Digital Catapult and Open Data Institute

Response to the Government Chief Scientific Advisor's report on distributed ledger technologies

Introduction

The **Digital Catapult** and the **Open Data Institute** (ODI) welcome the Government Chief Scientific Advisor Sir Mark Walport's report on distributed ledger technologies.

We support its thesis that distributed ledgers are a potentially important technology for data infrastructure, and can unlock social, economic and environmental value in both the public and private sector.

We also support the report's statement that there are a wide range of secure distributed ledger technologies, each with different properties, and that government efforts in this area should assess the entire technology landscape.

We would like to add a number of use cases, challenges and recommendations that may prove useful.

We welcome the recommendation by The Rt Hon Matthew Hancock MP and Rt Hon Ed Vaizey MP for collaboration between the Alan Turing Institute, the ODI and the Digital Catapult to work together with the private sector and international partners to unlock the full potential of these technologies and realise their value.

Context

It is important to see distributed ledger technologies within the context of wider government and innovation strategy.

The Prime Minister has set out his vision for a smarter state with three principles of reform, devolution and efficiency. The Digital Economy Minister is developing a digital strategy for the UK. The Minister for the Cabinet Office has set out his view on how the public sector will be reformed. The Government Digital Service are working on an initiative that will create authoritative lists of trusted information and new legislation for data sharing. The Government's work extends to city, national and global levels with organisations such as the UK-France data taskforce and the D5 group of digital governments working on strengthening

the digital economy across international boundaries. Making the right technology choices will help these initiatives and provide a competitive advantage for the UK economy.

The government also invests in and supports innovation through organisations such as the Digital Catapult and the ODI. Both are actively engaged in explorations and proofs of concept of **distributed ledger technologies** which can help achieve the above-mentioned strategic goals.

The ODI connects, equips and inspires people around the world to innovate with data. It has been investigating the governance, standards, policies, technologies and business models involved in building and maintaining a **data infrastructure**. It is crucial that we protect data that needs to be kept private, just as it is crucial that we openly publish data that should be open for everyone to use. Both privacy and openness help create trust. There are competitive advantages for the cities, nations and regions that get this right. A data infrastructure can maximise use, value and liquidity of data. Data infrastructure is vital for strengthening and reducing friction in the digital economy and securing our future economic prosperity. Research into **distributed ledgers**, supporting technologies such as blockchains, and the role they play in the data infrastructure are part of this work. The ODI incubates multiple startups who are exploring the commercial application of blockchains. For example, Provenance who are building a business that will use blockchains to improve supply-chain transparency and audit.

The Digital Catapult develops breakthroughs for the UK's data sharing movement. Clearly the challenges around improving the sharing and liquidity of data are only partly technological. Building citizen trust is essential, as greater citizen confidence in how personal data is handled will lead to economic benefits well beyond cost-savings and efficiencies in government. Currently the flow of organisational and personal data is significantly impeded by the diversity of legal terms, commercial structures and point-to-point technical connections. For these reasons the Digital Catapult is driving the **Trust Framework** and **Data Sharing Lab** Initiatives to create common standards and a reference architecture. This will place the citizen at the centre of an informed consent-based data sharing solution that will ensure enhanced privacy, innovation in personal data services and substantial societal benefits. **Distributed ledger technologies** can power auditability, increasing trust that consent and sharing agreements are adhered to. There are further clear applications of distributed ledger technologies for sharing data across the Internet of Things (IoT), where the Digital Catapult coordinates the IoTUK initiative, and also in the Copyright Hub initiative, that enables machine to machine negotiation of rights and licences reducing digital friction in the creative industries.

Report summary

The Distributed Ledger report makes eight recommendations.

Recommendation 1: Provide leadership	We recommend that government should: • Provide ministerial leadership to ensure that government provides the vision, leadership and the platform for distributed ledger technology within government. Specifically, the Government Data Service should lead work in government as a user of distributed ledgers and the The Department for Culture, Media & Sport (DCMS) Digital Economy Unit should lead work on government as an enabler of distributed ledgers (working with the Department of Business, Innovation and Skills and with Innovate UK). • The Government Digital Service (GDS) and the DCMS Digital Economy Unit should develop a high-level capability road map and a supporting outline plan based on the work of this report and very early stage activity already underway in departments, and deliver this in a timely fashion; and continue to oversee the recommendations made in the rest of this report, to maintain momentum and rapid action. In undertaking this work, they should work closely with other government departments and with industry and academia and should consider setting up a time-limited expert advisory group in support.
Recommendation 2: Invest in research	The UK research community should invest in the research required to ensure that distributed ledgers are scalable, secure and provide proof of correctness of their contents. They need to provide high-performance, low latency operations, appropriate to the domain within which the technology is being deployed. They need to be energy efficient. The newly-created Alan Turing Institute, working with groupings such as the Whitechapel Think Tank, could play an important role in coordinating and 'self-organising' the public and private research and development sector interested in this and related technologies. The private sector should consider investing in the Alan Turing Institute to support the pre-competitive research that will ultimately facilitate new commercial applications that are robust and secure. This includes work on obvious areas such as cryptography and cybersecurity but also extends to the development of new types of algorithm.
Recommendation 3: Create a city demonstrator	Government could support the creation of distributed ledger demonstrators for local government that will bring together all the elements necessary to test the technology and its application. A demonstrator at a city level could provide important opportunities for trialling and implementing distributed ledger technologies. Innovate UK could use its work with cities in the development of 'city deals' to implement the development of a city demonstrator.
Recommendation 4: Provide a regulatory framework	Government needs to consider how to put in place a regulatory framework for distributed ledger technology. Regulation will need to evolve in parallel with the development of new implementations and applications of the technology. As part of the consideration of regulation, government should also consider how regulatory goals could be achieved using technical code as well as legal code. The DCMS Digital Economy Unit could take ownership of this recommendation.
Recommendation 5: Develop standards for integrity, security and privacy	Government needs to work with academia and industry to ensure that standards are set for the integrity, security and privacy of distributed ledgers and their contents. These standards need to be reflected in both regulatory and software code.
Recommendation 6: Develop identification and authentication protocols	This recommendation is linked to Recommendation 5. Government needs to work with academia and industry to ensure that the most effective and usable identification and authentication protocols are implemented for both individuals and organisations. This work needs to go hand in hand with the development and implementation of international standards.

Recommendation 7: Establish public sector trials	Understanding the true potential of distributed ledgers requires not only research but also using the technology for real-life applications. Government should establish trials of distributed ledgers in order to assess the technology's usability within the public sector.
Recommendation 8: Build capabilities and skills within government	As well as top-down leadership and coordination, there is also a need to build capability and skills within government. We recommend the establishment of a cross-government community of interest, bringing together the analytical and policy communities, to generate and develop potential 'use cases' and create a body of knowledge and expertise within the civil service. GDS and the Data Science Partnership between GDS, Office for National Statistics, Cabinet Office and the Government Office for Science could act as the convenors of this community of interest. There are important opportunities for government to stimulate the business sector by acting as a smart customer in procuring distributed ledger applications.

Use cases

Both the ODI and the Digital Catapult are exploring use cases that will benefit from distributed ledger technologies.

Use case 1: Transparency based trust

Distributed ledgers and smart contracts can help improve trust across a network where the nodes have different levels of trustworthiness. This creates potential benefits for cases spanning legal jurisdictions such as increasing the trust in import/export contracts or when multiple partners are supplying foreign aid, as highlighted in the report. The Open Data Institute's global development theme and international node network are connected to data innovators in multiple countries and will explore opportunities in this area.

Use case 2: Security against data loss

The increased accessibility and robustness created by data storage in each node provides both increased liquidity and protection in case an organisation that maintains some of the data disappears. This creates potential benefits for some sectors of the economy where valuable data is being created but is under-utilised or at risk of loss such as the reputation of actors in the sharing economy.

Use case 3: Sharing personal data with trust

The Digital Catapult's Trust Framework Initiative looks at the use of distributed ledger technologies as a possible alternative to legacy forms of identity. Identity services that use these technologies could drive out fraud and error and in parallel enhance trust in government services derived from the transparency and control that will be afforded to the individual. This can complement other mechanisms that are being developed by the Open

Data Institute such as better understanding of privacy, improved organisational transparency and greater data literacy amongst citizens and organisations.

Use case 4: Collaborative maintenance of data assets

The Open Data Institute's Labs team are researching distributed peer networks to provide a mechanism for collaboratively creating shared open data assets. A large number of independent data publishers (such as local councils and community organisations) can add data to a distributed store without needing centralised systems or administration.

Use case 5: Copyright and licensing

There are two specific applications being developed at the Digital Catapult that utilise smart contract and distributed ledger technologies.

- The production and licensing of music, which could disrupt the existing label, publisher and collection society model, empowering individual creators as well as opening up the market to new digital players providing innovative services.
- Games development, to enable creative teams to collaborate and ensure each asset and contribution is recorded and appropriately rewarded. Reducing friction in the creative process of games while still providing protection of contributions and rights would lead to peer to peer trading of those game assets on digital marketplaces.

Use case 6: Distributed issuing of persistent identifiers

Where a number of organisations need to issue simple identifiers, a central issuing agency is required. Distributed systems could allow such identifiers to be created automatically and quickly by consensus across the network, reducing friction and opening up new applications. For instance, unique identifiers could be created for published media articles, journals and books allowing better citation and checking of sources.

Challenges

Distributed ledger technologies offer a range of exciting opportunities for government, the private and the academic sectors. When evaluating these opportunities against their counterpart challenges, it is important to differentiate between the separate use cases, as well as technology readiness levels of the different components.

As the report emphasises, enhancing governmental services with distributed ledger technologies has the potential to increase **efficiency**, **transparency** and **trust**.

We must also acknowledge that the radical opportunities also raise some other fundamental systemic challenges, principally around the **economics** of the distributed system and its scale. The distribution necessarily places obligations on a set of stakeholders, yet a

stakeholder's benefit may not reflect their cost in operating their components. Consider money systems built on consensus ledgers specifically reward stakeholders that undertake the computationally-intensive 'mining' function on the blockchain. In addition to such system-economic challenges, efficiency must also be considered.

When it comes to **efficiency**, distributed technologies, by their nature, push maintenance costs away from the centre of the network. This raises the challenge of remuneration and energy costs for running such a system, which may be wildly different for various stakeholders and technologies, and in some cases could be much higher than the cost of an equivalent centralised system. This challenge can be mitigated by testing different "flavours" of the technology in a discovery phase for each use case in order to establish the predicted economic gain.

The inherent **transparency** of distributed ledger technologies will naturally increase citizen's confidence and **trust** in how government handles personal data. Nethertheless, it is important to accompany the advance in technology with an educational one; the Digital Catapult is driving the Trust Framework Initiative to create common standards to empower the individual to control the use of one's personal data. In addition, the efficiency and uniformity of the interface between the intrinsically *public* data on a ledger, and associated *private* data must be considered.

Digital ledger technologies must be chosen based on user needs and **legal** requirements. For example; tamper-proof and immutable data stores prevent the modification of stored data, but this may not always be an acceptable property. The EU "right to be forgotten" requires the complete removal of information; if that data is in an unchangeable system like a blockchain, this could be impossible.

Recommendations

Over the coming years both the public and private sector will benefit from being open to trialling new ideas and gaining the expertise that will help society find the right answers for our data infrastructure. Our view is that we would see enormous benefit from collaboration across the Digital Catapult, the ODI and other organisations such as the Alan Turing Institute working to make the UK more competitive and innovative in its use of data, across public and private sectors. Among the UK government's digital investments, both the Digital Catapult and the ODI share the goal of increasing *data liquidity*: creating significant impact through better and increased use of data across the economy and across the [spectrum of data from closed to shared to open](#).

The UK is at a good position to take the lead on this new technology internationally. However, innovation in the **private sector** is essential in order to realise this economic win. Test-beds would definitely help creation of new products and services, as well as open innovation schemes, funding and appropriate skill pool. The Digital Catapult and the ODI are

well connected to the business reality of larger enterprises as well as startups/scale ups, and are well positioned to drive this innovative market forward.

Although much innovation in this area will come from the private sector, the public sector is uniquely situated to help develop and promote **open standards** which unlock network effects and wider benefits to society.

In the specific context of distributed ledgers, there is an important mission for these organisations: shepherd the definition of standards, practices, protocols, and interfaces that will allow **uniform**, efficient, transparent, trustworthy and **widespread** interaction across the emerging and diverse space of deployments.

Last, to win the in long term, continual investment in **academic research** will be crucial. Continual support of initiatives such as the Alan Turing Institute will ensure nurturing the right skills, as well as provide the theoretical background to the least mature aspects of distributed ledger technologies and their application.

As the Government Chief Scientific Advisor's report concludes, the UK economy would benefit from collaboration between problem owners and innovators, creating both open pilots to share findings and closed ones to support product and service development. **SME engagement** is key to to harnessing such innovation. Collaboration among public and private sectors, across verticals, will make data flow between them to realise full value. As well as bringing together government and commercial organisations, this collaboration would also accelerate academic research with more rapid deployments to solve real-world problems. Creating a **testbed** to allow experimentation and testing of distributed ledgers for real settings would bring in the broader ecosystem of academia, startups, corporates and public sector organisations. The Digital Catapult's Data Sharing Lab is the first step towards building such a testbed.

Further benefit would emerge from separate streams of opportunity for government and industry. On the one hand, government opportunities will be within a UK jurisdiction, driven by creating improved and more efficient services. Commercial organisations, on the other hand, will pursue new opportunities and create new markets in the **global** digital arena.

The report refers to an explosion of creativity leading to significant yet unpredictable innovation and wealth creation. We share this view that the range of distributed ledger technologies are a significant new tool in our data innovation arsenal. Both the Digital Catapult and the ODI are focussed on working with innovators to solve real-world problems in using data, and both organisations are already positioned to work broadly across sectors. We aim to take distributed ledgers, as part of a toolkit of technologies, together with a network of innovation partners, and provide a path to realise the innovation and wealth creation for the benefit of the UK.