



Over the horizon

Blockchain and the future of financial infrastructure

Contents

Introduction	3
Reimagining financial services	4
Key findings	6
Global payments	8
Commercial property & casualty claims processing	9
Syndicated loans	10
Trade finance	11
Contingent convertible bonds	12
Automated compliance	13
Proxy voting	14
Asset rehypothecation	15
Equity post-trade	16
Conclusion	17
End notes	18
Contacts	19

Introduction

Dear Colleagues,

When people hear about distributed ledger technology (DLT), or blockchain, usually they think: "Bitcoin." But that's only part of the story.

Here's the rest of it.

Deloitte Consulting LLP (Deloitte) and the World Economic Forum recently completed [*The future of financial infrastructure: An ambitious look at how blockchain can reshape financial services*](#), a study of how DLT can help financial firms. This document is a summary of that study.

What we discovered is that DLT is a technology that could transform the very infrastructure of financial services. It offers a chance to reimagine the industry, rebuilding financial processes into something simpler, more efficient and often altogether new.

DLT also challenges many of the assumptions underlying today's business models. It brings into question processes like internal/external reconciliation, liquidity management and regulatory compliance. An effective and economical application of DLT needs deep cooperation among incumbents, innovators and regulators, which may delay implementation.

We also found that despite all its promise, DLT isn't a panacea. It's but one of many tools, like cognitive computing, robotics, cloud and advanced analytics. Collectively, these will shape the foundation of tomorrow's financial services infrastructure.

And what about those new, DLT-powered processes—what will they look like? We don't really know yet, and of course it depends on the business need. But we can speculate. Here, we envision ways that DLT might help payments, insurance, deposits and lending, capital raising, investment management and market provisioning. Some of these push the boundary of what's possible, including capabilities that don't exist today.

However, they are ideas. There will be more, from every corner of the industry, all over the world. The best of them will become reality.

Sincerely,



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Reimagining financial services

It's seen 2,500-plus patent filings and over US\$1.4 billion in investments in just three years. At least 24 countries are investing in it, 50 corporations have joined consortia around it, and 90 banks are in discussions about it worldwide. One prediction has 80 percent of banks initiating projects on it by next year.¹

DLT has captured the imaginations, and wallets, of the financial sector.

But there are hurdles. The regulatory environment is uncertain. Standards are only just starting to be developed. Formal legal frameworks don't exist. All of these stand in the way of large-scale implementation.

Then there are the usual challenges of transformation. Updating financial infrastructure through DLT will require significant time and investment. And competing interests will turn any sort of collective action into a careful balancing act.

What is DLT that it could make all this pain worthwhile? Simply put, it's a technology that allows parties to transfer assets to one another in a way they can trust, through a computer network, without relying on intermediaries. Transactions are recorded in a public, tamper-proof repository organized in chronological blocks. An asset is represented as a token. All parties to a transaction may access this repository. It enables transparency, immutable records and allows autonomous execution of business rules, allowing superior automation capabilities.

The implications for financial services are significant. Transactions become faster and cheaper. Information silos disappear. Risk declines, as credit history and asset provenance become immutable parts of the record. Line of sight lengthens: It becomes easier, for instance, to verify that trading partners held up their end of a bargain. Dispute processes become simpler, since audit trails are readily available. Smart contracts execute binding agreements in real time.

With the new infrastructure, firms and regulators get along better, if only to the extent that DLT makes compliance easier. One way this could play out: Regulators end up being able to access the shared repository and help themselves to the data they need.

At the same time, value propositions change. Financial institutions can reconcile records and resolve disputes among themselves, prompting intermediaries to rethink their business models. Lenders gain greater visibility on assets pledged by their borrowers, resulting in better credit adjudication and pricing decisions. Fewer firms can count on information asymmetry for a competitive advantage.

A lot of work remains before all this can happen, however. Firms must stand up cost-benefit analyses, execution roadmaps and governance models. Industry and government must work out regulatory, legal and jurisdiction-specific tax guidance. Under the circumstances, it's much too soon to pick winners and losers in DLT. We won't even try.

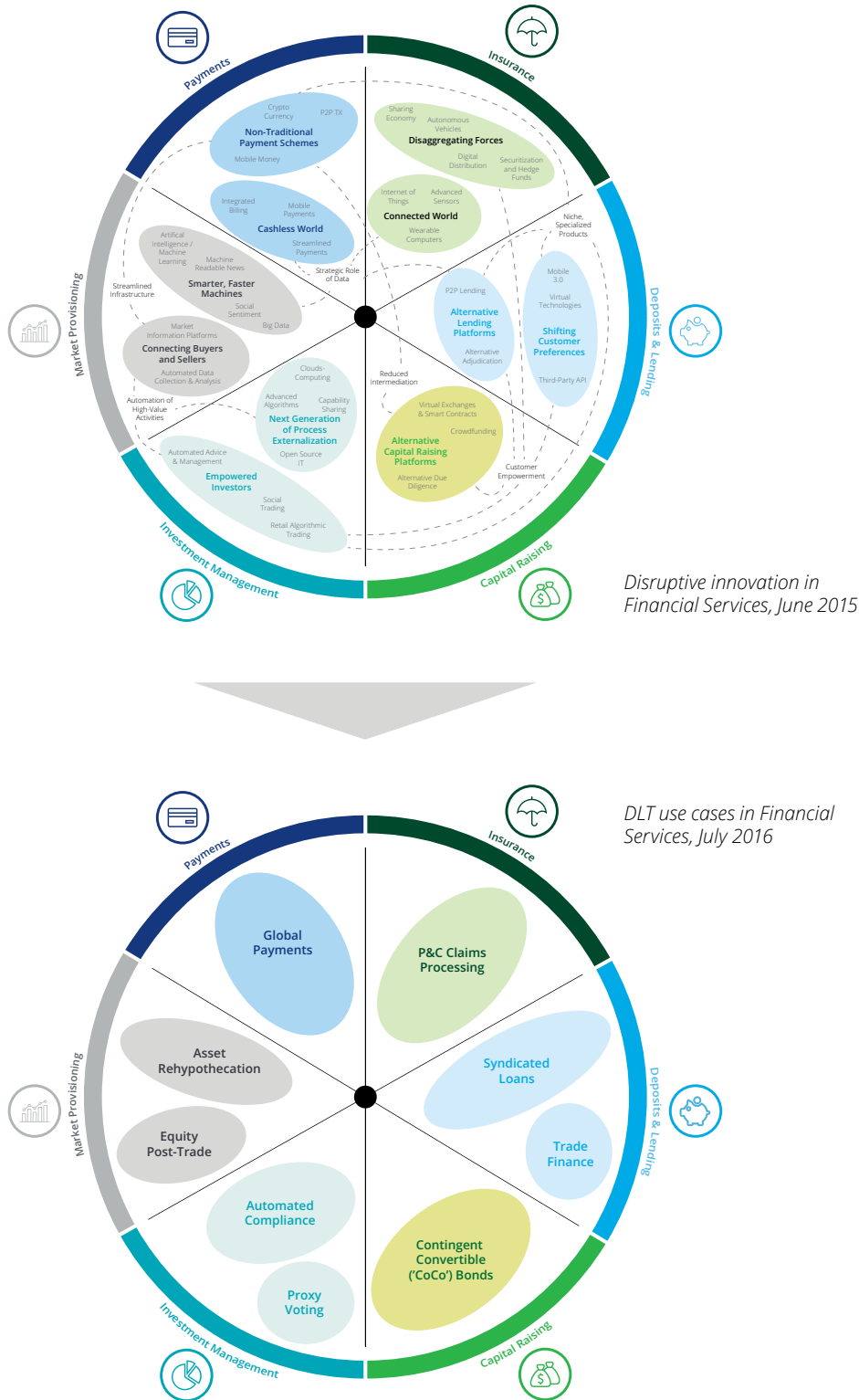
That said, we can talk about potential use cases. In fact, building hypothetical scenarios can be a useful way to understand what's possible and practical in transforming the structure of financial services through DLT. Given all the unknowns, it also helps to make some assumptions, such as:

- Other emerging capabilities (such as digital identity) are available for use with DLT.
- Distributed ledger solutions have the ability to scale (handling, in some cases, billions of transactions).
- Data sources that are accessible by distributed ledgers and/or facilitate autonomous execution behavior cannot be compromised.
- Benefits depend on the implementation and the jurisdiction.

We looked across the field of financial services, aiming for important ways DLT could apply to different sub-sectors and asset classes. We came up with nine. (Figure 1)

Figure 1.

Leveraging the financial services innovation taxonomy within the World Economic Forum's *The Future of Financial Services* 2015 report, the implementation of DLT is considered across each function of financial services.



Key findings

The nine use cases in this summary point to several conclusions about DLT.

It brings simplicity and efficiency.

Through new infrastructure and processes, DLT streamlines the financial services industry. It takes much of the labor out of reconciliation and dispute resolution. It erases the need for third parties to clear and settle transactions. And DLT enables real-time monitoring of financial activity between regulators and regulated entities.

But the potential efficiencies go beyond routine operations. With DLT, parties to a transaction codify and execute their agreements in a shared, immutable environment, reducing the risk of failure to fulfill obligations. DLT also reduces locked-in capital. Finally, it provides more transparency into asset provenance, transaction histories and sources of liquidity for assets.

DLT is one of many technologies to remake the financial services infrastructure.

Technology innovation has a 50-year history of transforming financial services. Semiconductor microprocessors allowed digital data to replace physical records, launching the era of credit cards. Terminals and PCs led to the development of ATMs. Local networks enabled electronic trading, and then the internet enabled digital banking. More recently, we've seen innovations like mobile payments come out of the proliferation of smart devices.

Financial services is about to change again—but this time, change is coming from a number of converging technologies. They include biometrics, robotics and machine learning. Cloud, cognitive and quantum computing are in the mix as well. Together with DLT, they're a set of tools that the industry will use to build its next infrastructure.

DLT's benefits depend on the business problem.

Each application uses the technology in a different way. In trade finance, for instance, DLT speeds up settlement. It also enables multiple parties to track and manage letters of credit in real time.

For compliance, DLT provides faster, more accurate reporting via automation that draws on immutable data sources. For global payments, DLT takes friction and delay out of transferring funds between financial institutions.

Another example is asset rehypothecation. In that case, a DLT application helps market participants make more informed decisions by giving them improved line of sight into assets.

Digital identity, digital fiat and other new capabilities can broaden DLT's appeal.

A DLT application won't be as useful as it could be if it depends on physical protocols to confirm identity. A digital identity system, on the other hand, can integrate with DLT-based infrastructure to seamlessly verify that customers and counterparties are who they claim to be. Other benefits include faster, more accurate anti-money laundering (AML) and "know your client" (KYC) processes.

Similarly, while DLT systems may have their own tokens of denomination, some users will demand high liquidity between system assets and fiat currency. To address this need, central banks could distribute legal tender within the distributed financial infrastructure so that liquidity stays readily available, meanwhile eliminating an inefficient bridge between the new infrastructure and cash.

What about other innovations? In the future, we might see distributed financial infrastructure combined with artificial intelligence or the Internet of Things. Technologies like these are evolving so swiftly that right now, we can only guess at their benefits.

The most important DLT applications require significant industry collaboration. Rollout will take longer and be more complicated.

Replacing existing financial infrastructure with DLT is a big, expensive undertaking. Incumbents, innovators and regulators will have to come together amid diverging interests to achieve standardization. This will delay larger DLT implementations in highly regulated markets. But the reward will be a more modern, scalable infrastructure with the laws and governance to support it.

DLT will upend today's business models.

Intentionally or not, it will change the assumptions underpinning financial services today. It's assumed, for instance, that there will be detailed reconciliation work. But the immutability of distributed infrastructure eliminates information silos so that everyone works with the same set of historical facts.

Today, it's assumed that central authorities must mediate among market participants. But distributed infrastructure brings transparency that makes intermediation unnecessary. That same transparency also eases the burden of regulatory compliance and enforcement.

Lastly, contract execution today is laden with bureaucracy based on the assumption that counterparties can't be trusted. Distributed financial infrastructure, however, offers a level of autonomy that makes trust unnecessary. Counterparties can ensure execution based on agreed-upon business outcomes and avoid the disputes that required third-party intervention.

With that, let's dive into the use cases. First up? Global payments.

Global payments

International money transfers through DLT offer lower fees, real-time settlement and newer models of regulatory oversight.

Global payments—transferring money across international borders—often involve sending relatively modest sums to people via banks or money transfer operators (MTOs). Such transfers, more commonly known as remittances, are a large and growing business. Expats, for example, are expected to send home more than US\$601 billion during 2016.²

But transfer fees are expensive. By the second quarter of 2016, the average cost reached 7.6 percent of the remitted amount.³ To understand why, let's take a look at how global payments take place today.

The first step is for the sender's bank (or MTO) to collect the necessary information about each party in the transaction—an often manual and repetitive process. The payment goes through a local clearing network to be validated by a correspondent bank. At this point the payment may be rejected if the correspondent bank can't meet the liquidity requirement or validate the transaction.

If the payment does go through, it's sent through another local clearing network to reach the beneficiary's bank or local MTO. There the identity and address of each party must be re-verified. Finally, every institution involved must file reports with the appropriate regulators.

With DLT, the sender's digital identity profile is verification enough for banks and MTOs. A smart contract containing the remittance information delivers the funds directly to the beneficiary's institution while simultaneously notifying the appropriate regulator. Meanwhile, liquidity providers on the distributed ledger take care of the currency conversion. Once complete, regulators can access the transaction history directly from the ledger for review.

So DLT can make small payments more affordable by taking much of the labor out of the process. Some initiatives are afoot among retail and wholesale banks in Europe and North America. And SWIFT is leading an initiative to enhance cross-border transactions, although it's unclear whether this effort involves DLT.⁴ However, developing standards, regulations and legal frameworks that suit multiple parties and jurisdictions is no small undertaking. Getting there will take significant cooperation among incumbents, regulators and innovators.

The future of global payments

- **Incorruptible.** Digital profiles stored on DLT will authenticate both sender and beneficiary.
- **Liquid.** Through smart contracts, participants willing and able to convert fiat currencies will support the foreign exchange.
- **Prompt.** Cross-border payments will be completed in real time.
- **Economical.** With less participants, improved cost structure can generate value.
- **Visible.** Regulators will gain automatic alerts to specific conditions along with on-demand access to complete transaction histories over the ledger.

Potential effects

Real-time settlement of international money transfers reduces liquidity and operational cost

Direct interaction between sender and beneficiary banks eliminates the role of correspondent banks

Trust improves as smart contracts capture obligations across financial institutions

Necessary conditions

KYC standards that are consistent across banks and MTOs

Binding legality of a DLT-enabled global payments solution

Consensus among financial institutions around DLT platforms and adoption timetables

Commercial property & casualty claims processing

DLT-automated claims processing has the potential to reduce fraud and improve assessment through historical claims information.

Commercial property and casualty (P&C) insurance (covering generally commercial motor, property and third party liability) is the second biggest category of insurance, trailing life and health (L&H). In 2014, global premiums for P&C insurance totaled US\$728.6 billion⁵, growing at a rate of 5.1 percent.

Claim and loss processing are a major source of friction in this valuable market, however. In 2016, they made up 11 percent of insurers' overall written premium (revenue).⁶

On closer examination, it's easy to understand why. To submit a claim, the insured typically must complete a complex questionnaire accompanied by physical receipts of all the costs incurred by the loss. Brokers mediate this process, sometimes creating delays.

Insurers, for their part, rely on third parties to provide asset, risk and loss data in the adjudication and underwriting process. Collecting the data is a manual effort and the data may not be updated to boot. Assessments take place by insurer, and the information isn't shared among insurers. This raises the potential for fraud and manual rework.

Then there's claim processing. A loss adjuster must review the claim for completeness, finding support for the claim, validating the loss coverage, gauging the scope of the liability, and calculating the amount of the loss.

DLT, on the other hand, can streamline the claim submission process by using smart contracts or even smart assets. Broker intervention becomes unnecessary and processing times shrink. Meanwhile, business rules encoded in a smart contract relieves loss adjusters from having to review every claim. With a record of prior claims and asset provenance on the distributed ledger, suspicious behavior is that much easier to identify.

The technology also facilitates the integration of trusted data sources, reducing the need for manual review. Even payment is automatic, again using smart contracts to deliver without back office involvement.

DLT's potential has attracted attention from both incumbent institutions and new entrants in the commercial P&C insurance sector. They're looking at solutions for immutable claim records, peer-to-peer insurance, and asset provenance for risk profiling and claims processing. Regulators might consider this a chance to influence the creation of a common DLT model and guide the direction of new DLT-based products.

The future of commercial P&C claims processing

- **Customer-friendly.** Smart contracts and smart assets will remove manual effort from the claim submission process.
- **Direct.** DLT will share loss information among insurers, eliminating the need for brokers.
- **Practical.** Loss adjusters will no longer have to review every claim, except in specific risk situations.
- **Clean.** Insurers will have seamless access to historical claims and asset provenance, making it easier to spot suspicious behavior.
- **Integrated.** DLT will automatically combine data sources from trusted providers.
- **Fast.** In most cases, smart contracts will facilitate payment without involvement from the back office.

Potential effects

Claims are processed automatically using trusted data sources and codified business rules

Fraud declines precipitously thanks to transparent and immutable data on the ledger

Expenses due to loss adjustment become irrelevant as DLT transforms the insurance industry

Necessary conditions

Asset profiles stored on the ledger to provide a comprehensive history in case of a claim

Standards for relevant claims data that are widely adopted among insurers and regulators

A legal and regulatory framework establishing the validity of smart contracts as binding instruments for insurance policies

Syndicated loans

DLT can make it easier, safer and more profitable for financial institutions to participate in syndicated loan opportunities.

Syndicated loans are a way for financial institutions to spread the risk of a single customer borrowing a very large amount. Usually the customer is a corporation or government agency looking to finance a major project. The amount in question might be too much for any one lender to put up. But a group of lenders (that is, a syndicate) could come together to make the loan.

The lender in charge of arranging the syndicate (the bookrunner) underwrites the loan and usually coordinates with the other lending institutions at the back end that collectively bear the credit risk. The borrower gets one note or credit line, like any other loan.

The volume of syndicated loans is significant. For 2015, it was US\$1.8 trillion in the United States, €1.1 trillion in EMEA, and US\$450.1 billion in APAC ex-Japan. In Latin America, it was US\$48.1 billion. Half of the US loan volume came through just four bookrunners—all incumbent financial institutions.⁷

The syndicated loan market could open up to more players if the back-office operations were simpler. As it is now, the pain points are many. First, selecting syndicate members requires a labor-intensive review of information pulled from multiple sources. The same goes for qualifying a borrower. Moreover, the underwriting system doesn't communicate with the diligence systems.

Delays and intermediaries add to the cost. The bookrunner must step in to disburse principal and interest. Verifying funds for settlement usually means investors must wait up to three days to get their money. Meanwhile, third-party firms often handle ongoing loan servicing on behalf of the syndicate. Much of this work is done in silos, leading to duplicated efforts.

DLT's record-keeping functionality could ease much of this process. In a DLT-enabled environment, the bookrunner uses the borrower's digital identity to complete KYC work, and investors' digital identities to identify those with the appropriate capital and risk tolerance. Smart contracts perform due diligence and automate key portions of the underwriting and credit adjudication process. They also fund the loan, disburse principal and interest payments to the lenders, and facilitate loan servicing. All the while, regulators have a view into this activity.

Given their heavy reliance on data access and manual processes, syndicated loans are a strong candidate for DLT implementation. KYC verification, due diligence, underwriting, loan funding and payment dissemination are some of the applications worth looking into. All offer the opportunity to get rid of manual work and operational risk throughout the life of a syndicated loan.

The future of syndicated loans

- **Expedited.** Smart contracts will automatically form syndicates, verify financial information and carry out settlement services, reducing the time to fund a borrower's loan.
- **Abbreviated.** Distributed ledgers and smart contracts will eliminate the need for third-party intermediaries.
- **Integrated.** Diligence systems will communicate pertinent financial information directly to underwriting systems.
- **Monitored.** Regulators will have a real-time view of financial details throughout the syndicated loan lifecycle.
- **Secure.** Operational risk will decline as DLT automatically disburses principal and interest payments.

Potential effects

- **Syndicates** come together via smart contracts and under the watchful eye of regulators
- **Risk underwriting** requires substantially fewer resources to carry out effectively
- **Intermediaries** turn their attention elsewhere as smart contracts facilitate loan funding and servicing

Necessary conditions

- **A rating system** for counterparties that all financial institutions accept
- **Templates** for diligence and underwriting so that information can move from one system to another
- **Willingness** among financial institutions and loan requestors to store financial details on the distributed ledger

Trade finance

DLT can boost import/export efficiency by providing streamlined access to trade documents, greater capital efficiency and faster settlement.

Trade finance closes the gap between exporters who need guarantee of payment before they can ship, and importers who need to know that the goods they paid for actually get delivered.

Financial institutions see to it that both parties get what they need. One bank, an import bank, provides letters of credit that guarantee payment for the shipment based on the terms of the purchase contract. Another bank, the export bank, reviews the financial agreement and enables the exporter to initiate the shipment. This reassures both parties that the deal will hold.

Today, financing is the lifeblood of world trade. Roughly US\$18 trillion of annual trade involves some form of finance, be it credit, insurance or guarantee. The size of the trade finance market itself tops US\$10 trillion per year.⁸

But the trade finance market has plenty of opportunity for improvement. The import bank must review the financial agreement from the importer and send financials to the correspondent bank. The export bank must conduct AML checks using the financials from the import bank. Today, both of these are annual processes.

Added to that are various risks. Exporters use invoices to secure short-term financing from multiple banks, which increases the consequences should the delivery fail. Parties use different platforms, raising the odds of miscommunication, fraud and problems with version control. Difficulties in verifying authenticity could result in invoices being financed more than once.

Lastly is the issue of time. Multiple checkpoints delay payment and slow the shipment of goods.

Now imagine this process with DLT. The purchase agreement between the buyer and seller can be codified as a smart contract that autonomously executes the terms of agreement. Documents on the distributed ledger allow all parties to conduct diligence for credit adjudication, check for AML and trace the location and ownership of goods. Banks no longer need intermediaries to assume risk. Compliance officials can enforce AML and customs activities without delay. Additionally, using smart contracts to codify agreements could lead to new products for alternative financing, securitization of trade obligations and downstream factoring.

Some trade finance DLT applications are in the proof of concept stage today, with recent news indicating early live trials conducted by global banks in partnership with innovators. These include solutions for electronic invoices and encapsulating letters of credit in a smart contract. If incumbent institutions don't seize these opportunities, upstart innovators most likely will.

The future of trade finance

- **Accelerated.** Time to shipment will shorten as financial documents are reviewed and approved in real time.
- **Disintermediated.** Banks facilitating trade finance will no longer require a trusted intermediary to assume risk or execute the contracts, eliminating the need for correspondent banks.
- **Decentralized.** DLT will show the status as contract terms are met, reducing the time and headcount required to monitor the delivery of goods.
- **Trackable.** Title and bills of lading available on the distributed ledger will show the location and ownership of goods.
- **Visible.** A real-time view into invoices and other essential documents will aid short-term financing, enforcement and AML.

Potential effects

Letters of credit automatically generate from financial details stored on the ledger

Regulators gain real-time tools to enforce AML and customs-related activities

Correspondent banks exit the scene as import and export banks interact directly

Necessary conditions

Transparency to ensure factoring and double spending aren't taking place

Interoperability with legacy systems to accommodate letters of credit, bills of lading, and inspection documentation

Regulatory guidance on the procedures that facilitate the use of smart contract reporting

Contingent convertible bonds

Smart contracts that automate regulator reporting can minimize point-in-time stress tests, reduce market volatility and improve investor confidence in these complex instruments.

A contingent convertible (CoCo) bond is a hybrid security, so called because it combines features of equity and debt. With a CoCo bond, investors can earn dividends until the principal is repaid, just like a regular bond. But once a predefined threshold is crossed—such as bank capital ratio falling below 7.5 percent—the bond converts to equity, saving issuers both the cost of the remaining coupons and the need to repay the security.

Although they can be an attractive way for financial institutions to raise funds, CoCo bonds are not without concerns. First, the market is largely untested, at the time of this writing no bank-issued CoCo bond has required conversion to equity. In addition, the instruments are highly volatile. We saw this in 2016 when market conditions combined with regulator stress tests erased all yields in just six weeks.⁹

Another concern is lack of insight. Today, banks calculate their own capital ratios. The only way regulators can know what the ratios are is if they request a stress test.

Perhaps because of these risks, European CoCo bond issuance flatlined in 2015 following a few years of double-digit growth.¹⁰

DLT can address these issues by embedding regulation into the business process. That is, when a bank issues a CoCo bond, it actually creates a token containing information such as the loan absorption trigger, the issuing bank, the coupon rate and the maturity date. Each time the bank updates its capital ratio, the result becomes part of the tokenized record for investors and regulators to examine.

If the capital ratio does cross the conversion threshold, a smart contract notifies regulators and bank management. Another smart contract activates loan absorption at the predetermined rate.

It's not clear yet how soon this will happen. So far, there hasn't been a lot of discussion about blockchain applications for CoCo bonds. That might be because the benefits are mostly ancillary and focused on improving market stability. Still, greater transparency, fewer reporting costs, and a more efficient process are no small things to those who have a stake in this promising market.

The future of CoCo bonds

- **Accessible.** Confidence in CoCo bonds will rise as DLT provides up-to-date capital ratio information.
- **Consistent.** Standards will arise for the way banks calculate capital ratios and input them into DLT.
- **Immediate.** Smart contracts will notify regulators of CoCo bond triggers as they happen.
- **Compliant.** With real-time insight into banks' capital ratios, regulators will have less need for stress tests.
- **Responsive.** Investors will claim their equity faster once the trigger condition is met.
- **Sought after.** A new rating system will encourage more institutional investors to participate in the market, raising demand for this type of bond.

Potential effects

Tokenized bond instruments help investors make informed, data-driven decisions

Smart contracts alert regulators when loan absorption must be activated, minimizing the need for point-in-time stress tests

Transparency into loan absorption reduces the uncertainty of CoCo bonds

Necessary conditions

Standards—including data fields, templates, trigger calculations and loan absorption—that apply across financial institutions

Processes for regulators and bank leadership to act on real-time trigger notifications at the financial institution that issued the bond as well as across the market

Automated compliance

By making financial information available to auditors via DLT, institutions can eliminate error-prone manual work, reduce reporting costs and strengthen trust in their financial condition.

Compliance is a fact of life for banks. Audits, tax reporting, stress testing, and routine filing with the appropriate financial regulatory authorities are just a sample of what firms must do to stay in operation.

Unsurprisingly, all this compliance has a cost—as high as US\$4 billion a year for some institutions, with much of that spent on labor.¹¹ One of the costliest activities is auditing. A study of 76 public companies found that audit fees for the 2014 fiscal year averaged US\$8.1 million.¹²

So when it comes to blockchain applications for compliance, audit might be the place to start. In this scenario, examiners use DLT to access the information they need to carry out an audit. Bank personnel needn't collect the data nor deal with the errors that can result from manual activity.

Then, after completing their report, auditors store it on the distributed ledger for bank officials and regulators to review. Finally, a smart contract moves information from the report to the relevant financial reporting instruments, streamlining what is often an inefficient process.

Incumbent institutions have already begun to explore DLT-based compliance applications. Besides continuous auditing, areas getting particular attention include AML/KYC verification and automated tax filing. Other interesting applications include compliance for securities trading (e.g., insider trading between multiple bank brokerage accounts), capital assessment reviews and suspicious transaction reporting (STR). Any of these might bring not only relief to what is often a labor-intensive process, but also greater confidence in the organization's financial health.

The future of automated compliance

- **Transparent.** Data stored in financial systems will be immutable, accessible, and updated in real time.
- **Painless.** Automation will slash the time and resources required to perform an audit.
- **Reliable.** With permissioned access to financial data, audit teams will have a streamlined update process and avoid the errors that often arise from manual activities.
- **Efficient.** Reporting through DLT will reduce duplicate effort and make it easier to prepare and file financial reports.

Potential effects

Audit software dramatically reduces the time and resources required to examine accounts

Financial examiners carry out their duties via permissioned access to pertinent financial information

Costs decline as the process for vetting transactions and filing reports becomes more straightforward

Necessary conditions

Permissions that allow each user to access only the financial data necessary to carry out their compliance responsibilities

Automatic enforcement of compliance activity so that financial institutions and regulators share material information in real time

Interoperability so that the legacy systems at financial institutions and regulatory agencies can communicate with the distributed ledger

Proxy voting

As a way to distribute proxy statements and count votes, DLT may someday improve retail investor participation, automate validation of votes and enable personalized analyses.

Proxy voting gives investors a say in the direction of a company even when they can't attend a shareholder meeting. To help investors decide how they'll vote, the company issues a proxy statement on the issues at hand. A third party delivers the proxy to the investor. After reading it, the investor can make their wishes known to another outside party, who casts the ballot on their behalf.

There are two kinds of investors—institutional and retail—and they don't behave the same way. A study of US public company shareholder meetings found that in the second half of 2015, on average, institutions vote 83 percent of their shares compared with retail investors' 28 percent. About 24 billion retail shares remained "un-voted".¹³

Corporations and financial institutions are concerned about this gap because low voter turnout gives disproportionate power to activist investors.

But proxy statements can be difficult for shareholders to navigate. Sometimes they contain errors. Their summaries can be misleading. And they're getting longer and more complicated, requiring intensive scrutiny to make an informed voting decision.

What's more, proxies are expensive to distribute. Companies must mail print copies to any investor who doesn't elect to receive them electronically. Generally they outsource this work, which means the intermediary is the only one with a single view of the company's investor population.

And in some markets, proxy statements can't be shared with institutional investors at all, further limiting the potential number of votes.

DLT offers a way to improve voter participation, particularly among retail investors, by streamlining and de-mystifying the voting process. When someone buys shares in a company, that transaction is recorded in the distributed ledger. Then, once the company completes its proxy statement, a smart contract notifies the owner of record along with the regulatory body. The shareholder's vote—be it by mail, online, or in person—appears as a tokenized asset on the ledger. Another smart contract matches the number of votes with the ownership record to determine validity. Finally, the company and/or investors monitor the results as they're tallied.

Financial institutions share an interest with other stakeholders in developing DLT applications for the proxy. Along with companies, they benefit when the proxy statement becomes easier for investors to access and analyze. And like the exchanges, they gain when equity markets become more open, authentic and participatory.

The future of proxy voting

- **Direct.** Storing all investment records on DLT will eliminate the need for a go-between to notify regulators and distribute proxy statements.
- **Paperless.** Costs from printing and mailing proxy statements will decline.
- **Dependable.** Smart contracts will ensure that voting is aligned to share ownership at the time of the vote.
- **Accessible.** Investors will have more ways (such as through mobile apps) to access proxy statements and cast their votes.
- **Immediate.** Depending on requirements, voting data will become available to the corporation and/or voters in realtime.
- **Progressive.** Evolving DLT applications will enable investors to conduct personalized, automated analyses.

Potential effects

Smart contracts reduce the time and effort of distributing proxy statements

Automatic reconciliation prevents investors from casting more votes than the shares they own

Self-service enables investors to see vote counts and standardize analysis across investments

Necessary conditions

Storage of investment records on a distributed ledger to identify beneficial investors

Conversion of votes cast via mail or phone into tokens to store on the distributed ledger

Collaboration among corporations to develop a common voting solution

Asset rehypothecation

DLT can remove much of the risk from the secondary trading market by automatically tracking assets and enabling real-time enforcement of regulatory control limits.

Asset rehypothecation is a common practice in which a financial institution uses collateral posted by its borrowers to cover trades of its own. This is also known as secondary trading.

Rehypothecation reduces the cost of borrowing, but it can be tricky to manage. If the institution mixes up who owns what assets, the risk to its trading partners goes up and the value of the rehypothecated assets becomes uncertain.

For that reason, regulators limit the extent to which institutions can re-pledge an asset. But enforcement is impossible without a way to track the transaction history. Right now, market participants are not required to report the details of a rehypothecated asset's transaction history, such as purchase price, purchase date or loan originator. Neither must they disclose who else has a claim on the asset.

If any of the counterparties defaults, it could affect the entire transaction chain. This, in turn, could have unintended consequences for other parts of the financial system. This is particularly concerning given the size of the secondary trading market. Annual trade volume in the US loan market reached US\$628 billion in 2014.¹⁴ This was 21 percent greater than the previous high in 2007.¹⁵

DLT might significantly mitigate the risk surrounding rehypothecation by creating an immutable record of the underlying asset's transaction history. A token represents the collateral. Whenever the asset is traded, a smart contract broadcasts the transaction details (such as collateral value, counterparty identification and so forth). Regulators monitor each trade as it happens. If the asset hits its regulatory rehypothecation limit, trading halts.

As incumbent institutions explore ways they can apply DLT to asset rehypothecation, likely starting points include gold markets, repurchase markets and asset transfers. But there are other opportunities too. They include a counterparty rating system, tools for storing asset transaction history, regulatory transparency solutions, and a smart contract enforcement platform. All can work together to take the worry out of a flourishing but unruly financial arena.

The future of asset rehypothecation

- **Documented.** Information such as collateral value, risk position and ownership history will be readily available to investors.
- **Assessed.** Counterparties will be rated based on transaction history, helping investors to hedge their risks.
- **Automatic.** Record-keeping, reporting and the movement of funds will take place without manual intervention.
- **Observable.** Regulators will have a clear view of the asset history so they can enforce legal constraints.
- **Orderly.** Smart contracts will keep assets from being rehypothecated over regulatory limits.
- **Stable.** Between effective regulation and greater transparency, the risk of default leading to systematic failure plummets.

Potential effects

Ratings based on prior transactions help counterparties make better investment decisions

Reporting of asset trades enables real-time enforcement of regulatory constraints

Controls that terminate trades via smart contract technology reduce the likelihood of systemic failure

Necessary conditions

A tokenization standard to represent collateral-linked assets within the financial system

A common framework for financial institutions to participate in the tokenized asset trading system

A distributed ledger solution flexible enough to handle changes in the over-the-counter (OTC) trading template

Equity post-trade

Applying DLT and smart contracts to post-trade activities can eliminate the need for intermediaries, reduce counterparty and operational risk and pave the way to faster settlement.

Equity post-trade processing enables a buyer and a seller to swap trade details, change the record of ownership and exchange assets or securities.

Post-trade processing kicks off once the exchange confirms a trade has taken place. A central securities depository (CSD) works with custodian banks to match trades and validate investor credentials. If all looks well, a central counterparty clearing house nets all transactions and transfers the cash and securities to the appropriate custodians. The custodians then store the assets in accounts for safekeeping. The CSD is responsible for initiating asset servicing (e.g., income distribution and proxy voting) as required.

All this takes anywhere from one to three days to complete, depending on the market. And that's for just one trade. A single market, the New York Stock Exchange, processes millions of trades every day.¹⁶

And it adds up. Between the time it takes, the dependence on costly intermediaries and the heavy regulatory compliance, equity trade processing is a significant investment for incumbents. In the United States, it costs the financial services industry up to US\$9 billion a year.¹⁷

DLT could alleviate these challenges by taking over many of the functions of today's intermediaries. Once the exchange confirms a trade, for example, a custodian bank working on the investor's behalf sends details of its part of the transaction to the distributed ledger.

Next, a smart contract validates the information and matches it with the other parts of the trade. Another smart contract determines the net transaction. Still other smart contracts carry out the simultaneous transfer of cash and equity among the appropriate custodians and record confirmation in the ledger. Finally, once the assets are stored for safekeeping, smart contracts initiate various servicing processes while notifying custodians and investors in real time.

DLT certainly seems to open up opportunities for significant cost reduction. A question is whether faster settlement saves more than what asset holders earn from the float during the settlement period. With equity post-trade one of the busiest areas of DLT activity—many are competing to develop post-trade processing solutions—the answer may reveal itself soon enough.

The future of equity post-trade

- **Swift.** Same-day settlement will become a possibility thanks to automation and efficiencies like common data fields.
- **Vetted.** Automatic validation will strengthen custodians' confidence that a counterparty is able to settle.
- **Connected.** Investors will receive immediate notification of trade settlement without relying on a custodian.
- **Straightforward.** When securities settlement systems become unnecessary, custodians will have more say in how to store assets.
- **Empowered.** Servicing activities initiated via smart contract will eliminate the need for third-party intermediaries.
- **Wrinkle-free.** Technology and manual errors will decline when smart contracts transfer equity and cash.

Potential effects

- **Automation** of post-trade processes reduces settlement time and lowers counterparty risk
- **Smart contracts** simultaneously transfer equity and cash in real time, reducing the likelihood of errors
- **Disintermediation** of clearing, settlement and asset servicing reduces operational costs and third-party fees

Necessary conditions

- **Incorporation** of 'net transaction' benefits within settlement in order to minimize transfers across custodian banks
- **Collaboration** among regulators, custodians and exchanges to develop a solution that can provide market stability while serving everyone
- **Standardization** of data fields that can match trades while preserving investor confidence and anonymity

Conclusion

An interesting thing about these use cases is that although the applications are very different, some basic characteristics are the same. They include a shared repository and multiple writers to the repository. They also often involve the removal of one or more intermediaries from the value chain, with trust enforced programmatically rather than through centralized institutions. Opportunities with these characteristics are the ones that benefit most from DLT-based systems.

So where to go from here? We suggest the following steps:

01. Educate yourself in the technology, its disruptive potential and its effects on your business. This includes getting to know the leading innovators in the industry.
02. Work with business leadership to identify areas where DLT can present material gains or increase risks of disintermediation.
03. Categorize and prioritize these opportunities, then experiment with different technology solutions. (Because the technology is so new, most of your discoveries will happen only through deep experimentation.)
04. Develop business cases for successful experiments, create a plan to commercialize the solutions and identify barriers to scaling that need further attention.
05. Join (or create) networks for use cases that require collaboration. (Often, collaboration in smaller networks can yield faster results.)

To accomplish all this, consider establishing a dedicated discipline or function within your organization. Doing so will bring weight to your efforts and signal to your people that this technological shift, however it plays out, is part of a broader disruption bringing exciting change to a traditional industry.

End notes

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