Financial Conduct Authority

Discussion Paper

DP17/3

Discussion Paper on distributed ledger technology

April 2017

Contents

We are asking for comments on this Discussion Paper by 17 July 2017.

You can send them to us using the form on our website at: www.fca.org.uk/dp17-03-response-form.

Or in writing to:

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We have carried out this work in the context of the existing UK and EU regulatory framework. We will keep it under review to assess whether any amendments may be required in the event of changes in the UK regulatory framework, including as a result of any negotiations following the UK's vote to leave the EU.

We make all responses to formal consultation available for public inspection unless the respondent requests otherwise. We will not regard a standard confidentiality statement in an email message as a request for non-disclosure.

Despite this, we may be asked to disclose a confidential response under the Freedom of Information Act 2000. We may consult you if we receive such a request. Any decision we make not to disclose the response is reviewable by the Information Commissioner and the Information Rights Tribunal.

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Abbreviations used in this paper

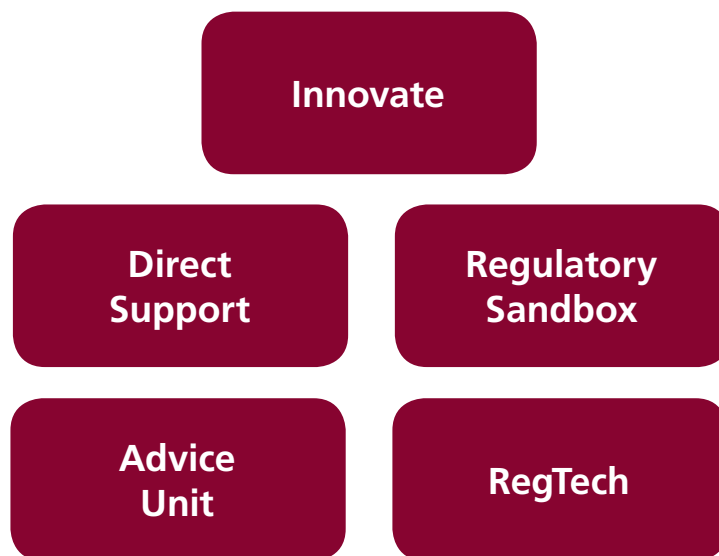| [Acronym]	[Description]
AML	anti-money laundering
DAO	decentralised autonomous organisation
DDBMS	distributed database management systems
DLT	distributed ledger technology
DP	Discussion Paper
ESMA	European Securities and Markets Authority
ICO	Information Commissioner's Office
IOSCO	International Organization of Securities Commissions
MPOR	margin period of risk
RAO	Regulated Activities Order 2016
UCITS	unregulated collective investment scheme

1.
Overview

Introduction

1.1   We are committed to fostering innovation that advances our objectives. Innovation can arise from diverse sources, such as start-ups, technology providers as well as regulated firms, including large financial institutions. They all have the potential to challenge existing business models, products and methodologies to benefit consumers and markets as a whole.

1.2   New technology plays a fundamental and increasingly pivotal role in delivering innovative products and services. These new products and services can improve on those currently available, offering consumers easier access to, and better, financial services. Equally, some products may not be suitable for certain consumers. Our objectives as a regulator mean that we need to strike a balance between supporting innovation and ensuring consumers are adequately protected.

1.3   Distributed ledger technology (DLT) is an example of rapidly developing technology which offers exciting potential to support the needs of consumers and the market. DLT may also present new challenges and potential risks. For example, how regulated firms allocate responsibilities for systems shared among them.

1.4   We generally take a 'technology neutral' approach to regulating financial services and are interested in considering whether there is anything distinctive about DLT which would require us to take a different approach.

1.5   We use this Discussion Paper (DP) to start a dialogue on the potential for future development of DLT in the markets we regulate. We are particularly interested to explore where the balance of risk and opportunities may lie in relation to DLT. Following this DP, we look forward to further engagement through public events, supervisory work and the various channels we have to interact with the Fintech industry.

The role of the FCA in supporting innovation

1.6   The FCA is the conduct regulator for 56,000 financial services firms and the prudential regulator for over 24,000 of those firms. Our strategic objective is to ensure that the markets we regulate work well. To advance our strategic objective we have three operational objectives:

- Protect consumers – to secure an appropriate degree of protection for consumers

- Protect financial markets – to protect and enhance the integrity of the UK financial system

- Promote competition – to promote effective competition in the interests of consumers

1.7   Our 'Innovate' initiative supports our competition objective. The objectives of the initiative are to encourage greater competition and innovation in financial services. We do so by removing barriers to entry where desirable and possible through clarifying regulatory expectations, examining our own rules and processes and providing a test environment for the most innovative ideas. We also help firms compete at scale by seeking to remove international barriers where possible. A diagram of the core functions of Innovate is below:[1]

Innovate

Direct Support

Regulatory Sandbox

Advice Unit

RegTech

1.8   We offer **Direct Support** through Innovate to businesses that are looking to introduce groundbreaking or significantly different financial products or services to the market. Our **Advice Unit** provides regulatory feedback to firms developing automated models to deliver lower-cost advice to consumers. The **Regulatory Sandbox** allows businesses to test innovative products, services, business models and delivery mechanisms. Through our **RegTech** work we explore how regulatory requirements and technology can align through regulatory technology.

1.9   In addition to supporting individual innovative businesses, we look to add more flexibility to our regulatory framework and identify barriers to entry for innovative firms. By reviewing our regulatory approach we aim to encourage and support innovation, providing it will not erode consumer protection or the integrity of the financial system.

The arrival of DLT

1.10   DLT is a relatively recent advancement that has received increasing amounts of industry, media, political and other stakeholder attention in recent years. It combines various existing tools such as shared databases, cryptography and peer-to-peer networking to offer firms the ability to share data efficiently and securely. Technology companies seeking to provide DLT-based solutions have grown sharply in number and size, and regulated firms have invested increasing resources in using this technology to provide financial services. Industry efforts to investigate DLT have become especially concentrated in the last 24 months, and in the second half of 2017 into 2018 we expect to see more movement from 'Proof of Concept' to 'real-world' deployments.

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1   For more information please see https://www.fca.org.uk/firms/fintech-and-innovative-businesses

1.11   We have already seen a variety of DLT solutions being deployed in regulated financial services through the various mechanisms of Innovate (e.g. the Regulatory Sandbox or Direct Support). We cover some of these examples in the sections to follow. We hope this DP will bring further use cases to our attention.

1.12   There has been a broad range of reactions to DLT. We remain aware that exponents of new technologies, particularly vendors, will often hype or oversell new technologies. Equally, detractors will remain sceptical about their capabilities. One of the purposes of this DP is, therefore, to invite debate and clarify what the real benefits and risks of DLT may be, and how they might impact our objectives.

DLT's risks and opportunities

1.13   DLT has the potential to provide various benefits for regulated markets. These benefits are likely to emerge in sectors where multiple participants need to share data and/or processes safely, particularly where firms are still reliant on paper-based records. DLT's ability to remove the need for certain intermediaries, to increase the speed of reconciliation and reduce costs has made it a popular subject of research for both regulators and the industry.

1.14   DLT's increasing popularity has underlined the growing challenge firms have to manage their data safely and efficiently across all sectors. That said, firms have told us that adoption of DLT will have to be in areas where the advantages in relation to efficiency are large enough to outweigh the risks of technology transformation and the high costs of implementation.

Our regulatory approach

1.15   Given that DLT is a new technology some of the products and business models it enables may require consideration of how specific regulatory requirements apply. Its potential to help promote competition through disruptive innovation must be balanced against our other statutory objectives of consumer protection and market integrity.

1.16   There are a variety of use cases, some only theoretical, which have prompted us to take a closer look at DLT. DLT has the potential to offer, for example, digitised assets that can be delivered directly to consumers, legal agreements that can be composed in software and enshrined in cryptographic layers, and secured data provenance for property or identity.

1.17   DLT's potential, combined with processing speed (the likes of which has not yet been seen), might suggest that aspects of existing rules may need to be reviewed in the light of this new technological context.

1.18   Historically, the FCA's philosophy has been one of 'technology neutrality' i.e. not to regulate specific technology types, only the activities they facilitate and the firms carrying out these activities. This approach is designed to accommodate innovation but avoid arbitrage and unfair competition. However, there may be specific areas where DLT does not fit with our requirements but still achieves our desired outcomes. We may, therefore, need to consider whether our rules prevent or restrict sensible development that would benefit consumers and hence whether changes may be needed.

1.19 At this stage we do not see a clear need to consider changes to our regulatory framework for DLT solutions to be implemented. Instead we want to explore emerging business models, and how their potential risks and opportunities operate in the context of our regulatory framework. In particular, we invite discussion on two sets of issues:

- What new risks and opportunities does DLT present to our statutory objectives of market integrity, consumer protection and competition? Can DLT support more effective competition, financial system integrity and deliver better consumer outcomes? How can regulated firms mitigate any risks?

- Do any of DLT's characteristics make it challenging to fit DLT solutions into the regulatory framework, despite our approach of 'technology neutrality'?

Out of scope

1.20 There are certain legal questions which are matters for the courts to decide rather than being part of our remit. An example might be the conflict of laws issues regarding contracts executed on a DLT platform across multiple jurisdictions simultaneously. Regulatory changes which require amendment of primary and secondary legislation, and therefore, need the involvement of HM Treasury (such as to the Financial Services and Markets Act 2000, or the Financial Services and Markets Act 2000 (Regulated Activities) Order 2001 (RAO)) are also out of scope, as are regulatory issues under the remit of the Prudential Regulation Authority or Bank of England.

International engagement

1.21 We are also working actively with overseas regulators and standard setting bodies on collaborative initiatives and reports relating to DLT. In Europe, this includes the European Securities and Markets Authority (ESMA); internationally there is work going on in such organisations as IOSCO (the International Organization of Securities Commissions) and the Financial Stability Board. We recognise that the cross-border applications of DLT will require regulatory collaboration to ensure that these applications are developed in a safe way and that disproportionate barriers to innovation can be identified.

Who does this document affect?

1.22 This DP is aimed at both users and providers of DLT solutions in the sectors which we supervise. It assumes a basic understanding of DLT and its main features. To serve as a starting point for an industry discussion, we set out some context for those who are using and providing DLT solutions and ask a variety of questions aimed at enhancing our knowledge in this area. We encourage regulated firms, start-ups and technology companies to provide input where possible.

1.23 DLT's potential to create for example new distribution channels or ways of holding and sharing client data has certain consumer implications so we also invite the perspective of consumer groups where there is interest.

Next steps

What do you need to do next?

1.24 Please send us your comments by 17 July 2017.

How?

1.25 Use the online response form on our website or write to us at the address on page 2.

What will we do?

1.26 Once we have received responses to this DP, we will review these and decide our next steps. This might take the form of a Summary of Responses, or, if we want to take a closer look at our requirements, a Consultation Paper. We will continue to learn from the use cases being tested in the Regulatory Sandbox. Additionally, we look forward to engaging with the industry through our planned series of events, roundtables and bilateral discussions on the subject of DLT.

2. Context

Key terms

2.1 While there is no formal definition of DLT, it can be described as a set of technological solutions that enables a single, sequenced, standardised and cryptographically-secured record of activity to be safely distributed to, and acted upon by, a network of varied participants. This record could contain for example, transactions, asset holdings or identity data. This contrasts with a traditional centralised ledger system, owned and operated by a single trusted entity. We consider a blockchain to be a type of DLT where records are collated into "blocks" and linked using a cryptographic signature.

2.2 To aid our discussion, we have defined the following concepts:

- 'Public/private keys': a type of encryption involving an identifier code which is known to others (the public key) and a code known only to the user (the private key). On the presentation of the public and private keys, users can for example be given certain rights to distribute or receive data.

- 'Nodes': participants on a distributed ledger. Different nodes may have different rights to read, write and/or delete data.

- 'Miners': this is a participant on a distributed ledger that adds new records by solving a cryptographic puzzle and is rewarded in the protocol's digital currency.

- 'Public' DLT networks: these are networks where all users of the network can see records being added or changed. The opposite, 'private' DLT networks, are those where visibility is restricted to a subset of users.

- 'Unpermissioned/permissionless' DLT networks: these are networks where anyone is allowed to validate and add new records to the existing set of records. The opposite, 'permissioned' DLT networks, are those where only users with specific rights are allowed to do this.

Shared database models

2.3 DLT can be considered as another architectural model under the umbrella of distributed database management systems (DDBMS). These systems typically allow participants to process, store and share data across multiple points in a network. DLT is, therefore, not unique or new in its ability to allow multiple participants to have reading rights to the same data in near real-time. However, we have noticed that because of DLT, firms are contemplating setting up their own networks to share data to a greater extent than previously seen. This development is one of the topics that we wish to explore in this DP.

Digital currencies

2.4 DLT includes the use of digital or 'crypto-' currencies. For the purposes of this DP, our working definition of digital currency is 'any publicly available electronic medium of exchange that features a permissionless distributed ledger and a decentralised system for exchanging value'.[2] Bitcoin is a digital currency and is the first use case of DLT. However, research and discussion more recently have focused on the underlying technology underpinning Bitcoin and how it could be used.

Other potential uses

2.5 We are now seeing application or potential application of DLT technology across a range of sectors and activities. The Regulatory Sandbox has been a rich source of case studies to inform our understanding of this technology. Firms have found the Regulatory Sandbox to be a useful mechanism to explore areas where our requirements do not anticipate their type of solution. We have found some areas of regulatory uncertainty in how our custody and payments rules apply to DLT and these case studies form a key part of the regulatory analysis which we have performed to date. These tests are still ongoing and as a result we have not yet drawn any firm conclusions. Even so, the work done so far has raised various questions which we would like to explore further.

Adoption of DLT in regulated markets

2.6 The adoption of DLT could take many forms and firms face a variety of challenges before widespread use and any resulting benefits might materialise. It is reasonable to assume that a number of DLT systems will need to interact and share data between one another and with non-DLT legacy systems. Therefore, at this stage, it may be difficult for DLT to be fully incorporated in the existing core processes. While the volume of successful Proofs of Concept has been an indication of market interest to date, what is still uncertain is the future likely breadth and depth of market adoption. Considerations such as the ease and cost of adoption will be essential.

2.7 Until recently, we have not seen much consideration by firms of the regulatory consequences of deploying DLT solutions in regulated financial services. This may be because, up to this point, firms are still developing their own understanding of the technology and realistic cases where it could be used. However, with firms devoting increasing attention to DLT solutions, it is important we remain abreast of developments in this area and how it impacts our regulatory approach. We look forward to the responses to this DP and ongoing interactions around DLT with the industry.

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2 This is a variation of the definition provided in John Barrdear and Michael Kumhof, 'Bank of England Staff Working Paper No. 605' p.4

3.
Distributed ledger technology: risks and opportunities

3.1 This section sets out our initial understanding on some of the potential benefits and risks of DLT. It is organised according to the key features of DLT as we see them. These are:

- governance and technology resilience

- DLT and distributed data

- recordkeeping and auditability

- smart contracts, and

- the use of digital currencies to deliver financial services.

3.2 We would welcome views on these topics, particularly on areas where use cases have already been live tested and where our understanding of DLT's key features can be expanded or improved.

Governance and technology resilience

3.3 Regulated firms use a variety of systems to run their businesses. These systems underpin diverse activities from calculating consumers' mortgage amortization to trading securities intraday. The integrity of these systems are, therefore, vital to our objectives to ensure market integrity and consumer protection.

3.4 From a regulator's perspective, systems outages compromise the orderly functioning of markets, deprive consumers of access to financial services and undermine faith in the financial services sector. We, therefore, have a variety of requirements to ensure that regulated firms' overall IT and cyber arrangements are proportionate to the nature, scale and complexity of their business. These arrangements must also be sufficiently robust to ensure the continued availability, reliability and security of key regulated services. If DLT can offer a more resilient system than currently available, it may help deliver on our statutory objectives.

3.5 As DLT is a combination of existing technology types, it is likely to present similar challenges, risks and benefits to other types of technology currently being used today. There will also be common considerations firms need to bear in mind when adopting any new technology. Even so, combining existing technological products in new ways does sometimes give rise to new benefits as well as risks.

Governance considerations for DLT

3.6 DLT is by its nature a shared system. As a result, firms will have to pay careful attention to allocating responsibilities appropriately given the absence of a central point of authority. Individuals' responsibilities under our Senior Managers and Certification Regime will also have to be clearly set out.[3]

3.7 There are also implications for firms regarding their third party service providers. For example, if a regulated firm using a DLT platform relies on third parties to add, validate, safeguard and preserve transactions, does it have sufficient oversight of these activities to fulfil its regulatory obligations around having appropriate systems, governance and controls? What interaction would firms have with the 'core developers' group of public, unpermissioned DLT networks, who typically carry out updates and have other important responsibilities?

> **Q1:** **How will firms demonstrate appropriate outsourcing arrangements when relying on third parties (such as core developer groups of public, permissionless networks) to deliver DLT-based solutions?**

3.8 Firms will also have to manage the implementation process of a new DLT system very carefully. This will be particularly the case where a DLT system differs significantly from those which a firm is currently using. The greater the difference between a new solution and an existing one, the greater the potential impact on the operational risks facing the firm. Given that DLT is still in its nascent stages, the extent of its impact is still not certain. Some issues are still unresolved, such as: (i) the full range of operational risks that will be posed to network participants; (ii) how these might be addressed; and (iii) what risks arise when a DLT system is deployed at scale, rather than at 'Proof of Concept' level.

3.9 Whilst we do not want to underestimate the degree to which DLT may potentially impact regulated firms going forward, our interaction with the industry so far does not suggest an immediate and comprehensive shift in business models. Even so, as with the adoption of any new technology or business model, firms need to consider what conduct and operational risks may arise from using DLT.

3.10 The potential for market-wide DLT solutions raises questions about the sort of risks that might arise in the event of a system-wide failure involving multiple participants. One possible source of such an event might be through an error in code. It will be crucial therefore that the code on which a DLT network's nodes are based is robust, as an error in the code would affect all participants across the entire network. Arguably, therefore, rather than a single point of failure being that of one firm's specific system, this risk would be code-based in the context of DLT, and affect multiple firms

> **Q2:** **What operational risks have firms identified with (i) implementation of DLT systems (ii) system-wide issues affecting multiple firms, and how will they manage them?**

3.11 Another area deserving of specific attention is cyber resilience. The strength of the security afforded by a particular form of encryption is continually under challenge. This reflects the increases in computing power and sophistication of algorithms. DLT networks will need to establish mechanisms to ensure that appropriate levels of encryption are maintained and that these include responsibilities for key storage, availability and integrity.

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3 For more information, see https://www.fca.org.uk/firms/senior-managers-certification-regime

> **Q3:** What is the best way for DLT networks to protect themselves against attempts to break DLT network security?

Potential benefits of DLT in a technology resilience context

3.12 Although there are potentially new governance and controls challenges around the adoption of DLT systems, market participants and technology firms have cited various potential benefits which DLT may offer to a firm's technological resilience.

3.13 A common market practice to maintain business continuity in the event of a system failure is to have a second system in place which can take over until the first is repaired, at which point the first takes back responsibility. This transfer process between different databases can be complex and costly. DLT is different in that multiple nodes contain the same record, all of which operate simultaneously. In the event of failure of one node, the others are still able to continue operating without the need for a wholesale database transfer and new nodes can be added more easily if required.

3.14 DLT potentially offers a variety of cyber security benefits as cryptographic encryption is in-built into every record on the network. Additionally, when using a consensus mechanism, if one node's record is compromised, for example, by a cyber attack from a malicious third party, the consensus process should ensure that this record is rejected by other nodes. After such an event, DLT may also enable firms to find out which node(s) was subject to attack, allowing them to pinpoint the attack vector more efficiently, ensuring a faster response.

> **Q4:** What technology resiliency advantages, if any, does DLT have over other types of systems currently available?

DLT and distributed data

3.15 The ability to share information efficiently is a feature of DLT which has arguably attracted the most attention in financial services. This feature is not unique to DLT; other types of DDBMS do exist that offer the same benefit. However, firms have told us that DLT delivers combined efficiency and security benefits in a better way than other types of technology. This is particularly where regulated firms want to share information selectively with other parties. The data which regulated firms share could take the form of order instructions, client information for anti-money laundering (AML) purposes, checking policies for reinsurance, or giving investor transparency to fund unit holdings. Other shared database systems may not, for example, offer the same ability to track the addition, amendment or deletion of records among multiple participants. We set out examples of how DLT might be used for data-sharing in financial services below.

Reinsurance markets

3.16 DLT's data-sharing capabilities are particularly relevant in the reinsurance market where multiple reinsurers need to underwrite each reinsurance treaty. The simple administrative benefits of validated contract version control are, in themselves, likely to be significant. For example, industry loss warranty products could benefit from DLT enabling automated claims settlement through smart contracts. There are also potential benefits to market functioning when the various players better understand the links between a claims payout and the person (or investor) bearing the loss of the payout.

3.17 For the insurance market to realise these sorts of benefits, common standards may be necessary. We have already seen multiple insurers and reinsurers joining the B3i initiative to develop DLT for use in the reinsurance market.[4] Clear DLT standards for the management of contracts and risk data could significantly improve market functioning.

3.18 Improved data quality and transparency is likely to remove significant uncertainties from the reinsurance market, and may lead to a reduction of cost for insurers that ultimately flows through to end customers. For example, participants in the reinsurance market may be able to form a clearer view of risk aggregation across portfolios and better identify 'risk spirals'. A risk spiral can arise when a reinsurer unknowingly insures itself when writing new retrocession agreements. By having a clearer view of the contracts being underwritten, reinsurers will be able to better identify and avoid risk spirals.

3.19 Considering the administrative and data quality improvements combined, it may be possible in the longer term for DLT to support new forms of risk transformation. This could lead to more significant shifts in the reinsurance market including DLT-based tradable reinsurance, insurer operated mutual reinsurance pools and innovative insurance linked securities.

3.20 These new forms of risk transformation may become increasingly viable as the benefits of DLT materialise throughout the insurance and reinsurance market. We consider these applications have the potential to drive further competition in reinsurance and ultimately deliver positive outcomes for end consumers. However, investors in new forms of risk transformation will require an appropriate degree of protection and we will continue to monitor these risks as the reinsurance and capital markets develop this area.

> **Q5:** **What DLT use-cases are currently under development in the (re)insurance sector? Are there likely to be significant (re)insurance DLT deployments in the near term?**

Regulatory reporting

3.21 The ability to make data easily available using DLT also has potential applications for regulatory reporting requirements. This is a key area of our research into RegTech, a sub-set of FinTech that focuses on technologies that may facilitate the delivery of regulatory requirements more efficiently and effectively than existing capabilities.[5]

3.22 Regulatory reporting requirements apply in different ways depending on the financial activity being carried out. However, the obligations to report on time and accurately are features common to all of them. Complying with these obligations in a cost-effective manner can be challenging for firms as it often involves the interaction of multiple systems, some of which are legacy and others new.

3.23 We expect that implementing a DLT solution to perform regulatory reporting would carry similar challenges and risks as implementing any other new solution. For example, managing the interface between a 'front-office' system which accepts orders and a DLT regulatory reporting system. In certain situations, this use case for DLT might enable a report to be generated at the same time as an order is placed. This might help firms to mitigate the potential operational risk of multiple legacy systems interacting with each other. However, it remains an open question whether firms would be willing to commit the significant capital which would be necessary to implement such a solution. Additionally, firms will need to be clear on the advantages of a DLT-based system in this use case over other technologies.

4 https://www.allianz.com/en/press/news/commitment/sponsorship/161018-insurers-and-reinsurers-launch-blockchain-initiative-b3i/
5 https://www.fca.org.uk/firms/project-innovate-innovation-hub/regtech

> **Q6:   What use cases have been live tested for regulatory reporting? What challenges are there to implementing these solutions?**

DLT networks of regulated firms

3.24   Since the arrival of DLT, we have seen market participants making large shifts towards close collaboration and using shared networks which they collectively manage. Consortia such as R3 CEV or B3i are good examples of this.[6] One possible reason for this is that only recently has technology as a whole made sufficient advances in computation, storage and messaging speed such that a large-scale (i.e. multi-firm) DDBMS such as DLT has become feasible.

3.25   Various potential benefits may also be gained where there are large groups or networks of firms, each of which use the same information. A good example of this is customer due diligence or AML checking, which often come under the term 'know your customer'. Firms currently operate on a spectrum between (i) performing all such checks themselves, and (ii) outsourcing these checks to a third party. This means that firms operate in silos and it can be challenging to track criminal activity from a transaction's origin to its destination.

3.26   Multiple firms operating on a DLT network could enable more effective transaction monitoring. The ability of DLT to replace paper trails with easily-auditable, digital ones may facilitate compliance with rules seeking to mitigate financial crime. The Money Laundering Regulations 2007 require firms to apply policies and procedures to minimise their money laundering risk.[7] These include keeping records of customer identity and transactions, which must be promptly accessible. Currently, tracing criminal activity where transactions are routed through multiple accounts across different providers is very challenging. In a scenario where a customer is assigned an identity on a DLT network (using a public key or another mechanism), information about that customer's transactions could potentially be more easily traced, resulting in a reduction in financial crime and costs of AML compliance.

3.27   Of course, such a solution would require network adoption by a number of firms to be effective. This represents one of the biggest hurdles to implementing a DLT solution in the money laundering space. Historically, regulated firms have been hesitant to outsource or share their AML responsibilities with third parties, including other regulated firms. How and whether DLT solutions will change remains to be seen.

> **Q7:   How might DLT be deployed to mitigate financial crime risks, and will regulated firms adopt such solutions? If so, in what timeframe? If not, what are the barriers to adoption?**

Recordkeeping and auditability

3.28   Keeping accurate records is fundamental to the operation of financial services. These records can constitute amounts owed, identity or cover held and are used both in day-to-day operations and in the event of a firm's insolvency. Their accuracy is vital to our market integrity and consumer protection objectives and we, therefore, require firms to comply with a variety of rules regarding recordkeeping. These rules sometimes require firms, for example, to reconcile

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6   See http://www.r3cev.com/

7   We have provided examples of good and poor practice in the Financial Crime: A Guide for Firms to help firms in benchmarking existing systems or creating new ones. The Joint Money Laundering Steering Group (link is external) has also produced guidance to help firms meet their AML obligations.

their records with a third party's copy (e.g. our custody rules and client money rules in CASS) and to maintain a robust audit trail (e.g. the Money Laundering Regulations, examples of which are in the previous section). Additionally, regulated firms must ensure they have adequate systems, governance and controls in place to carry out their business.

3.29   Currently, some firms in various sectors are heavily reliant on manual, paper-based processes which might interact with different legacy systems for record. These processes and systems sometimes involve multiple parties, which can be costly. They can also carry higher risks of inaccuracy and of data loss. DLT offers the ability to aggregate and verify data from multiple sources and offer a shared view of the same record. It, therefore, has the potential to reduce discrepancies and costs substantially. For example, when risks are written in the London insurance subscription market there is currently a heavy reliance on paper-based contracts and a manual exchange of risk data. This requires significant reconciliation, governance and audit processes which introduce both administrative costs and uncertainty. If subscription contracts were transacted using DLT, it might be that greater trust could be placed in the system leading to lower costs and more competitive premiums for policyholders.

3.30   One of the purported advantages of DLT is its ability to assign a record to a customer's identity (e.g. of a transaction or investment) at a very granular level of detail and keep this detail throughout that record's lifecycle. For example, when investing in an unregulated collective investment scheme (UCITS), a consumer might instruct an independent financial adviser, who purchases a fund on that consumer's behalf through a platform, who in turn uses an order management system to place orders with the UCITS fund manager who then purchases investments in the market. The fund manager might use third party transfer agents to aggregate orders and registrars/custodians to maintain and reconcile its client records.

3.31   In this scenario, potentially every time the record (e.g. the customer order or fund unit) changes hands, its format has to be updated to reflect the system of the record's holder. Additionally, sales of authorised funds may be aggregated at platform level; with the effect that granularity of beneficial ownership is lost. As with the insurance example above, the exchange of paper-based documentation in this process can also introduce certain risks.

3.32   DLT might offer the ability to represent or create proof of ownership when the customer places an order at both the consumer level and at the fund level simultaneously, effectively bringing the consumer closer to the point of origin of the financial product. From a fund perspective, this gives them a more transparent view of who owns how much and reduces some levels of intermediation and hence cost through its distribution network. This might make it easier to provide 'direct to consumer' (or D2C) financial services if that option is desirable. From a consumer perspective, this might result in lower costs.

> **Q8:**   **Is this a viable use case for DLT in the context of asset management? What other examples are there for this sector?**

3.33   Another area where enhanced granularity of ownership may benefit consumers is in securities investments. Shares in particular normally carry voting rights and rights to dividends. Auditable, transparent and fully verifiable electronic election DLT platforms are already commercially available, and may augment or replace the existing process in soliciting a proxy vote for exercise of shareholder rights. Furthermore, this technology could potentially work to empower investors as it could reduce the use of a tiered holding system, such as through nominee firms, and make it easier for the investor's name to be directly registered on the securities.

> **Q9:**   **What other examples are there of DLT providing direct**

and tangible benefits to consumers? What are the risks
associated with these?

Use of DLT for recordkeeping in custody

The custody rules (CASS 6) are designed primarily to restrict the commingling of client
and the firm's assets and minimise the risk of the client's safe custody assets being
used by the firm without the client's agreement or contrary to the client's wishes.
These rules also seek to prevent client assets being treated as the firm's assets in the
event of the firm's insolvency. These obligations require firms to maintain their records
and accounts in a way to ensure their accuracy, and in particular their correspondence
to the safe custody assets held for clients. Reconciliations are one of the key required
practices that help to ensure the accuracy of a firm's books and records.

In the Regulatory Sandbox, we have seen a business model where a DLT platform
has been deployed to facilitate the issuance of short-term debt. The firm fell within
the scope of the CASS regime. In its test, the platform issued debt to investors and
maintained records of client assets and client money. Its business model seeks to allow
the issuer to view each investor's holdings and to reconcile its client account record
and internal book on an intraday basis. If workable from a regulatory perspective, it
also potentially offers the ability to reconcile more frequently than on a daily basis.

Another common DLT use case is to manage the validation and storage of documents.
Documents are typically 'hashed' – a cryptographic technique to generate a unique code to
represent that document which keeps the contents of that document confidential. These codes
are then used to verify that a certain document exists and has not been tampered with. This
may, therefore, allow regulated firms to identify fraudulent documents more easily. The ability
to easily compare the cryptographic hashes of documents communicated via DLT may also
improve the ability to detect organised crime where criminals use multiple regulated firms'
services. This could reduce the costs of fraud in financial services and lead to lower costs for
consumers over time.

Smart contracts

3.34   DLT can facilitate greater levels of automation through so-called 'smart contracts', a phrase
which pre-dates the Bitcoin network by over a decade and relates chiefly to executing terms
of legal contracts digitally. Ethereum, another public, unpermissioned DLT protocol enabled
more complex automation on blockchain than possible with the Bitcoin protocol. In his White
Paper, Vitalik Buterin (Ethereum's founder and CEO) defined smart contracts as 'systems which
automatically move digital assets according to arbitrary pre-specified rules'.[8] There are now
multiple definitions being used, the broadest of which use the term 'smart contracts' to refer
to any sort of automation on blockchain. We define smart contracts for the purposes of this
DP as 'blockchain functionality to execute pre-determined commands without further human
intervention'.

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8   http://www.the-blockchain.com/docs/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_
platform-vitalik-buterin.pdf

3.35   The industry's commentary on the benefits of automation focus mainly on the improved efficiencies in firms' back offices and this is where we see the most immediate potential short-term benefits. This is particularly the case in situations where participants not only have to see a record but act upon it. Currently, some sectors of industry operate on the basis of legacy, manual technology such as facsimile and paper-based documentation in order to execute certain contractual rights and obligations. Not only is this prone to error, fraud and loss but also comes with significant cost. Even where firms do not employ this technology, some firms circulate spreadsheets of information by email for human verification (e.g. derivatives margin requirements) which are also prone to manual error.

3.36   These challenges have persisted in the industry for some time and it is unclear how smart contracts on DLT constitute a significant improvement on currently available systems. Arguably, the execution of commands conditionally on an event occurring pre-dates DLT and there are a wide range of vendor offerings which automate certain practices such as collateral management. Firms will, therefore, have to assess carefully their options in selecting the right product to automate their systems, whether it involves DLT or not.

3.37   Firms will also need to consider carefully if full automation is appropriate. For example, some commentators have claimed that DLT could significantly impact post trade infrastructure as it can reduce the settlement cycle for cash equities from a standard settlement cycle of T+2 to a cycle of near instantaneous settlement. Participants argue that in such circumstances the need to clear these cash markets is removed. Firms have informed us that potentially, because of the near real-time way that DLT updates, reconciliations may not be necessary. However, this speed of settlement (i.e. the transfer of title of a property) may not always be the market preference, particularly if there are other aspects of trading (e.g. collateral management) which are not part of the system.

3.38   Even so, there will no doubt be situations where smart contracts may be a useful option. Examples for the payments and insurance sectors are provided below.

Use of smart contracts in payments
Smart contracts have a variety of applications in payments specifically where the need to make a payment is dependent on certain events occurring. One firm in the Regulatory Sandbox applied this aspect of DLT to facilitate charitable donations.

In this Regulatory Sandbox use case, donors transferred funds to a donations platform using traditional means of payment. Subsequent to the receipt of funds, the donations platform sent the funds to the Sandbox firm which issued the corresponding amount of e-money on DLT. The funds were at that point 'tokenized' and, conditional on the verification of a third party that the charity had fulfilled certain objectives, the tokens were transferred to the charity for redemption at the Sandbox firm for fiat currency. This aimed to provide assurance to existing and potential donors and increase donations as a result.

According to participants, DLT demonstrated its benefits in providing greater transparency to donors and allowing payments only to be made to charities on the fulfilment of certain conditions. Additionally, DLT's ability to give different permissions to various parties in a secure way reportedly made it an effective choice for this business model.

Use of smart contracts in insurance

The ability for a smart contract to be negotiated and later fulfilled using DLT has clear applicability for the insurance industry. Provided there is some trusted method of establishing the insurable interest, and substantiating a loss, DLT may enable full or partial automation of claims pay-outs. This would allow the insurance to be underpinned by several smart contracts leading to 'smart insurance' products. Smart insurance relying on DLT and other technology could lead to significant shifts in the insurance market over the longer term.

Smart insurance could also be combined with a new type of insurance product known as a parametric loss product. Parametric products pay claims based on the occurrence of trigger conditions being met, rather than on the basis of a loss incurred. For example, the existence of drought conditions can be the trigger condition of a parametric farm insurance product leading to a pay-out without the need to assess crop or livestock losses.[9] These parametric products usually rely on trusted third-parties called 'oracles' that supply trusted data to trigger claim pay-outs.

One theoretical example of smart insurance with parametric features may be a travel insurance product issued using DLT. When a flight is cancelled or delayed, this information is reported into trusted flight management databases that can act as an oracle for the smart insurance DLT. Smart insurance products on the DLT could then be automatically triggered with a claim pay-out triggered. Consumers could benefit significantly from expedited and automated claim settlement allowing them to proceed with travel without incurring out of pocket expenses. The industry may also benefit from reduced claims administration costs.

> **Q10:** How do respondents see the use of smart contracts developing in financial services? Please provide examples, ideally which have been already live tested.

The use of digital currencies to deliver financial services

3.39 We have seen that public DLT networks, such as those underpinning Bitcoin or Ethereum, can be used in ways other than for trading digital currencies. However, the use of digital currencies is the most widespread activity currently being carried out using DLT.

3.40 Since the release of the first version of Bitcoin in 2009, a variety of applications have been built on top of the Bitcoin network to enable people to keep and trade Bitcoin for services or to realise a return on capital. These applications have been replicated on other public DLT networks and include wallet providers and digital currency 'savings accounts' which pay a regular return in digital currency. Firms have also used 'Initial Coin Offerings' to fund themselves, which we cover in more detail below.

3.41 In the early days of widening public interest in Bitcoin and other digital currencies, a number of regulatory bodies published warnings to consumers about the potential risks of digital currencies and advised on key points to bear in mind. In December 2013, the FCA drew attention to

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9   As just one example of parametric insurance please see: Swiss RE, Successful Kenya Livestock Insurance Program scheme scales up, available: http://www.swissre.com/reinsurance/successful_Kenya_livestock_insurance_program_scheme_scales_up.html (Accessed: 31/01/2017)

a warning issued by the European Banking Authority. In November 2014, the Government undertook a review of benefits and risks associated with digital currencies and underlying technology, with a particular focus on the question of regulation. Following that exercise the Government published a response document alongside the Budget in March 2015 which said, amongst other recommendations, that it intended to apply anti-money laundering regulation to digital currency exchanges in the UK, to support innovation and prevent criminal use. The Government committed to work with the British Standards Institution and the digital currency industry to develop voluntary standards for consumer protection.

3.42   In July 2016, the European Commission published proposals for making amendments to the 4th Money Laundering Directive agreed in May 2015 to apply anti-money laundering obligations to firms which operate as digital currency platforms or as custodian wallet providers for digital currencies.[10] The proposal is available on the Commission's website[11] and is still subject to negotiation. This will mean that once this directive is transposed in member states, including the UK, these types of operators will need to comply with obligations to identify customers using their services, monitor transactions through their business and identity and report any suspicious activity to law enforcement.

Digital currencies as a means of exchanging value

3.43   Buying and selling digital currencies themselves are activities outside our regulatory perimeter as the digital currency in itself is not a regulated financial product. Derivative instruments that reference digital currencies though may be regulated financial products.[12]

3.44   We have seen a risk of some consumers still perceiving digital currencies to be regulated financial investments. We will, therefore, post relevant information warnings on our website and encourage consumer groups to increase consumer awareness in this area.

3.45   Where institutions engage in using digital currencies to deliver regulated financial services, while the digital currency trading element is not regulated, we maintain an interest in firms' governance of the systems they use, whether digital currency-based or not. An example of a regulated firm using digital currencies to facilitate regulated activity is below.

Q11:   **Does the use of digital currencies to provide financial services carry with it different or more benefits and risks than current systems available? Are there examples of this already occurring in industry?**

Digital currencies in cross-border payments
From a consumer perspective, cross-border payments made through traditional systems have a variety of issues. For example, the time taken for funds to reach their destination can sometimes be multiple days, potentially much longer than domestic transfers.

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10 Please note, the European Commission's proposals contain a definition of 'virtual currencies' which differs to the working definition provided in this DP

11 http://ec.europa.eu/justice/criminal/document/files/aml-directive_en.pdf

12 For example, if the derivative instrument referencing the digital currency amounts to a future under Art 84 RAO, or a contract for difference under Art 85 RAO.

The FCA Regulatory Sandbox has provided us with use cases where DLT has been deployed with the goal of delivering cheaper and more efficient cross-border payments. One business model of note is where a payor deposits money in an account belonging to the payments firm. The money is then converted from currency A into digital currency, transferred cross-border and reconverted into currency B for the payee.

Among various other features, those of notable appeal to consumers are the ability to transfer small amounts cost-effectively and transfers being executed in a short timeframe. Consumers could also make micropayments as the cost of payments was reduced compared to the usage of current payments rails. Such solutions may be beneficial from a competition perspective, as current aspects of the payments infrastructure are operated by a small pool of incumbent firms.

Firms will of course need to be mindful of any digital currency-specific risks which may arise because of these business models. For example, while many options and counterparties exist to help mitigate foreign exchange risk of fiat currencies, a firm may find it more challenging to mitigate the risk of price fluctuation in digital currencies.

Digital currencies as a means of record keeping

3.46   Digital currencies can also be used as a record-keeping system. For example, in one Regulatory Sandbox case, a firm's business model included the use of the Bitcoin network as a means of managing records, rather than as a value exchange mechanism. Another example is Quorum, an Ethereum-based private, permissioned DLT application which processes transactions among a group of known participants.[13] These types of systems do not necessarily mean exposure to the price of a digital currency (in these cases Bitcoin or Ethereum respectively) or using digital currencies as a means of exchanging value. However, one key consideration for firms to bear in mind is whether there are competition issues in a self-selected group of firms operating a network to the exclusion of other competitors.

> **Q12:** What are the benefits and risks of using a public, permissionless DLT network on an existing protocol, rather than the development of proprietary DLT protocols?
>
> **Q13:** What are the risks to competition of a group of incumbents operating a closed network to the exclusion of others?

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13 https://www.jpmorgan.com/country/US/EN/Quorum

4.
DLT's compatibility with the existing regulatory framework

4.1   Our rules seek to achieve our statutory objectives of ensuring consumer protection, market integrity and competitive markets. Our approach is typically to regulate the outcome, rather than the specific process. For example, if we expect a firm to maintain appropriate records, firms are open to use paper-based or cloud-based solutions. In both cases, the underlying principles are the same: we expect firms to be able to maintain robust copies of these records and to be able to present them promptly on our request. We refer to our approach of not regulating specific technology types, only the activities they facilitate and the firms carrying out these activities as 'technology neutrality'.

4.2   Despite our philosophy of technology neutrality, it is conceivable that some of our rules may presuppose technology types and business models other than those which DLT facilitates. There may be regulatory barriers to DLT innovations which are currently unknown to us as a result. One example where innovation necessitated regulatory change was the move from paper-based to dematerialised securities. This required certain changes to the regulatory framework to take account of new market and technological paradigms. It is possible that DLT may be a technology which challenges existing conventions and may not fit with our current regulatory framework as a result. We have engaged with firms to seek clarification and set out various examples below.

Allocation of responsibilities

4.3   In shared networks, particularly in a 'trustless' environment (i.e. without a single controlling entity) it is not always clear who is responsible for what. One advantage of centralised systems is that there is a clear nexus of control. To take stock market trading as an example, while multiple firms may be able to see and act upon the same record (i.e. the order book), ultimately the system underpinning this is likely to be an operator of a regulated market or multilateral trading facility. These are regulated entities, with significant obligations for ensuring that the trading venues they provide are robust, reliable and have adequate systems, controls and governance in place. By contrast, a trustless DLT network may not have any such central point of control with a regulatory nexus.

4.4   In particular on a public, permissionless DLT network, it is possible for all participants to participate in executing transactions on DLT and be reliant solely on the code which a developer has provided. One such recent example is the decentralised autonomous organisation (DAO) known as "The DAO".

The DAO

4.5   The DAO was a group of individuals who agreed to interact on the basis of code that was executed on the Ethereum protocol. The code enabled investors to participate in a self-directed venture capital fund, without the need for an investment manager. Security flaws in the code enabled a malicious third party to siphon funds from the DAO, resulting in substantial losses to investors. To resolve the issue, the Ethereum foundation's core developers resolved to create a 'hard fork', effectively reversing the transactions to restore investors to their original position.

4.6   This provided not only a reminder of the risks of implementing code which is inadequately tested but also raised some unresolved questions around the governance structure of such an arrangement in the UK context. In particular:

- What was the regulatory classification of The DAO?

- Is the network provider, in this case the Ethereum foundation, the appropriate point of governance for resolving issues?

- Under which regulator's remit, if any, is this arrangement and who is the party(s) carrying out the relevant regulated activity?

> **Q14:** **Where should responsibility lie in fully decentralised applications such as the DAO? What governance arrangements do firms plan to have in place when using applications on public, permissioned networks?**

Digital asset trading

4.7   From our interaction with the industry through the Regulatory Sandbox and broader information gathering, it is clear that firms seek to use DLT to underpin trading in assets. The adoption of novel ways to transact in financial instruments may impact our market integrity objective and this is an area of important research for us.

4.8   Firms have proposed one or a variation of the following models to issue and transact in financial instruments. The first is based on a Regulatory Sandbox case, and the others are currently still in the testing phase, having not (to the best of our knowledge) yet moved into a 'business-as-usual' environment in the UK:

4.9   Model A: a firm (Firm A) wishes to provide issuing agent and registrar services to a company (the Issuer) by taking in investor money and keeping track of bond holdings. Firm A uses a DLT system to maintain various records. Among these, one record reflects client money holdings in a client money bank account. Another record determines ownership of bonds issued by the Issuer. Investors wish to trade bonds throughout the issuance. Payments are made by investors into Firm A's client money account to purchase and redeem bonds, for settlement with the investors' own bank accounts at a point (or points) during the day.

4.10   Model B: a closed group of firms issue their own proprietary tokens to transact in financial instruments, and the amount of tokens each firm has determines the amounts for fiat currency settlement between their bank accounts at end of day. A custodian or central securities depository may need to be involved depending on the type of financial instrument being traded.

4.11 Model C: transacting firms obtain digital currency from a third party (e.g. via digital currency exchange) and this digital currency is used to pay for financial instruments. Payments (e.g. coupons or dividends) arising out of these instruments may also be made in digital currency. The firms hold digital currency on an ongoing basis and convert to fiat currencies as and when they require.

> **Q15:** Do firms see the above examples as realistic use cases for DLT in securities issuance and trading?

4.12 Model B above also touches on potential regulatory issues around the classification of proprietary tokens. Some start-ups in the DLT space have used 'initial coin offerings' to raise capital at early stages of their development. A start-up will issue their own proprietary cryptographically secured DLT tokens which give investors the opportunity to realise capital growth. If the start-up manages to issue sufficient tokens, digital currency exchanges may make a market in these tokens which might drive up the value (often determined in digital currencies such as Bitcoin or Ether). Initial coin offerings, therefore, have various parallels with Initial Public Offerings, private placement of securities, or crowd sales. Depending on how they are structured, they may, therefore, fall into the regulatory perimeter.

> **Q16:** What legal and regulatory challenges do firms find in fitting initial coin offerings into our regulatory framework?

Collateral management

4.13 Some firms have proposed using smart contracts to reduce certain prudential requirements by automating the calculation and exchange of collateral. These requirements seek to mitigate the risk firms are exposed to when they are unsecured or under-collateralised. Often they involve firms holding collateral to mitigate this risk and make certain assumptions based on market convention. For example, derivatives initial margining requirements take into account 'margin period of risk' (MPOR), i.e. the time period between (a) the most recent exchange of collateral for transactions with a defaulting counterparty and (b) when those transactions can be closed out. This time period is fixed in legislation at ten days for non-centrally cleared OTC derivative contracts.[14] DLT could potentially reduce the MPOR in practice to less than ten days. However, firms would not be able to realise any reduced margin requirements unless legislation is updated to reflect a new, shorter market convention for MPOR, if DLT proves itself to allow for it.

> **Q17:** Are there other parts of regulation where DLT might offer a new market convention?

Data Protection

4.14 It is worth noting that one area of potential regulatory challenge when storing and processing client data will be managing firms' obligations under the Data Protection Act 1998. The Information Commissioner's Office (ICO), which has published guidance on its requirements,[15] in

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14 Delegated Regulation supplementing Regulation 648/2012 with regulatory technical standards on risk mitigation techniques for uncleared OTC derivative contracts.

15 https://ico.org.uk/for-organisations/guide-to-data-protection/

particular the right to erasure (also referred to as 'the right to be forgotten') and other principles which protect consumers' privacy, may cause issues for DLT where firms use immutable records and share data among themselves. The General Data Protection Regulation is the new legal framework of data protection requirements, due to apply in the UK from 25 May 2018, for which the ICO has issued guidance. We, therefore, advise firms to consider the ICO's guidance and their data protection obligations carefully, particularly when DLT is used to store, share and process client data.

5.
Next steps

5.1   DLT is a nascent technology in financial services. Like many technologies whose implications are not yet fully understood, it merits careful attention both from firms and regulators. Ultimately, firms will have to decide whether they are sufficiently comfortable with adopting, using and maintaining systems using this technology and whether the benefits outweigh the risks.

5.2   One of the core features of DLT is the ability to share information securely and efficiently. However, what may be arguably one of the technology's advantages may be the element which presents firms with the most regulatory and governance challenges. In our engagement with firms, we have not yet discovered a need for fundamental change to our regulatory framework. At this stage it seems that our current requirements appropriately reflect our strategic objectives of consumer protection, competition and market integrity in the context of expected uses of DLT.

5.3   One question which remains is the extent to which DLT itself is actually essential to any of these potential market developments. Many appear to be equally achievable through more traditional technology. For example, existing settlement systems are capable of settling more quickly than the market standard two days. The fact that settlement is still done over a longer period is largely a function of market preference rather than technological constraint. Equally, it appears likely that faster payments could be delivered with non-DLT technology. However, even if such innovations do not in practice rely crucially on DLT, if the existence of the technology provides a spur to useful innovation, it may help the industry to achieve our statutory objectives.

5.4   DLT may offer some benefits which, while perhaps not unique, when combined with its other features, represent an improvement on other available technology. For example, we see potential to prevent and track financial crime in its ability to offer a shared record keeping platform with in-built validation rules, encryption and an audit trail of all changes. Additionally, DLT might enable challenger firms to offer more robust financial services at a better price than incumbent institutions which currently operate on less efficient legacy systems. DLT might, therefore, foster disruptive innovation in the interests of consumers in certain markets.

5.5   We acknowledge that there may be some specific areas of regulatory challenge for DLT adoption. If there are challenges, we welcome this discussion with firms so that we can work through any regulatory barriers to innovation and ensure an effective and competitive market. We will publish our findings from the first cohort of participants in the Regulatory Sandbox later this year. This includes firms seeking to use DLT in a variety of sectors. The Regulatory Sandbox has proven an immensely useful initiative to interact more directly with firms and understand, from a regulator's perspective, where innovation in the UK is heading on subjects such as DLT. We look forward to the continued engagement from firms through this and the other mechanisms of Innovate.

5.6   We also look forward to hosting and attending events on DLT where we will have the opportunity to interact directly with stakeholders such as regulated firms, technology providers

and consumer groups to gain their feedback. We encourage stakeholders to engage directly with us wherever possible and to respond to this DP.

Annex 1
List of questions

Q1: How will firms demonstrate appropriate outsourcing arrangements when relying on third parties (such as core developer groups of public, permissionless networks) to deliver DLT-based solutions?

Q2: What operational risks have firms identified with (i) implementation of DLT systems (ii) system-wide issues affecting multiple firms, and how will they manage them?

Q3: What is the best way for DLT networks to protect themselves against attempts to break DLT network security?

Q4: What technology resiliency advantages, if any, does DLT have over other types of systems currently available?

Q5: What DLT use-cases are currently under development in the (re)insurance sector? Are there likely to be significant (re)insurance DLT deployments in the near term?

Q6: What use cases have been live tested for regulatory reporting? What challenges are there to implementing these solutions?

Q7: How might DLT be deployed to mitigate financial crime risks, and will regulated firms adopt such solutions? If so, in what timeframe? If not, what are the barriers to adoption?

Q8: Is this a viable use case for DLT in the context of asset management? What other examples are there for this sector?

Q9: What other examples are there of DLT providing direct and tangible benefits to consumers? What are the risks associated with these?

Q10: How do respondents see the use of smart contracts developing in financial services? Please provide examples, ideally which have been already live tested.

Q11: Does the use of digital currencies to provide financial services carry with it different or more benefits and risks than current systems available? Are there examples of this already occurring in industry?

Q12: What are the benefits and risks of using a public, permissionless DLT network on an existing protocol, rather than the development of proprietary DLT protocols?

Q13: What are the risks to competition of a group of incumbents operating a closed network to the exclusion of others?

Q14: Where should responsibility lie in fully decentralised applications such as the DAO? What governance arrangements do firms plan to have in place when using applications on public, permissioned networks?

Q15: Do firms see the above examples as realistic use cases for DLT in securities issuance and trading?

Q16: What legal and regulatory challenges do firms find in fitting initial coin offerings into our regulatory framework?

Q17: Are there other parts of regulation where DLT might offer a new market convention?

Financial Conduct Authority