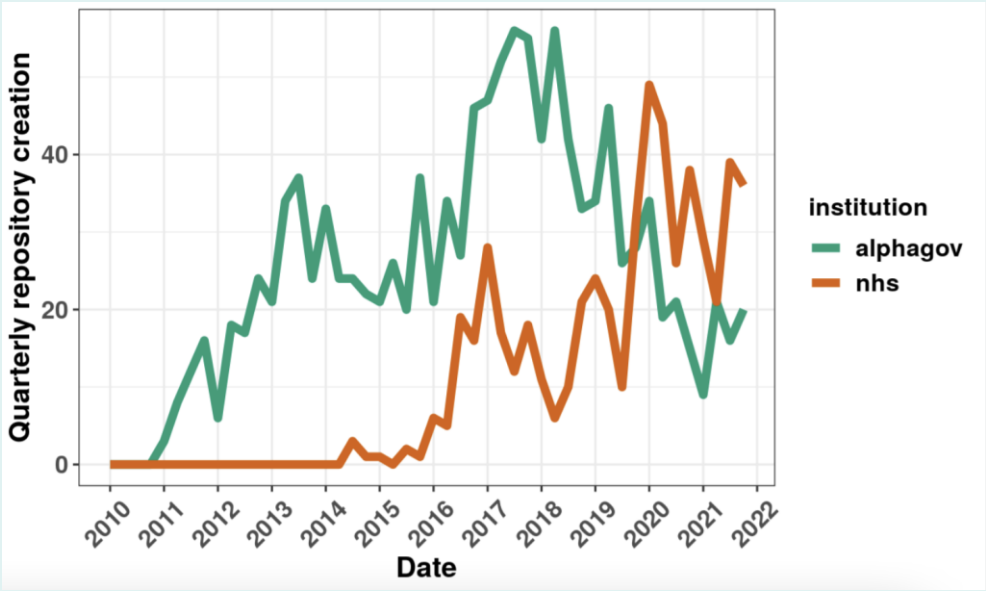
UK government organisations accelerated the creation of new public repositories from 2014 to 2018, prior to the pandemic…



Source: Quarterly counts of public repository creation by UK government organisations listed in https://raw.githubusercontent.com/github/government.github.com/gh-pages/_data/governments.yml, own calculations using the Github SEARCH application programming interface (API).

This data also suggests different speeds of adoption: while GDS (username: alphagov) were present on Github from 2011, the online presence of NHS institutions mainly picked up from 2016, with a marked increase since the start of the pandemic in 2020.

… but with different phases: for instance, we find GDS (alphagov) was an early adopter, while NHS institutions came later, with a marked increase during the pandemic



Source: Quarterly counts of repository creation by UK government organisations listed in https://raw.githubusercontent.com/github/government.github.com/gh-pages/_data/governments.yml, own calculations using the Github SEARCH API. In the chart above, 'nhs' refers to organisations whose username on Github include 'nhs': nhsconnect, nhsdigital, nhsengland, nhsuk and nhsx.

3.2 Wider data science ecosystem

Government also benefited from a broader ecosystem of data science skills in responding to the pandemic emergency, notably among universities and research institutes. For example:

- Famously, Imperial College London provided epidemiological projections of Covid-19 to government from the early stages of the pandemic (Imperial College London, 2021) and extended these to low- and middle-income countries to estimate infections, deaths and healthcare demand (Imperial College London, no date).
- The Turing Institute provided support to government in modelling the impact of the Covid-19 contact tracing app (The Alan Turing Institute, no date b) and subsequently developed a partnership to support the Joint Biosecurity Centre along with the Royal Statistical Society (The Alan Turing Institute, no date a).
- Researchers at the University of Nottingham developed a real-time economy tracking tool in collaboration with private data providers to give insights to government regarding the local economic impact of Covid-19 (*Track the Economy*, no date).
- The Economic Statistics Centre of Excellence developed a more detailed assessment of the predictive power of RTIs (Kapetanios and Papailias, 2021).

This illustrates the benefit of having a vibrant science and innovation ecosystem at a time of crisis. However, as with in-government skills, this was the result of longer-term funding and the development of data science capability in the UK's research and innovation sector.

3.3 Challenges remain

Despite these efforts, there remains a risk that data science skills are confined to narrow analytical professions instead of being more widely shared within organisations' cultures. This may perpetuate situations in which civil servants have little awareness of how data science works, and what type of data is useful.

High staff mobility in the civil service can make it difficult to develop expertise (The Institute for Government, 2019). Combined with a system that favours generalists for promotion to the highest levels, this makes it challenging to recruit and promote staff with high technical skills. For instance, over a third of new recruits for the government's Fast Stream programme in 2021 were generalists (Cabinet Office, 2021) who were unlikely to possess significant data science skills. These recruits are most likely to be rapidly promoted to the top of the civil service. Efforts such as the Data Masterclass for Senior Leaders (Kuht, 2021) have been deployed to improve data science literacy among the Senior Civil Service, but this is likely to be an ongoing challenge that will be slow to change.

4 Infrastructure

4.1 Cloud servers and databases

As with skills, successes in developing RTIs were dependent on previous efforts to improve government infrastructure.

Fundamentally, rapid development of RTIs requires access to large volumes of data and the tools necessary to analyse it. In terms of access, this implies having automated processes to ingest and clean data to make it useable, which is time-consuming and can be a major hurdle in a time of crisis. Equally, access to cloud infrastructure is necessary both for storing large volumes of data and for rapidly scaling up processing power when necessary. Finally, access to modern software tools like Python, R or Structured Query Language are part of all data scientists' toolbox.

For instance, BEIS data scientists relied on its Cloud-Based Analytical System (CBAS) to develop its RTI dashboard, while the ONS turned to Google Cloud to help support its operations during the pandemic (ITProPortal, 2020).

However, significant amounts of government data is still saved and shared in unsuitable formats. It is 'held in fragmented ways' and is 'difficult to aggregate' (Gould, 2021), creating a plethora of inconsistently formatted Excel, CSV, Word or PDF files that can be hard to exploit at pace. The costs of IT legacy systems became obvious during the crisis, as illustrated by the failure to report some Covid-19 test results that were saved in Excel files (BBC, 2020). This issue affects analysis beyond Covid-19: for example, impact assessments are produced with the aim of being read by humans and are generally saved as PDF files (*Legislation.gov.uk*, no date), whereas considerable value could be gained by systematically collecting the data (including text) from these.

4.2 Infrastructure for collaboration

Combining different data sources can generate greater value than the sum of their parts if they can be linked – this is the case for RTIs and for all data projects generally. In turn, this depends on the ability of government departments to access and share data. The vision for a digitally-integrated government through the concept of 'Government as a Platform' (O'Reilly, 2010; Loosemore, 2018; Pope, 2019) has been integral to digitalisation efforts by GDS since 2011. This vision, currently best implemented in countries like Estonia, sees 'government reorganized around shared components, application

programming interfaces, open standards and canonical datasets' (Pope, 2019).

Some progress has been made in improving the sharing of administrative data across government – for instance, DWP developed a set of APIs to facilitate data queries by other government departments (Leggetter, 2020). These APIs bore fruit when it came to identifying and supporting vulnerable people and businesses during the pandemic. This support included setting up online payments for a new range of services as well as using the Notify platform to send messages to vulnerable people (Raines and Buckley, 2020).

Despite these successes, 'the largest departments operate their own databases with few links between them' (Margetts andNaumann, 2017). Barring a few exceptions, government departments use separate cloud servers and IT providers to store and analyse data for statistical purposes, and there are no standard, generalised processes for easily sharing data. Additionally, these servers tend to have stringent security protections that create extra difficulties to get data in and out. While this is justifiable on security grounds, it means government data scientists often work in silos, hampering data sharing and collaboration.

The lack of a common analysis platform across government goes beyond data sharing. Data scientists could save considerable time and money through collaborative working and sharing code and techniques more easily. Beyond a single server, having a common platform for version control (e.g. Github, Gitlab or Bitbucket) for data scientists to share techniques and work on joint projects would also help to improve collaboration between departments.

Some schemes do already exist, such as the Secure Research Service (SRS), which allows accredited researchers to access ONS microdata. The ONS has recently launched a trial version of its new Integrated Data Service (IDS), which aims to provide easier access to ONS data across government and for external accredited researchers (Pritchard, 2021). Navigating the tension between the infrastructure that keeps data secure and having the technical means of collaborating with third parties is important for tapping into the deep pool of data science knowledge that exists across academia and the private sector (see section 3.2).

5 Legal frameworks and processes

5.1 Cross-governmental data sharing

The third foundation necessary to the development of RTIs consists of the regulations and processes that allow data to be accessed and shared while protecting sensitive data. The framework for 'Government as a Platform' envisioned by the creators of GDS would enable data to be accessible across government. However, as outlined above, there has been limited progress on creating a shared digital public infrastructure for data exchange. Similarly, processes for data sharing across departments are not systematic and continue to hinder collaboration.

The Independent Review of Economic Statistics (HM Treasury, 2016) identified the value of administrative data in producing faster indicators of economic activity and made several recommendations around access to both administrative and private sector data as well as data matching to improve the production of statistics. In response, parts of the Digital Economy Act (Legislation.gov.uk, 2017) were designed to encourage the process of data sharing and acquisition, and facilitated a number of data-sharing agreements prior to the pandemic (Cabinet Office, DCMS and Home Office, 2020). However, evidence suggests significant barriers around data sharing persisted, including due to risk-aversion regarding the potential downsides of acting incorrectly (Kantar, 2020).

According to multiple reports, the urgent need for action during the pandemic and the huge potential benefits of data sharing led to changes to the culture of this practice (Gould, 2021), whereby sharing across government became more of a rule than an exception. While part of the success in data sharing can be attributed to a lower aversion to risk that could yet persist, it may also result from a change to the balance of risks and benefits during the pandemic. This change in risk perception could mean that, in the absence of an emergency, practices may revert to lower levels of sharing. As an indicator of intention, the NHS draft data strategy published in 2021 included three key priorities, including making 'appropriate data sharing the norm and not the exception' (Department of Health and Social Care, 2022).

Given the lack of a consistent and easy framework to share sensitive data across government, departments are also developing new

approaches to data sharing. For instance, DWP has spearheaded the development of a Labour Market Data Trust alongside BEIS, the Department for Education (DfE) and HMRC. The aim of this structure is to create a 'legal, digital and data protection framework' (Lodge, 2022) necessary to share labour market data between these departments. While this type of initiative will improve data sharing, creating new RTIs and better insights for policy-makers, it also reveals a lack of a viable alternative in the near term.

5.2 Procurement

There are benefits to be had from government procuring third-party data as a single buyer. However, this practice is not always prevalent, which limits the amount of data available across government departments. There are examples of some joint procurement such as the purchase of footfall data by BEIS and the ONS, but this is not always the case. Government departments procured online job vacancy data separately during the pandemic (e.g. Adzuna for the ONS and Burning Glass for BEIS). Facilitating the joint procurement of data could lead to far greater data sharing across government, but this hinges on culture, rules, processes and the limitations to infrastructure as previously highlighted.

5.3 Rules and culture around statistical production

The crisis showed that government was able to work reactively in emergency situations. For instance, the ONS created new statistics and surveys at a faster pace than ever before. This reactivity required a greater acceptance of uncertainty and risk around statistical production by the ONS than what they were previously accustomed to. The ONS was also able to demonstrate reactivity during the end of the EU transition period, when it added new questions to the Business Impacts of Covid-19 Survey to get initial, real-time data on its impact on businesses.

The push to develop faster indicators cannot replace the development of regular national statistics. In addition, further work is needed to understand the validity and predictive power of many RTIs. This is typically a challenge during times of crisis, both because there is little time for in-depth analysis, and because new indicators frequently have shorter time series than established indicators (as explained in section 2.2). In the long run, further testing and development is needed to better understand and exploit RTIs. However, this investment may be challenging for civil service teams to justify during budget prioritisation exercises compared with short-term deliverables that have a more immediate and tangible impact.

6 Conclusions

The UK government's response to the pandemic displayed a step change in its use of real-time data compared to the 2008 financial crisis. Within days of the lockdown announcement, policy-makers were already receiving new data on the rapid spread of Covid-19 and its impact on the economy.

Although new waves of Covid-19 have continued to disrupt plans to relegate the crisis mindset to the past, government is progressively moving back to business-as-usual. It is important to take stock of the successes and limitations of crisis management. When it comes to using RTIs, success relied on three pillars:

- A build-up of data science skills over years prior to the pandemic, so that analysts with advanced skills could rapidly be deployed to exploit new data opportunities.
- Investment in infrastructure, especially cloud services that allowed data scientists to store and process large volumes of data.
- A greater acceptance of risk and flexibility around data sharing and the production of statistics.

However, a number of factors continue to hold back the development of real-time data. These include:

- High staff mobility and limited knowledge of data science across the civil service, especially at higher levels where generalist policy skills dominate at the expense of technical know-how.
- Large swathes of data continue to be stored in inconsistent, hard-to-use formats outside of databases, while the absence of joint servers and platforms restrict data sharing and collaboration between data scientists.
- While civil servants were able to cut through rules and processes for sharing data to deliver results at pace, risk aversion may revert as the default in the absence of an emergency.

Government officials are likely using RTIs developed during the Covid-19 crisis to provide insights into shocks created by the Ukraine–Russia war and the sanctions on Russia (as illustrated by the inclusion of real-time gas prices in the ONS public RTI series (ONS, 2022)). Yet it is important both to not lose sight of longer-term objectives and to lay the foundations for improved responses to future crises. While the development of data science skills and awareness across the civil service is likely to continue, improving

infrastructure and frameworks around data storage, ethics and collaboration could provide a real step-change in officials' capacity to exploit data to support government decisions in times of crises. Even in normal times, these investments are likely to pay dividends.

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