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Global Financials / FinTech

Global Insight: Blockchain in Banking: Disruptive Threat or Tool?

Blockchains could have widespread potential to disrupt financial intermediaries. Our in-depth study suggests several misconceptions & identifies 10 hurdles to overcome to make blockchain a reality in banking. The opportunity is clear but the blue sky is too far off to impact our 2017/18e.

The pot of gold? Higher efficiencies. It's early days, but industry heavyweights are sponsoring a wide range of blockchain use cases supported by industry consortiums. As NIM fades and capital builds, global bank managements press harder for a step down in costs. Cost mutualisation through blockchain architected financial system utilities could provide some earnings boost after the related multi-year investment spend plateaus.

But blockchains could be a double-edged sword and disrupt financials. Blockchains won't just change the Financial Services' IT architecture. They could also change accessible profit pools. A lot will depend on the governance and how quickly incumbents move. The firms holding the keys to the data and the IT architecture could drive more profit pool towards themselves. So it's no wonder that the custodians like JPM, BK and STT are among the lead sponsors of Linux Hyperledger and are members of R3 as they seek to drive the standard and retain their ground.

The market underestimates the advantages banks and custodians have already, given not a single policymaker we met with for this note would allow an "unpermissioned" distributed ledger. Nor would the banks, given concerns on AML and KYC. As a result, we think industry supported consortia rather than VC sponsored start-ups will have the edge.

10 roadblocks for blockchains to become a reality in banking: 1) is the use case cost/benefit compelling?, 2) cost mutualisation/who funds the overhaul old systems?, 3) misaligned incentives, 4) evolving to the right standard, 5) scalability/performance, 6) governance, 7) regulatory issues, 8) legal risks, 9) cryptology/security, and 10) simplicity/interoperability.

What's the best use case? The majority of ideas hinge on reducing inefficiencies in capital markets infrastructure. Several industry leaders including Blythe Masters (CEO of Digital Asset Holdings – see [conversation](#) later in this note) put post-trade settlement for a variety of asset classes at the top of the list. Domestic payments is already efficient, especially with real-time pay in much of EU/UK and coming to the US, but some believe international payments could benefit from a blockchain-type communication protocol.

While the long-term opportunity is clear, the blue sky is still too far to the right to affect 2017/18 EPS, we think, so our stock positioning generally reflects medium-term earnings issues for our banks.

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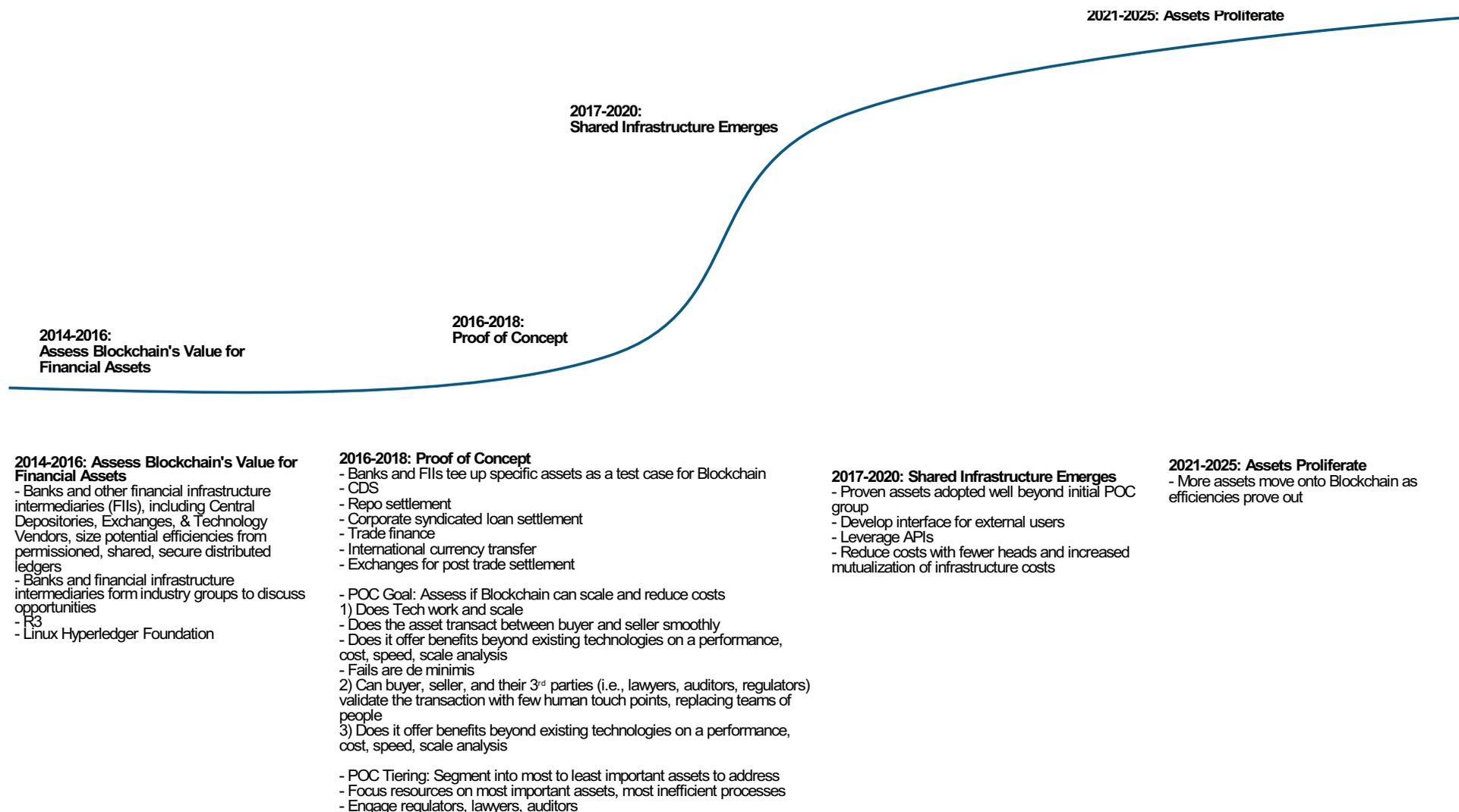
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Our roadmap for adoption of distributed ledger by financial institutions

Exhibit 1: Financial infrastructure intermediaries iterating on a path to improve efficiencies using blockchain over the next decade





10 key hurdles to cross to make blockchain a reality in financial services

Exhibit 2: Framing the hurdles to adopting blockchain – what to watch for

Key Hurdles		Economics	Technology	Cooperation	Policy
Use case cost / benefit		✓			
Cost Mutualization		✓		✓	
Aligning incentives		✓		✓	
Evolving to right standard			✓	✓	
Scalability /Performance		✓	✓		
Governance				✓	✓
Regulation					✓
Legal risks				✓	✓
Security			✓	✓	✓
Simplicity		✓	✓	✓	✓

Source: Morgan Stanley Research

Blythe Masters is CEO of Digital Asset Holdings, a private technology company that provides innovative distributed ledger technology solutions to wholesale financial firms. The views expressed in this report are those of Morgan Stanley Research unless otherwise stated.



Making blockchain in banking a reality

Blockchain technology could help banks reduce the clutter and cost of numerous complex processes. However, it could be a double-edged sword given that profit pools could fall or shift as new players change the competitive landscape.

To explore, we have undertaken an in-depth study focused on two key questions:

- What would it take for blockchain in banking to become a reality?
- How disruptive it could be for financial stocks? Who could be the winners and losers?

For this note:

- We met with C-suite at numerous banks, custodians, market infrastructure players and asset managers, as well as many VCs and start-ups active in distributed ledger.
- We met with several policymakers about receptivity to new technology.
- We joined various industry workshops on making blockchain adoption a reality (e.g. via World Economic Forum, industry groups).
- We also hosted Blythe Masters, CEO of Digital Asset Holdings (DAH) at our recent European Financials Conference on March 16. As CEO of DAH, Blythe is running one of the most visible experiments in financial service IT architecture. We discussed the potential for blockchains in banking, the business case, as well as some of the key roadblocks, and her thoughts on how challenging and surmountable they are. At the end of this note we give a summary of our conversation.

We've subdivided this note into:

1. [Investor roadmap: Which businesses are most prone to disruption? When?](#)
2. [Misconceptions of how disruptive blockchain adoption could be](#)
3. [Box: Why should we care about blockchain?](#)
4. [10 key hurdles to surmount to make blockchain implementation a reality](#)
5. [So just how disruptive for financial institutions? Our tentative conclusions](#)
6. [A conversation with Blythe Masters](#)



Investor roadmap: Which businesses are most prone to disruption? When?

There isn't really a major financial institution, either bank or infrastructure provider, that isn't deeply involved in exploring and in some cases beginning to commercialise this technology today."

– Blythe Masters

Which businesses are most prone to disruption?

"The challenge for us has been boiling down the ocean of opportunity. The number of applications of this technology to wholesale financial services... we've merely limited ourselves to wholesale financial services. The challenge is trying to figure out what are the projects that have legs that are viable, that can be scalable, and so have interest to multiple parties." – Blythe Masters

Financial institutions are expected to spend over \$1bn on blockchain projects in 2017, making it one of the fastest developing enterprise software markets of all time, according to a report by Magister Advisors.

Emerging use cases

Proposed use cases are mostly ones with costly and complex processes for post-trade settlement and change in title. Santander Innoventures identified 20-25 use cases including international money transfers, trade finance, syndicated lending and collateral management (*Business Insider*, 17 June 2015). Interestingly, some of these use cases could be solved with existing technology. But it took the threat of new entrants funded by VCs at growth-tech multiples (not bank multiples) to get the incumbents together to discuss how to deliver more speed and efficiency at a lower cost. We expect the financial institutions and their customers will adopt blockchain technologies asset class by asset class for validated proof of concepts (POC) efforts over the next 2-5 years in an iterative process that will likely last decades. Similar to Uber, there are likely to be many potential use cases we can't imagine today. Below are those that come up most frequently when engaging with the industry.

1. Post-trade settlement (corporate loans, CDS, repo, derivatives, equities and so on): Post-trade settlement is costly. Each transacting party has a team of controllers, internal auditors, external auditors and regulators reviewing transactions. A distributed ledger could enhance the audit function as specific securities are more easily tracked. This would be most helpful in DKs, or "don't-knows", which are the most costly part of post-trade settlement, as more people are required to be involved and delays mean capital and liquidity are tied up. Transacting parties using the same distributed ledger could have more visibility to help speed up resolution management which should lower staff costs associated with post-trade settlement.

Corporate whole loans trades are well known for long settlement periods, with 2-3 weeks not unusual. There are a wide range of reasons, including a lengthy review process. Long review periods are costly as they can expose traders to market risk and limiting liquidity in the product. Blockchain technology could enable all participants in the chain to see where the documents are in the sequenced approval process, highlighting who is reviewing, how long they have had the documents, pushing intermediaries to speed up the review process.

Additionally, there are opportunities to shorten the settlement window. While settlement windows are a function of regulatory and legal requirements, technology is pushing people to expect increasingly quick response times. Regulators are already moving to shorten the settlement window in equities (US moving to join Europe from T+3 days to T+2 over the next 12-18 months). And while today's technology can adapt to deliver shorter settlement times, blockchain technology can be useful particularly in assets that have the least efficient netting, clearing, collateral management and longer clearing periods.



Additionally, a faster settlement window lowers cost to trade as less capital is tied up in the settlement process, improving liquidity if that capital is recycled back into the market. The challenge is establishing who will create the standard for all market participants to link into. This is simpler to do in a smaller, vertically integrated market like Australia, which has one regulator responsible for all the participants in the post-trade food chain – the exchanges, clearers, banks, investment banks, and asset managers. ASX is leading the charge, migrating its CHES infrastructure to a more efficient blockchain infrastructure over the next few years, pulling the rest of the industry that ties into them along for the investment spend today for better efficiencies tomorrow. We will address the implications for local and global industry structure more thoroughly in future notes.

"... there's been an arms race in pre-trade infrastructure for more than a decade now ... It should be ironic to all of you that trading infrastructure has evolved to the point that competitive advantages is measured in fractions of nanoseconds and yet we're still dealing with T plus two, three or worse, depending on your asset class ... Eight years on after the financial crisis, that is a pretty shocking statement. And, you know, one of the reasons why post-trade infrastructure is monolithic: there hasn't been an incentive really to speed it up, it's very expensive to replace because it's clunky and processing enormous volumes of activity and taking the wheels of anything that's moving fast is always a challenge. It's heavily regulated." – Blythe Masters

2. Trade finance: Trade finance can pose some challenges. Specifically, you need to ensure the goods transfer before the payment is made. With a blockchain, all parties – financiers, trading houses, and any other trusted intermediaries – are able to see when the goods have shipped and can release funding appropriately. This should reduce time to confirm assets, confirm transaction, release payment and received confirmations.

3. International payments: International payments have friction in them with multi-day settlement times and a relatively slow bank settlement system. Moving to a blockchain should shorten settlement periods, speed up transactions and reduce the risk of fraud. This would become even more important as intra-country payments systems increasingly move to real-time, including the US in October 2016. SWIFT and Ripple are both leading interesting suggestions for international payments.

4. Reference data: Blockchain technology could offer significant efficiencies to transactors by holding reference data for individual securities. Providing a rules-based standard on data could enhance quality and auditability as transactions occur. The history could enhance resolution management as well.

5. Regulatory: The banking system has numerous capital and liquidity charges. A blockchain holding the data for regulators could be more efficient for banks assessing the data intra-firm as well as for regulators wanting to compare their regulated entities.

"Simply put, the opportunity to cut out layers and layers of non-value added post-trade reconciliation activity whereby parties who keep their own records of the same information have to ensure it's consistent with other parties to the same information. Where of course because it's kept separately and in different infrastructures there are discrepancies." – Blythe Masters

Misconceptions of how disruptive blockchain adoption could be

We think there are a few misconceptions that may overstate quite how disruptive distributed ledgers could be.

Blockchain adoption does not mean unpermissioned networks

Not one bank nor policymaker that we have met with on blockchain gives even a second thought to an unpermissioned public network. KYC, AML and other considerations means it has to be a permissioned network. This reduces the risk that a new start-up will be able to disintermediate entire value chains. How many tech companies want to vertically integrate into a regulated financial institution? It seems more likely that they will want to retain their tech-oriented multiple as a supplier of software and consultants to the financial services industry rather than as a regulated financial. More likely, we expect that financial industry blockchains will be built around industry consortia – which agree common standards – with close regulatory support. In this



environment, we believe the market may underestimate the opening advantages for banks and custodians. Yes, they will need to invest to deliver faster, less expensive financial services while ensuring 24x7 viability and security. But they have the client relationships. If they can deliver a more streamlined process with lower costs, they will be a formidable competitor.

Blockchain adoption does not mean T+0

There are quite a few blockchain firms whose business model centres on a "T+0" settlement timeframe. The pitch is that it is more efficient than today's T+3 (days to settlement). Their business case misses a few key points. First, the primary reason for multi-day settlement periods is regulatory and legal rules and market practice, which enables a broader participation by retail investors. Second, current technology could deliver T+0 settlement today in a broad range of asset classes if regulatory and legal rules allow for it. You don't need a blockchain to deliver T+0. Third, markets with T+0 today appear to have less liquidity and more volatility than markets with a settlement window. Several reasons, chief among them is that in a T+0 settlement window there is no shorting, which reduces liquidity. We expect settlement windows to shrink due to regulatory and legal changes, but not to T+0. As they shrink, lenders lose some revenues but also free up capital. If blockchain technology can drive down costs too, competition could migrate settlements to T+1. Digital Asset Holdings is building a "T+What You Want" into its blockchain solution, which should also enable users to more explicitly price for the liquidity they want.

"We find that there are some vested interests of custodians, or potentially banks, where actually T plus two or three is quite helpful because they get the carry. Or is the benefit case of resilience and cost-cutting offset the nuisance of the carry. Generally, the reason why there are vested interests who need to, for example, earn the carry is because they're operating a massively expensive infrastructure, without which the business would be completely unsupportable".

"So the carry has to be there in order to justify the cost associated with inefficient process. And there isn't really a custodian in the world that, when you get to the right level of seniority, doesn't understand that problem. So they will give up the carry in a nanosecond if they give up a more than proportionate amount of the costs. And it's as simple as that." – Blythe Masters

Venture capitalists don't like projects that require industry consortia – but banks need partners to share the expense given profitability challenges

"If you came to me and said, 'Are you interested in tech that can solve back-office problems and requires a consortium approach?', I'm not interested in that as an investor." – Matt Harris, Managing Director, Bain Capital Ventures at [DTCC Blockchain Symposium](#), April 2016

We argued in January *"So many Western banks are so focused on "lights on" issues, responding to regulatory issues or simply trying to put off the heavy costs involved. Simply put, the payback on many technology investments is beyond 3 years, whilst given the poor profitability of Western banking, banks have been rationing IT spend not increasing it to keep themselves in the black. As I've argued before, perhaps this more than any other factor explains why many banks in particular have been so slow to respond "* (see [Financials: What I learned at Davos](#)). As a result of this, and some of the other constraints we discuss below, banks will form partnerships to address. See also [The FinTech Challenge: Adapt or Partner](#).



No one blockchain. Expect a plurality of blockchains

When you hear blockchain, think software. A lot of IT experts are probably bristling right now, but to a financial sector analyst, that is what a blockchain delivers. A new software architecture that provides shared, immutable records making processing transactions less error prone. Seems like a logical upgrade. The point is that there is no "one size fits all" blockchain application. We are likely to see different blockchains for different use cases. Developers will be able to leverage consulting and analytics from some blockchain solutions; others may be able to hit their goals through owning a large global use case. We expect most will integrate with existing infrastructure, but some may require a totally new core interface (although those better be large opportunities with lots of cost mutualisation). One similarity for all successful blockchains? They need to not only enable process efficiency, but also organisational efficiency. Financial service companies will only be adopting blockchains if the investment spend to retool delivers hard dollar cost savings within 3 years.

Blockchains do not have to entail a complete transformation of IT, and early trials especially may use some workarounds

Rather, blockchains will need to plug to existing technology. Financials cannot afford to reinvent their financial technology, nor take a massive punt on new technology until proven. Clearly blockchain technology will be simplest in markets that are already fully dematerialised with clear title (why Australia stock exchange, ASX, is a focus) but an even larger win will be dematerialising complex Western markets too.

One industry expert at a recent event (held under Chatham House rules) said that distributed management of digital signatures offered by blockchain technology might be separated from its indelible record keeping mechanisms in near-term capital markets implementations. This would be a form of "cheating" whereby new transactions would be added from a distributed set of nodes, but where the "golden copy" of these data would be maintained in a centralised repository, an example of a workaround for a desired use case; reference data.

Blockchain technology is not centred on payments

Bitcoin may be the most widely recognised instance of the blockchain, but global financials are likely to put a lot of daylight between themselves and Bitcoin. Financial institutions are required to allow regulators to review transactions. Financial institutions have to ensure that all the customers on their platform are reviewed under the know your customer (KYC) and anti-money laundering (AML) guidelines, which a permissionless blockchain like Bitcoin would not allow. That said, there could be some payments mechanisms between trusted, authenticated parties, in particular cross-border, which seems inefficient today.

The 101 of blockchain

What is a blockchain? Software that enables data sharing across a network of individual computers. A blockchain describes computers transferring blocks of records in a chronological chain. Blockchain technology is also known as distributed ledger. The term "distributed ledger" refers to the concept that each user shares the same "ledger" or set of accounts as defined by the software. Blockchain and distributed ledger are used interchangeably.

How does it work? Through shared software infrastructure and trust. Users agree to a software protocol describing the rules for the type, quality, and transferability of data in addition to the rules for authorisation, verification and permutation. Users trust that information entered into and transactions conducted over the blockchain software are valid. Blockchain technology in financial service's best initial use cases, we think, are to solve cluttered processes in the post-trade settlement period where there is a change in title.



Why blockchain?

1. Blockchains can enhance security: Cryptography used to ensure that records can not be changed or altered. 'Tokenisation' can also enable security for each block of data, whether it is resting or transacting. Private keys for each user and product, coupled with encryption for data transfer, improves data security and resiliency. 'Bad guys' self-select out. Users, data and transactions are all encrypted. Transactions permissioned via security 'keys'. In financial services, we do not expect blockchain security to ride off of fully distributed permissionless ledgers which can help police a fully decentralised blockchain system.

2. Blockchains can enable lower costs: A shared, encrypted, transparent database can reduce the teams of people across the ~6 firms responsible for authenticating and approving each specific transaction. The data are irrevocable and auditable. Additional benefits as users can share costs of building and maintaining infrastructure. More efficient than managing individual systems. The potential for a material reduction in costs from current utility-like structures is potentially one of the most compelling reasons to investigate, we think, and is echoed by the C-suite we meet.

"So why is that relevant to this context? Well one way out of that box, there need to be several solutions but one way is to radically restructure your cost base. And we're not talking five, ten, 15% cuts in costs we're talking 30/40/50% and there's only one way to do that and that is to share a mutualised common infrastructure that previously was kept separately and run independently by every market participant." – Blythe Masters

3. Blockchains increase speed: Transactions are more streamlined as a buyer's and seller's account update simultaneously when a transaction is authorised. Fewer mistakes as buyers authorisations are transparent to not only the transacting parties, but also any related parties including lawyers, controllers, accountants, etc. Fewer mistakes means less capital tied up in disputed trades and more capital for new trades improving velocity of capital.

4. Blockchains enable greater visibility: Transactions can be monitored in real-time. Users can see transactions completed, important if sequencing matters (as in trade finance). This could be as valuable for regulators of banks.

"You get some cyber security benefits and improved regulatory transparency because one of the benefits of this technology is one of those credentialed parties that can get access to this information can include regulators." – Blythe Masters

5. Dispute resolution management: Each step of the transaction approved. If there is a dispute, both parties have a digital record showing who authorised approval for transaction. Should enable swifter dispute resolution.

6. Potential for fraud reduction if permissioned blockchains: Valid users onboard. The multi-node architecture makes it harder for corruption to go unnoticed. We assume the financial institutions use permissioned blockchains, not the anarchic plurality of peer invigilation or the like. One clear difference between some VCs and tech folk we meet, and the use case in financial services, is we have yet to meet a single banker who values the anonymity or decentralised system. After all, we estimate, over \$250 bn of fines for the top 25 US and European banks we cover. See [Investor Roadmap – how are banks responding post ~\\$260bn litigation?](#)



10 key hurdles to surmount to make blockchain implementation a reality

Let's be clear, whenever we meet C-suite of financial institutions, we see the hurdles and limitation of blockchain technology. That's not to say they are insurmountable – but to take a view of quite how disruptive blockchain technology could be and how long it could take to be realised, you need to understand the hurdles and roadblocks. This is not to say any of the below are not solvable, but none is trivial and suggests to us we are not talking 2017 or 2018 impact on bank, custodian or market infrastructure profits, in our view. Rather materially beyond this.

"It is a series of challenges and questions that you have to answer appropriately but it is not a showstopper." – Blythe Masters

Exhibit 3: Framing the hurdles to adopting blockchain

Key Hurdles		Economics	Technology	Cooperation	Policy
Use case cost / benefit		✓			
Cost Mutualization		✓		✓	
Aligning incentives		✓		✓	
Evolving to right standard			✓	✓	
Scalability /Performance		✓	✓		
Governance				✓	✓
Regulation					✓
Legal risks				✓	✓
Security			✓	✓	✓
Simplicity		✓	✓	✓	✓

Source: Morgan Stanley Research

1. Use case cost benefit – does the benefit of a given use case justify the investment?

We regularly see banks that could move to real time systems but have put this off given expense and risk. Many also cite that it took CBA (Commonwealth Bank of Australia), a well run bank, five years to install a new system. So are these "use cases" large enough to support the incremental spend? Would they be better serviced on current platforms rather than using a distributed ledger?



2. Cost mutualisation: Who funds the cost of building new infrastructure?

Banks will need to share infrastructure build-out costs equitably if new systems are to be truly inter-operable industry utilities. This is potentially subject to organisational disputes as users assess how much to invest (which can enable free or freer riders), or customise (which degrades interoperability/speed) and by which measure to allocate costs among participants (by revenues? market share?). The alternative is a third-party building out industry infrastructure standard to specifications of major users (e.g. via industry consortiums such as R3, details in grey box below). Many banks are dedicating the most of their IT spend to upgrading and overhauling legacy systems and with profitability already under pressure finding budget for blockchain projects may prove challenging (although in some parts of the world these pressures are less, e.g. Australia).

3. Disparate incentives of companies in the financial value chain

Inevitably there are winners and losers. So far much of the action has been from VC backed companies, but within the larger financials it's the custodians that have been most active for offensive and defensive reasons. For example the banks involved in the Linux Hyperledger Project (see grey box below) are predominantly custodians.

"Many financial institutions are experimenting in private with a technology that uses consensus protocols to provide transparency. This mirrors the history of financial innovation beyond the few points in time where an industry mandate or regulation forced the industry to cooperate. The current path will result in a new jumbled, disconnected maze of distributed ledger silos. The industry should seize the emergence of this technology as an opportunity to assess how to modernise and significantly lower risk and cost."

– DTCC White Paper, Embracing Disruption – Tapping the Potential of Distributed Ledgers to Improve the Post-trade Landscape, 25 January 2016

4. Evolving to the right standard

Avoiding picking Betamax over VHS! Clearly this is work in progress, which is why consortia are debating hard how best to do it.

5. Managing network effects to maintain scalability

Scalability has limits, including across network bandwidth, storage and even processing power. In some implementations of blockchain, including Bitcoin, scalability challenges have already become evident, or at least well anticipated. For blockchain to move forward, it needs to offer a more efficient, scalable solution over current infrastructure.

Scale limits tend to emerge in a variety of circumstances, including:

- When the full blockchain ledger is intended to fully distributed to all participant nodes;
- Multiple nodes must agree in order for a transaction to be executed;
- All nodes are required to have coincident access to the ledger and transactions; and
- The blocks are too small to allow for high velocity or frequent transactions, causing transaction recording to overflow the block size.

Not controlling the above elements, among others, creates a network effect that can cause the compute, storage and network requirements to approach hyperbolic geometric growth. The implications for just power consumption have been studied with startling results: one study suggests that to encrypt all permutations for the 100 million individuals in Germany and the spectrum of bank products used in that country would cost more energy annually than that produced by the country as a whole. Separately, the UK Government Office For



Science, *Report on Distributed Ledger Technology: Beyond Block Chain*, estimated "that the energy requirements to run Bitcoin are in excess of 1GW and may be comparable to the electricity usage of Ireland".

While Moore's Law and specialised silicon development may help reduce power consumption marginally, we are seeing various iterations of the blockchain concept emerging that better limit network effect and its impact on hardware requirements. Generally speaking, most new blockchain proposals are looking at a range of mitigating characteristics, including:

- Limiting participant nodes (permissioned networks);
- Centralising all or part of the blockchain ledger;
- Paring the blockchain ledger under certain circumstances;
- Making block sizes and their analysis more variable and
- Incorporating data analytics and probabilities into the verification process, etc.

6. Governance

Many of the issues raised by banks and market infrastructure are not technology but process and governance related. For example, who would be in charge of maintaining and managing the blockchain? Who admits new participants to the blockchain (with the corresponding duty to run KYC/AML checks) in a permissioned system? Who validates any given transaction and who determines who sees which transactions?

"On the other hand, the ability to process transactions directly between parties without the need for the trusted central utilities that currently serve the function of reducing counterparty risk poses a risk to traditional banking." – UBS White Paper for the World Economic Forum Annual Meeting 2016, January 2016

7. Regulation

There are numerous policy issues that crop up when we meet banks and policy. Digital identity, cross border standards and integrity of systems are nearly always head the lists. Regulation is also critical in driving to a fully dematerialised environment for securities trading. Arcane physical certificates need to be digitised to fully benefit from the speed and fraud control offered by a fully digitised system.

"Can you use this technology to mutualise the infrastructure for identity management and KYC for financial services purposes boils down to a very simple question. And that is: Will the regulators let you? Because in essence what you need to be confident of is that, if you're going to rely on a shared service, and the shared service gets it wrong, are you all collectively going to be held individually responsible for it having got it wrong? And is it therefore safer or more responsible for you to have independently gone and gathered the same information to prove that you were trying extra especially hard instead of irresponsibly relying on this shared service?" – Blythe Masters

8. Legal risks, especially KYC and AML

In particular, not one bank we have met wishes a disaggregated, open source model for identity. Banks and policymakers need close control for KYC and AML issues. Finding a single digital identity passport authoriser will be key. That is why we see most progress in those markets with a relatively small number of players to work together. It is partly why payments are far tougher than post-trade loan settlement initiatives. How these initiatives work across borders is equally a large issue to resolve.



"It is absolutely the case that the initial regulatory reaction to anonymous making of payments over the internet was extremely negative for reasons of the obvious risk to anti-money laundering controls, sanctions avoidance, promoting criminal activity a long, long list of concerns. And that remains valid... And not to mention consumer protection concerns. That remains a valid set of concerns but it's a small subset of the concerns and the deploying of this technology in wholesale financial infrastructure provision is a much more nuanced topic. Set up a private permission network using the same technology but where the access to participants is permissioned. You can't play if you aren't previously credentialed on board and identified and where the incentives for maintaining the resiliency of the network are not the pursuit of financial gain by mining Bitcoins but rather the incentive is to participate in a network that is resilient and works and you use to run your business, which, by the way, all of you already do, as many of you operate data centres and benefit from networks that have to work to run your business." – Blythe Masters

"Conduct issues, particularly those relating to know your customer (KYC) and anti-money laundering (AML), would also have to be addressed by such firms [offering digital currency services]. Further research would also be required into how digital identity management could be achieved while balancing privacy considerations." – Bank of England, Open Bank Research Agenda, 25 February 2015

9. Cryptography/security

Resilience to any security attack, especially state sponsored terrorism and bugging, is critical. We work on the assumption that financial markets are going to be hacked intensely – and the issue is one navigating the risks as best one can. We are encouraged by the success of the established payment networks, which have made effective use of both improved authentication technologies (EMV), as well as seemingly effective behavioral and historical analytics to keep fraud rates low. In most parts of the world, fraud rates have been kept flat to down during the past 5 years, while they have only risen by about 4-5bps in the US (where EMV is not yet fully utilised). At the same time there doesn't seem to have been upward pressure on interchange rates, which are largely intended to help issuing banks cover their costs of fraud.

"Further research would also be required to devise a system which could utilise distributed ledger technology without compromising a central bank's ability to control its currency and secure the system against systemic attack." – Bank of England, Open Bank Research Agenda, 25 February 2015

10. Simplicity

Any killer app in software has to deliver simplicity. This goes for blockchain solutions too. Uncomplicated and easy to understand. It needs to interface with other parts of the tech foodchain seamlessly, enabling faster set-up time, training time and fixing time. It must deliver on the promise of efficiency and be easy enough for all parties to understand and leverage.

"I didn't have time to write a short letter, so I wrote a long one instead." – Mark Twain



Key projects

R3 Blockchain Consortium

In their own words: *"R3 is a financial innovation firm that leads a consortium partnership with over 40 of the world's leading banks, to design and deliver advanced distributed ledger technologies to global financial markets. We collaborate with our partner banks on research, experimentation, design and engineering to bring the ultimate users of this technology into the design and production process from the outset."*

Who's involved? Banco Santander, Bank of America, Barclays, BBVA, BMO Financial Group, BNP Paribas, BNY Mellon, CIBC, Commonwealth Bank of Australia, Citi, Commerzbank, Credit Suisse, Danske Bank, Deutsche Bank, J.P. Morgan, Goldman Sachs, HSBC, ING Bank, Intesa Sanpaolo, Macquarie Bank, Mitsubishi UFJ Financial Group, Mizuho Financial Group, Morgan Stanley, National Australia Bank, Natixis, Nomura, Nordea, Northern Trust, OP Financial Group, Scotiabank, State Street, Sumitomo Mitsui Banking Corporation, Royal Bank of Canada, Royal Bank of Scotland, SEB, Societe Generale, Toronto-Dominion Bank, UBS, UniCredit, U.S. Bancorp, Wells Fargo, Westpac Banking Corporation. R3 is in a Partnership with Microsoft.

The Hyperledger Project

In their own words: *"The Hyperledger Project is a collaborative effort created to advance blockchain technology by identifying and addressing important features for a cross-industry open standard for distributed ledgers that can transform the way business transactions are conducted globally. The Project is a Linux Foundation Collaborative Project and implements many open source best practices familiar to other leading projects."*

Who's involved?

Banks: JP Morgan, ABN AMRO, ANZ, BNY Mellon, State Street, Wells Fargo

Exchanges: CME Group, Deutsche Borse Group

Post-trade: DTCC, CLS

Others: Accenture, CISCO, Digital Asset Holdings, R3, Blockchain, Blockstream, bloq, Calastone, Consensus, Credits, evue, Fujitsu, Gem, guardtime, Hitachi, IBM, Intel, intellect, itBit, Milligan Partners, Montran, NECm, NTT Data, Red Hat Ribbit, Thomson Reuters, VMWare

There are also numerous other bank initiatives. For example UBS, Santander and Barclays all have internal incubators working on blockchain solutions.



So just how disruptive for financial institutions? Our tentative conclusions

At the heart of our interest is this: will distributed ledger help or hinder financial institutions?

- The bullish case is that sharing and decluttering of infrastructure could radically reduce costs and provide much needed boost to RoEs. Let's be clear, for many banks, especially investment banks in 2016, a radical reduction and simplification in processing costs would be a blessing. We showed in our recent [Blue Paper](#) with Oliver Wyman that banks will need not just to prune but also to change their model to sweeten their RoEs 2-3% to hit hurdle rates. According to Santander, more efficient digital ledgers could cut costs in the banking industry by up to \$20 billion a year.
- The bearish case is that dramatic reduction in margins at the same time as higher IT spend is destabilising and disruptive. It also risks profit pools leaking to other players.

Our tentative conclusions

- *As with any early-stage, highly complex technology that demonstrates the ability to change conduct business, we think it is too early stage to make any profound comments about winners and losers or breadth of adoption.*
- *We think 5-10 years off for widespread adoption and not material to 2017/18 earnings of any financial we cover. Rather as we show in our roadmap, expect proof of concept tests in 2017-18.*
- *Rather, shared utilities (for KYC, securities processing and the like) are likely to have a bigger impact on bank earnings in 2017-19 than blockchain implementation.*
- *We buy into the concept that distributed ledger has the potential to help reduce the costs of post-trade activities dramatically. Studies range from \$15bn to \$20bn (BCG, Santander Infoventures June 2015) at this stage.*
- *Best use cases in financial services strike us as post-trade – especially for loans, CDS and securities more broadly. Payments much further off, although we keep a close watch on Ripple and its cross-border payment offerings which look to bridge faster domestic payment systems between countries.*
- *Watch two experiments closely: first, the dematerialised and simpler markets such as Australia and Singapore first for broad market initiatives; second, a cumbersome process where cost savings could be large (such as bank loan settlement) for signs of progress.*
- *For custodians such as BNY Mellon, State Street, Northern Trust, Citi, JPM, which generate profits from ensuring securities are accurately measured and moved and which benefit from the carry from T+2/3, blockchain technology threatens their value add and shorter settlement periods could cut into revenues more than they could free up capital for buybacks – but that's why the custodians are at the leading edge of distributed ledger work to ensure that they can deliver the most efficient blockchain solutions to their clients.*
- *It may not be quite as radical as some hope. Expect workarounds for the near-term trials.*

We will be revisiting the blockchain theme periodically and refreshing and expanding the views in this note over the coming quarters and years.



A conversation with Blythe Masters

Blythe Masters, CEO of Digital Asset Holdings

Prior to joining DAH, Blythe spent 27 years at JP Morgan Chase and rose to Managing Director at the age of 28. She served in numerous senior positions at the firm including Head of Global Commodities, CFO of JP Morgan Investment Bank, Head of Global Credit Portfolio and Credit Policy and Strategy, in addition to other senior roles. She was on the board of SIFMA for multiple years in addition to chairing the association for two consecutive years. Additionally, she was Chair of GFMA from 2012 to 2014. Blythe is on the board of The Breast Cancer Research Foundation and the Global Fund for Women. She is also the Chair of the Board of Santander Consumer USA Holdings Inc.

Huw van Steenis, Morgan Stanley

Huw is a Managing Director at Morgan Stanley. He sits on the World Economic Forum's Agenda Council on Banking and their Working Group on Disruptive Innovation in Financial Services as well as the European Central Banks's Macro-Prudential and Financial Stability Contact Group. He is a Fellow of the Royal Society of Arts and Board member of English National Opera.

The following is a summary of Huw's conversation with Blythe Masters at the Morgan Stanley European Financials Conference on March 16, 2016. Questions and answers have been condensed for clarification purposes. You may contact Morgan Stanley Research for further clarification. Please note that Blythe Masters is not a member of Morgan Stanley's Research department. Unless otherwise indicated, her views are her own and may differ from the views of the Morgan Stanley Research department and from the views of others within Morgan Stanley. We make no claim that Blythe Masters' representations are accurate or complete.

Huw van Steenis: Good afternoon. Morgan Stanley is absolutely thrilled that Blythe Masters has flown in especially to meet with us and share her enthusiasm for blockchain and the opportunity it presents for the financial system. Blythe Masters is CEO of Digital Asset Management, a company that builds, distributes encrypted, straight through processing tools to improve efficiency, security and compliance and settlement speed. Blythe previously, as many of you know, was a leading member of JP Morgan, with a long and distinguished career, successfully running the commodities business before selling it. Really, today, Blythe, I'm delighted you've come along. Where we want to start is: what inspired you to make the switch to start up your Digital Asset?

Blythe Masters: I left JP Morgan at a natural point, having sold a business for them, and was planning on minding my own business for at least a year, doing a few things that I hadn't done for the preceding awfully long time, and I became, during the course of that what turned out to be four months of the year, exposed to the concept of blockchain, through this little company called Digital Asset. Every now and again, in a long career, you come across an idea that is a real 'ah-ha' kind of idea, where a couple of things fall into place and you think, wow, actually, that has real implications.

And as I thought things through, with the benefit of having the better part of three decades of experience in financial services, having worked in and around market infrastructures, having run global trading businesses... I was CFO of the investment bank for a while, I operated in the risk organisation, and I had the joy of helping JP Morgan and others navigate the post-financial-crisis re-regulation process, Dodd-Frank and the corresponding changes in Europe and the rest of the world, so a good sense of financial regulation. And here was this idea that had implications for the core ... the way that industry operated, largely for the better and, in my opinion, arriving at a time where the need was great.



And you don't come across ideas of that magnitude very often, even once in a career, especially not at a time where you really have nothing better to do. So that got me off the horse and back onto the... desk, and I decided to join this little start-up. I was employee number four. For full disclosure, it wasn't my idea, the company, I didn't create it. It existed and I was hired to run it. And that was almost exactly a year ago to the day, and we can talk about what's happened since, but it's been a lot.

Huw van Steenis: Before we dig into that, why do you think distributed ledger is such a breakthrough technology?

Blythe Masters: Okay, so, to answer the question, I'm going to have to explain what distributed ledger is, so brace yourselves. And let's see if we can do this without causing consternation. So, I think the best thing to do, first of all, is to ask all of you to suspend everything you've heard or read about Bitcoin or crypto-currencies and all of the associated noise, connection with criminal activity and other undesirable aspects, and just put those thoughts away for a minute – and we'll come back to why there is a connection and why it's interesting – but instead, focus on the fact that underlying the invention of alternative currencies, crypto-currencies, was the creation of a technology, and that technology actually enables all sorts of things, of which just one use case is crypto-currencies.

And that technology, which is known universally as blockchain technology, or perhaps more generically as distributed ledger technology, is where all the interest and the focus is, at least by wholesale, regulated financial institutions ... It is actually a really pretty simple concept, and if you know what a database is, then you're in the right sort of territory. And you all know what a database is. Because, in fact, blockchain technology – although when you get into the technology itself, there is some complexity there and some ingeniousness – is nothing more than a new form of database ... approach to database architecture, that is. Fundamentally, an improvement over the way that, traditionally, databases have been designed and used in the past.

So, what's a database? You know, it's a place where we store important information that we want to refer back to for various purposes, at some point in the future. Visually, you can imagine it as a cylindrical thing. It's owned by someone, it's administered by someone, it typically exists in a physical location. The administrator of the database is very interested in investing and ensuring that the perimeter security to that cylinder that protects the contents is strong, impenetrable. The lucky ones are the ones that know that it turned out that penetration happened, and then there's the rest of us who just don't know yet.

And, typically, the information that's kept in databases is raw information, not encrypted, not further protected other than the perimeter security which, increasingly proves to be penetrable. So when someone gets in there, that isn't authorised to do that, the consequences can be dire, whether it's the theft of someone's identity for theft of funds or what have you, you read about this every day. So that's traditional database architecture, and pretty much everybody keeps databases because they have important information about their activity, their client's activity, that they need to keep a record of, and as a matter of fulfilling their fiduciary responsibilities, they need to keep that record.

Interaction between entities who keep their own separate databases requires a process of taking information from that database, sending it off to another party, for whatever the relevant purpose is, independently validating, verifying and then, of course, when the two sets of information aren't consistent, reconciling the reasons for the differences. And, simply put, that reconciliation process between different renditions of the same data that needs to be communicated between parties accounts for tens of billions of dollars of cost every year, in the financial manufacturing process.

So that's the way things have traditionally worked in financial database architecture for years, and along comes a new technology, this is blockchain technology or distributed ledger technology, which makes a few fundamental changes to what I just described. The first thing is that instead of this cylinder in one place, you have a network with multiple nodes, and you have a technology which enables the multiple nodes in that network to be accessed by those with a need and right to know it, and for ensuring that the data, the important information that we're all referring back to, can be kept in sync and replicated continuously, on a real-time, or as near as need to real-time basis, between parties.



And protecting all of this is the fact that the data itself is encrypted, and the identity of the users or those who have the right, need and right, to access that information, is subject to a sophisticated identity management regime involving, again, cryptographic tools, so that it is very possible to independently verify whether or not an actor is who they say they are and has the right to access that information. And, simply put, what that allows you to do, for the first time, is responsibly share, mutualise, common infrastructure and use this database environment as a place to keep a record of important transactional information that is one record, a golden or prime record, that can be shared by multiple, independent entities, that is protected through cryptography, so that only those with a need and right to know, only the piece of information in that environment that they have the need and right to know, can do that.

And this creates the opportunity to cut out layers and layers of non-value added post-trade reconciliation activity whereby parties who keep their own records of the same information have to ensure it's consistent with other parties to the same information. Where of course because it's kept separately and in different infrastructures there are discrepancies. And it's as simple as that. It's a shared database infrastructure in a cryptographically secure environment which means different entities, independent competing entities can now share the same infrastructure with enormous implications for efficiency and actually cyber security and other things because of the cryptographic security that's introduced.

Not a lot of sex appeal in that. It's amazing it's as hot as it is. And the reason why ... the fact that this technology was first used to invent crypto-currencies which were designed to facilitate essentially anonymous payments of money or value between unknown actors over the internet, which immediately raises flags about who are they, why are they doing it and how do we stop it; perfectly legitimate concerns on the part of regulators and regulated entities.

In fact that's just one subset of how you can use this technology. Others involve post-trade processing of much more mundane things like securities, other financial assets. And this is coming at a time where as you all know, the industry is a little challenged. It's challenged from a performance point of view. You want to boil it down to one metric: it's an ROE problem. ROE as you know has, sort of, three inputs depending on how you want to express it, but its revenue minus expenses divided by capital.

And revenue is down and has been compressed for a while, no more proprietary trading, no more principal investing, low interest rates, low credit spreads. Costs are high and rising. Compliance with new regulation, etc and regulatory capital has gone in one direction more than proportionately since 2008 with the result that ROE is a challenge. And if you're consistently making returns on your capital that is below your long-run cost of capital, that becomes an existential problem for financial services providers.

So why is that relevant to this context? Well, one way out of that box, there need to be several solutions but one way is to radically restructure your cost base. And we're not talking five, ten, 15% cuts in costs; we're talking 30/40/50%, and there's only one way to do that and that is to share a mutualised common infrastructure that previously was kept separately and run independently by every market participant.

So there's a great need right now. Added to that you get some cyber security benefits and improved regulatory transparency because one of the benefits of this technology is one of those credentialed parties that can get access to this information can include regulators. So post-trade transaction reporting becomes a thing of the past because they get to look directly into the transactions of record. And interconnectedness between parties is reduced because if one of those points in your network of nodes fails, guess what, all of the other points in the network of nodes is still there and has the same information. So single point of failure due to operational or cyber-attack is significantly mitigated.

So there is a lot of benefit associated with this technology that are of interest at a time of great need and it's of interest to both regulators and regulated parties. And in short, I woke up one morning in bed, like that was the 'ah-ah' moment that I had when I finally came to realise what the potential implications of the technology were once I'd managed to get over my scepticism at what Bitcoin was all about and realised that there was a lot more to it.



Huw van Steenis: You make a very powerful case for the benefits and I was chatting to the CEO of UBS this morning on this stage and he was saying the same, that blockchain, and fundamentally rethinking the model, is at the heart of how financials will have to reinvent themselves. So let's start with how are we going to make it happen? As an entrepreneur now you're actually making it happen, what are the problems you need to solve? What are the issues you are already biting into?

Blythe Masters: So there's a good list of them and it wouldn't really be entrepreneurial if it was easy. So in no particular order but obviously a major one certainly at the stage where I took this job a year ago was widespread scepticism. I spent the first two months of doing this job persuading friends and otherwise who all thought that I'd lost the plot again and had gone off to start trading Bitcoin for a living, so that took a bit of explanation. And there really was an issue where for the first several years after the invention of this technology it was being promoted by a group of advocates and in some cases inventors who took a pretty dim view of the financial services sector.

In fact you were thought to be at best inefficient, profit hungry but at worst evil intermediaries exploiting the rest of the world who had proven their collective unworthiness as a result of the effects of the financial crisis which, I mean, not to belittle the effects of the financial crisis but the notion that the entire financial services industry adds no social economic value is obviously probably not the conclusion to draw from the lessons of those events. But there was this community that felt very much that that was the case so let's invent an infrastructure that allows us to bypass all forms of financial intermediary.

And while we're at, it bypass the government, central banks and any form of adult supervision and that's a better way to run financial services. So that was the story behind Bitcoin or the application of this technology to alternative currencies. That didn't really play too well to either financial regulators or the regulated community so they focused on that and didn't initially understand or appreciate the potential application of the technology as distinct from that particular use case.

So the first challenge was just that, education, and I think getting a few people like myself who speak the language of financial services, who've been there, done that and understand that there is actually some value added going on. And understand that why, not just that the regulation exists but why it exists and what purpose it serves who can translate the positive attributes to this technology into financial speak. And that was a pretty big body of work. I certainly wouldn't ascribe all of that having been down to myself, but myself and a number of others, other companies, other individuals, UBS and Oliver Bussmann who is their CIO has been a great advocate, and there have been many others.

So that was number one and I think to be honest at this stage we're past that point. There isn't really a major financial institution, either bank or infrastructure provider that isn't deeply involved in exploring in some cases beginning to commercialise this technology today. The second issue that comes up inevitably is regulation. Now as all of you know because you're in the industry, there is not just one regulatory framework that you need to worry about in this context there are many, many of them. There is the regulation of payments and consumer protection, prudential regulation of financial institutions, regulation of markets and market infrastructure and their resiliency and the rules of the game; many, many dimensions to this.

It is absolutely the case that the initial regulatory reaction to anonymous making of payments over the internet was extremely negative for reasons of the obvious risk to anti-money laundering controls, sanctions avoidance, promoting criminal activity... a long, long list of concerns. And not to mention consumer protection concerns. That remains a valid set of concerns but it's a small subset of the concerns and the deploying of this technology in wholesale financial infrastructure provision is a much more nuanced topic.

And much like the market participants, the initially deeply sceptical regulators themselves have come a long way over the past year and see some of the potential benefits. And the potential benefits here, actually regulators have a high degree of existing authority to ensure are delivered and to prevent if they are not delivered. So as you know, if you have the pleasure of operating a sensitive market infrastructure today you are subject to a considerable degree of regulation and you have to demonstrate things like resiliency and privacy and compliance with law and KYC and auditability and reversibility and one could go on for hours.



So it turns out that if you want to introduce a new technology, a new database infrastructure that has some benefits, you have to be able to answer all of those questions satisfactorily and if you don't, it's go back to square one and hopefully don't pass jail along the way. So, having said that, all of those questions can and with the right design choices, are answerable, you just have to tweak some of the original assumptions about blockchain. For example, the public Bitcoin blockchain was invented to facilitate activity between anyone and everyone and you had no ability to know who, therefore, you were dealing with, nor who was actually providing the resiliency of the networks, of processing the transactions.

So, okay, that clearly is not going to work for financial regulated assumptions so change that assumption, so set up a private permission network using the same technology but where the access to participants is permissioned. You can't play if you aren't previously credentialed on board and identified and where the incentives for maintaining the resiliency of the network are not the pursuit of financial gain by mining Bitcoins but rather the incentive is to participate in a network that is resilient and works and you use to run your business, which, by the way, all of you already do, as many of you operate data centres and benefit from networks that have to work to run your business.

This is not new. It's just a new technology implementation for an old-fashioned concept. So when you go have that kind of conversation with a regulator and you've tweaked these concerning features of the original implementation of blockchain, it becomes a much less scary conversation. And there has been tremendous progress made with regulators all over the world. There are a number of them, who are now actively speaking in the public domain about their enthusiasm for this approach, if done right, including, in Australia, the ASIC, who are the securities regulator there, who regulate the Australian Stock Exchange, ASX, with whom we're working on one of the earliest deployments of this technology 'in the wild', if you will. So regulation always comes up as an issue but actually, speaking as someone who knows deeply the regulatory requirements and the biases and preferences and objectives of regulators, I don't see that as a fundamental impediment. It's a series of challenges and questions that you have to answer appropriately, but it is not a showstopper.

The last thing that always comes up is the network effect. Many of you operate big companies with many departments, different geographical locations, that keep their own records of things separately and tackling that internally to the organisation – using this infrastructure is one benefit but the big benefits come when you're talking about facilitating Goldman and JP Morgan and UBS and others, interacting with a stock market, call it the ASX, and a settlement and clearing system in the CSD in the case of the ASX, having multiple parties leverage the same common infrastructure and that, obviously, requires mutual decision making or a coalition of agreement of direction.

The good news is, referring back to my earlier comments, the need and the incentives to do this are enormous and fundamentally different than they were five or ten years ago, when people used to treat this space as either irrelevant because it was just the back-office stuff and [banks] were making enough money to cover the cost or, in some cases, it was felt to be proprietary. Not many people have that view any longer. Most people would love to see the back of it all – but in any case, the incentive to collaborate has changed.

And where you can find central point of decision making, so where there is an existing central market infrastructure, as there happens to be in Australia and many other places around the world. Let's talk about Australia for a minute – very interesting market. Fully dematerialised stock market so none of this nonsense with physical stock certificates that have to be kept in vaults and boxes anywhere. So, mentally, the leap has already been taken towards having purely electronic records of ownership. Some competition in the exchange space, but a government mandated, essentially, monopoly in the provision of the CSD Essential Securities Depository, which is the ledger of record and the settlement and clearing system for the whole market. And one provider of infrastructure to all of that, even though multiple entities, all the banks, brokers, custodians, etc, plug into that; it's administrative, essentially.

It also happens to be 30 years old and nearing the end of its useful life. It's got to go, one way or the other. It's not about to break, by the way. I don't want to create alarm in the Australian markets here but it has to be upgraded. It's going to be changed and therein lies the ingredients for adoption, early in a very interesting space. Sizeable market but not gigantic, not nearly as fragmented as many of the other markets around the world, multiple interested parties with the line interest, the need to replace it anyway and conditions on the



ground where economies of scale can be maintained and extracted here because you're replacing completely one infrastructure with the new infrastructure instead of having the old infrastructure hang around in whole or in part. So you'll see that the early adoptions happen where you find those ingredients, if you will; and they exist.

Huw van Steenis: Let's pursue that a bit and we'll come back to some of the obstacles in a moment. What is Digital Asset hoping to achieve? And why Australia?

Blythe Masters: We're focused on reforming post-trade. As you know, there's been an arms race in pre-trade infrastructure for more than a decade now and if you think about it, it should be ironic to all of you that trading infrastructure has evolved to the point that competitive advantages is measured in fractions of nanoseconds and yet we're still dealing with T plus two, three or worse, depending on your asset class. Eight years on after the financial crisis, that is a pretty shocking statement. And, you know, one of the reasons why post-trade infrastructure is monolithic: there hasn't been an incentive really to speed it up, it's very expensive to replace because it's clunky and processing enormous volumes of activity and taking the wheels of anything that's moving fast is always, it's always a challenge. It's heavily regulated, etc, etc, etc.

So the opportunity, in terms of the enormous inefficiencies, the slowness, the potential lack of resiliency, lies more in the post-trades base than the pre-trades base and when you think about post-trade, let me give you an example of a simple transaction involving you and me finding each other in a stock market and trading a stock. Now, you and I, as individuals, have no idea who the other is. We probably each have a broker and they may be a small broker, our friend; probably aggregates up to a larger broker. There's a clearing member somewhere there that provides clearing services. There may be an affiliated or even unaffiliated bank providing leverage into your account, not mine and much more. Prudent, in that I don't use leverage.

There is the clearing house itself that cares because our transaction that we agreed to has to be admitted for clearing and then, way up the top of the hierarchy, there's probably a custodian somewhere. One of these brokers is using a third-party custodian and then there's the CSD, the ultimate ledger keeper of record. And that's just you and me doing one trade, that's assuming we will get it right. That's a lot of parties, whose agreements are needed to, essentially, credentialise or authorise a transaction so that what you and I agree via the stock market price discovery venue can ultimately flow through to final settlement, legal final settlement, the exchange of the stock from your account to my account. And by the way, along the way, very interesting netting algorithms are going on, adding up what you and I are doing, along with other people's activity to, hopefully, minimise some of the operational consequences of all of this. Now, think about that for a minute. If you go back to my original description of how databases are used, every one of the parties in that simple cash equity transaction that I just listed off is, essentially, a party with a need and right to know about our deal and who has a role in authenticating it before it can be completed.

It is the process of the gathering of those acknowledgements, authorisations as necessary and keeping them all together and all referring to the original record of the transaction that there only be one record of the transaction. So my broker and your broker and the broker's broker and the clearing broker and the agent and the custodial entity and the bank and the clearing entity and the CSD don't all keep their own separate record of this ridiculous little trade that we did. They all share the same record.

And that inherently is a post-trade benefit, because we've found each other with no impediments. In an efficient market we've probably got a good price, and there wasn't really any need to change that process. But it's all the stuff that comes afterwards that really is low-hanging fruit. In essence that's what we're building for ASX: a tool to allow those related parties' authentications to be gathered at the point of transaction, not one or two days after the fact.

Huw van Steenis: Just out of curiosity, in Australia we're finding that there are some vested interests of custodians, or potentially banks, where actually T plus two or three is quite helpful because they get the carry. Or actually is the benefit case of resilience and cost-cutting. Offsetting the nuisance of the carry.

Blythe Masters: Well, it helps to have been in one of those organisations to understand that, but generally, the reason why there are vested interests who need to, for example, earn the carry, is because they're operating a massively expensive infrastructure, without which the business would be completely unupportable. So the



carry has to be there in order to justify the cost associated with inefficient process. And there isn't really a custodian in the world that, when you get to the right level of seniority, doesn't understand that problem. So they will give up the carry in a nanosecond if they give up a more than proportionate amount of the costs. And it's as simple as that.

Huw van Steenis: Yes. That makes sense. When I was on a panel recently with the WEF ... we were talking about some central bankers, entrepreneurs and banks about the use case, and the one issue which they stumbled on is around having a single authentication agent. Because the banks that Betsy and I cover have had a quarter of a trillion of fines in six years. And not even just French bank one, or UK bank one, or US bank one have different KYC rules. Even US bank A, B, C have got different rules. How do you solve that problem so actually they feel there's a single passporting authority which can be trusted and mutual recognition?

Blythe Masters: There are two parts to the answer. Number one, you just assume you don't solve the problem and build systems that have to comply with the existing smörgåsbord of highly differentiated and do it yourself KYC requirements. So for example, where any entity brings itself or its customer into the network, the permission network, they have to do the same exact KYC that they would do today, one way or the other, and technologically the way to evidence that is you refer to the KYC database to check that authorisation is present and otherwise the transaction is invalid and so on and so forth. So obviously that's a perpetuation of the messy status quo.

But that is the bare minimum requirement. So the first question you'll ever get out of a regulator is: You weren't thinking about not doing KYC or anything silly like that were you? No. Okay. No, we definitely weren't. So use the existing KYC infrastructure. Now, you can also use, in theory, this exact same technology for the purpose, amongst other things, of identity management. So the technology I've described, the use cases I've described, have been about keeping records of asset ownership and transferring asset ownership and gathering the signatures or the authentications needed to do that. But there are other important things that we need to keep track of in life. Like proof that you are who you say you are, either individually or corporately.

And you'll find that if you go read about distributed ledger or blockchain technology, there are plenty of applications that are being pursued, inside and outside financial services, relating to identity management. My particular favourite is healthcare records. How absurd is it that you cannot walk into a point of service venue, doctor, hospital, stick your fingerprint on a biometric reader and have your history right there for you? Well, this is a technology that eventually could enable that. A few other changes need to happen too. And you're closer to it in the UK than America ever will be.

But coming back to your question, the issue of "can you use this technology to mutualise the infrastructure for identity management and KYC for financial services purposes" boils down to a very simple question. And that is: Will the regulators let you? Because in essence what you need to be confident of is that if you're going to rely on a shared service, and the shared service gets it wrong, are you all collectively going to be held individually responsible for it having got it wrong? And is it therefore safer or more responsible for you to have independently gone and gathered the same information to prove that you were trying extra especially hard instead of irresponsibly relying on this shared service?

And that over-simplifies the question, because there are some jurisdictions where there is some ongoing discussion about the government playing a role in managing centrally ... Central identity management venues, which of course if the government is administrating it and you rely on it, it seems a little bit more reasonable for you to rely on it than otherwise. So as a technology matter there absolutely is the opportunity to improve the KYC process, because inherently there is so much duplication in that with people doing the same thing.

Not just JP Morgan doing the same thing as UBS has to do, but even within JP Morgan, different departments in JP Morgan doing the same thing multiple times, typically for different product applications. So there really are benefits there, but it boils down to: what does the law impose on you as an institution, and what would be deemed acceptable meeting of your obligations in that respect? And there are different regulators around at different stages with different degrees of opportunity around the world who have a different orientation towards that.



In Singapore, there is a government-funded project from one of the development agencies that is explicitly looking at use of this technology for precisely this purpose, for the Singapore markets. So the government is actually working with the banks, and potentially non-banks, to run a POC on just this. A proof of concept on exactly this. I found that incredibly encouraging.

Huw van Steenis: Fantastic. We had Jeff Gooch, CFO of Markit, here yesterday. Markit, Reuters and TTCC are all trying to do KYC utilities. They are making progress, but the US is proving to be the toughest market, and that's sadly the biggest market.

Blythe Masters: Yes. Principally for regulatory reasons.

Huw van Steenis: Yes, exactly. On the other hand, when I meet central bankers, sometimes the 'ah-ha' moment for them is the resilience. Because the resilience of this is so much stronger, and the point you made earlier on in the introduction about if you think you haven't been hacked you're even a bigger loser than you think... Because you don't know it's happening. Talk to us a little bit about the resilience.

Blythe Masters: Yes. So this is a bit of a complicated topic. There are different aspects of it. So number one, remember what I said about data itself being encrypted. So remember I described this transaction that you and I do, and I don't know how many entities that I listed out, but call it nine or something that are involved. Not every one of those entities, although perhaps if you wanted to add a tenth entity that is a regulator that has a God's eye view of everything, who has a need and right to know what everybody did with everybody. Other than that regulatory view, you certainly don't need to know what I did with my broker, and my broker doesn't need to know what you did with yours, etc.

So the way that transaction information is protected in this environment is each transaction becomes de-compounded into those nine different bilateral relationships that I described, effectively, and each one of those pieces of information is separately encrypted and subject to separate authentication and identity management. So you have to prove who you are, and that proving who you are gets you access only to the relevant sub-part of the transaction. So that's important. So it's not like there's one key and that gives you access to everything, unless necessarily you're a regulator. And one would have to be careful about that too.

The actual data itself is encrypted. So if someone hacked into this network, what they would see is gibberish unless they'd managed to separately and individually steal everybody's codes, which is practically infeasible. The second point is the point of having the distribution of the technology. Instead of having data in one database at one point with the older-fashioned back-up, fall-back mechanism where you have a data recovery centre and so on and contingency plan, here if one node goes down, the other nodes are there and you instinctively... all know what that looks like because that's the way the internet works. The reason why the internet is generally there, well, nowadays, assuming you have Wi-Fi or whatever, the access mechanism, the thing behind it is there because there are multiple nodes keeping the internet running independently. When one goes down, there's plenty of others there. It's the same exact concept. So there's that element of resiliency.

The issue of ... can this whole thing be hacked? Well, number one, bear in mind the encryption tools that are being used here are not specific to this industry or this application, there's an entire science of cryptography. The tools that are being used here are cutting-edge, but they are being developed in that field and being used by this field and that field is the same field that works on government security. No comment, but you get the point. And in the case of the public Bitcoin blockchain, a scenario was set up whereby it was assumed that we were building a network for anyone or everyone. Anyone could play. No censorship at all... because of that assumption you had to assume that you're going to encounter bad actors of course and so a design had to be come up with to make the framework resilient to that and the ingenious design was this thing called proof of work.

The mechanism whereby the world arrives at a consensus on what is ... the true state of the Bitcoin blockchain database involves use of computing resources. Essentially those computers are solving complicated algorithms that can only be solved by brute force and the only way you can do that is by throwing a lot of computing power at it, a lot of chips, and a lot of electricity, and the ones that are quickest essentially win. It's a lottery in essence and when you win, you get a reward, and your reward is a bit of a Bitcoin and that has some independent value.



That leads to all sorts of interesting questions. What happens if the majority of the Bitcoin miners are sitting in China or who knows where because you can't actually tell on an a priori basis who the winners will be and what happens if one day we wake up and 51% of them have colluded and clubbed together and they essentially, wipe out the entire history of everything? Then what are we going to do? Because if the idea behind the Bitcoin blockchain was that it was to be computationally infeasible to overwhelm the computing resources of the network, which is a fair enough assumption because – by the way – you'd need far more computers than Google has today or any individual private... any individual government entity bar a few – China, the US debatably – but more than Google, but if they're all located in a similar jurisdiction and the government is that way inclined, what does that mean?

That's a question about resiliency. That's one of the reasons why there are concerns about the use of the public Bitcoin blockchain for these purposes. You can convince yourself it would be expensive to do it. You can't convince yourself that a nation-state acting with intent couldn't overwhelm that. So, in the case of private or permissioned networks we relax some of these assumptions. We don't assume that anyone and everyone can access. We assume only trusted entities that have been pre-established and identified are permitted to play.

That allows you to reduce the need for a proof of work... a threshold for commitment to the database that is based on computing resources, but it requires you to trust those entities not to be up, running, and devoid of bad actors at all, but that the majority of them are free of compromise, but if you define that group as being regulated institutions, you know, in and around the City of London for example or Sydney, that's not such a tall order. In fact, the way that financial services work today is on the basis of some element of trust because you know you're operating in a common jurisdiction. There is a regulator who assesses competency and if you misbehave there will be consequences and you know who to go for in order for there to be consequences.

The security-resiliency concepts are very complex here. They're multifaceted. It absolutely depends on what you're designing and how and for whom and what assumptions you're making. The one thing... it is almost unambiguously easy to prove that if you compare any existing infrastructure today with what is being proposed here, what is being proposed here is strictly a stronger security environment. That's your benchmark, which realistically it should be. Unless there's another better alternative, you're in pretty good shape because right now you don't have anything like that degree of sophistication in the way that existing infrastructures work.

Huw van Steenis: So, let's maybe come back to Digital Asset. You've achieved a huge amount in the last 12 months. You're active in Sydney. You're active in Singapore. I mean, one of the challenges... you've gone to a job where almost every time zone the Digital Asset is in, so talk to us a bit about how you prioritise the bets, the business, the prospects that you're pursuing and where do you want to take it over the next couple of years?

Blythe Masters: We have offices in New York... well, people in New York, San Francisco, Tel Aviv, Budapest, somewhere to be announced in Western Europe but that's not London, and London and Sydney and I think that's it. You know, we're a one-year-old company and we're somewhere between 40 and 50 souls as we speak, at a pretty steep trajectory. Some of those are offices where we just have developer resources; so, just technical personnel. Why did we go to some of those places? Well, we go there because the talent pools in those particular markets are very interesting and talent is a scarce commodity in this space; especially talent that has a combination of cryptography skills and financial services skills and that in essence... that's what our company is all about. If not... it's finding those and then building those.

Obviously it's a big challenge, running an organisation that is as dispersed as that, but then it's still only a 50-ish person... 40 or 50-ish person org, so, you know, let's get real. Some of you manage tens of thousands of people and certainly hundreds of people. It can be done and it turns out that when what you do is development... if you're a technology company, which is what we are, actually technologists are rather used to remote working and using slack boards and gyro tools and other things to coordinate and when you're working in the context of doing sequential sprints, which are just defined sub-projects on the path to the Holy Grail with defined goals, being able to programme 24 hours a day because you have programmers in different geographical time zones is actually incredibly powerful. So, we like that model and we'll evolve things and try to keep it as simple as possible, but we also need to be close to our clients and our clients are – without exception – big global firms, most of whom have operations all over the world or connectivity with partners and others all over the world.



The challenge for us has been boiling down the ocean of opportunity. The number of applications of this technology to wholesale financial services... we've merely limited ourselves to wholesale financial services. You know, we're not doing healthcare. We're not doing identity management for other purposes. The challenge is trying to figure out, what are the projects that have legs that are viable, that can be scalable, and so have interest to multiple parties? I described the Australian situation for a reason because it does check a lot of those boxes. There are other similar projects like that and what we're building for Australia has direct relevance for the Deutsche Börses, the LSEs, the DTCCs, the TMXs, the Hong Kong Exchange, the Singapore Exchange, indisputably and there is great alignment of interest on the part of those organisations that as this technology develops, it develops in a fashion that... it has a foundation that's open-source and in the public domain and that is subject to all the rigor that goes into that and avoids them being proprietarily captive to a proprietary platform that then proceeds to extract super-normal rents out of them for the use of it.

So, what we've found is a collaboration amongst both banks and central infrastructure providers where there's a lot of incentive to share work and we're essentially positioning ourselves to be able to deliver similar product as a foundational product and then build on top of that the things that each individual customer needs to customise the tools to their particular marketplace. Again, just to reiterate, we're a software vendor. We are not seeking to put DTCC out of business or replace T2S, or otherwise become an infrastructure provider ourselves.

We sell software solutions to people that do that, which is itself a very... it's a very scalable business model and doesn't require us to be capitalised, doesn't require us actually at this stage anywhere in the world to be regulated although, in principle we wouldn't object to that, but we don't take care of anyone's asset. We don't act as a principal. We can't ... we don't look after your keys or tokens ... there's nothing of yours that we can lose. We don't receive customer data from clients, so it makes sense that as purely a software provider we don't... we aren't regulated. Almost every single one of our customers is, so we are very involved in the process of helping them with the regulatory dialogue.

Huw van Steenis: I'm conscious of time, so I've got two questions. One is really about making this happen. So, to the extent it's not commercially confidential, when will we all get to... if we were trading in Australia, when would we get to see this in action and what are the milestones we should watch for?

Blythe Masters: Well, the first milestone will be a decision sometime this summer or technically this winter... sometime between June and August in Australia where ASX in conjunction with its board, regulator, and customers will be making a decision to proceed with the replacement of CHES using this technology or not as the case may be. We're in the process of that evaluative phase and the point at which they make that decision will not be the point at which you see the technology being rolled out for commercial deployment because again you recognise this is a gigantic piece of infrastructure with millions of transactions flowing through it and multiple parties involved, so this will be a multi-year project to replace CHES. It won't be a multi-month project, but this is a serious project with real resources and commitment behind it.

We have a whole floor in ASX's building where we work jointly with the corresponding team at ASX in a shared space. They're in the process of syndicating what they're up to with their regulators, their clients, the government there because one of the other interesting features of the Australian market is... the mandate that they enjoy for settlement and clearing is up for review periodically and so one of the rationales for investing in this technology is that it achieves the benefit of competition by eradicating cost without fragmenting the settlement and clearing infrastructure, which is the other way in theory to impose competition on the Australian market, but given the economies of scale in that business, that's a pretty heated argument.

Huw van Steenis: Penultimate question: obviously we've been seeing many bank, insurance, exchange CEOs here, yesterday, today, and tomorrow. What advice would you give the CEO of a major financial institution to get ahead of the curve in changing the operating model, getting the cost down, and taking advantage of your technology?



Blythe Masters: Usually when you talk to anyone in the C suite of a firm like that, they have a pretty acutely defined sense of what their top strategic priorities are and nowadays... what I mentioned earlier about concern about the operating environment, compressed revenues, rising cost whether it's directly or pressure from their customers to reduce cost, and if they're a capitalised entity, rising capital requirements, or, if they're not, it's rising capital requirements on the part of their clients, so it all amounts to the same thing.

So, this ROE thing that I talked about plus concern about cybersecurity, which is sort of an existential threat that everybody is very focused on but no one is comfortable about. Then, if you're lucky and you've got long enough, you might get to a few other agenda items like growth, new markets, customer experience... nobody has really got the time to focus on that as much as they perhaps should, but if that is what you hear, which is what you hear when you speak, then that's the way in which to introduce this... that's the point at which to introduce this technology as a concept.

It's not as simple as, here, buy this solution now, and you've solved your problem by the next calendar year. It's just that it is a dialogue which says, well, the trajectories here are either radical surgery on yourself, including the possibility of considering exit of certain lines of business ... or a fundamentally new approach to the manufacturing process in your business. You'd be amazed how many people don't want to do surgery on themselves or exit businesses that they've been into, and that's how these conversations go and that's how you end up with a receptive audience. And there is an understanding that investing now in order to achieve benefits in the long run is kind of the nature of the beast and that the need is great enough to justify doing that.

Huw van Steenis: In a few words, Digital Asset in five or ten years' time: what should we be expecting or what... defines success for you?

Blythe Masters: Well, we will have operating products in the real world deployed by major financial services, banks, and infrastructure providers on multiple continents and we'll be bigger than we are now and... as to how we're financed, who owns us, whether we're public or not, we'll cross those bridges when we come to them. My goal is to build a client-centric company that understands the needs of its customers to deliver high-quality solutions to those needs as opposed to peddling a product that is interesting but otherwise not necessarily meeting a need and in the process build a very profitable company, because we will be very handsomely paid if we meet those two first criteria, which is, we're client-centric, we understand the needs of our customers, and we deliver solutions that solve them. That's how you build a profitable company, so that's the strategy.

Huw van Steenis: Blythe, it has been a huge honour to host you here at the conference and I think if you can improve the ROEs of all the banks and insurers we'll be seeing in the next few days, we'll all be immensely grateful to you. So, thank you very much indeed for coming and flying in.

Blythe Masters: Thank you very much.



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	COUNT	% OF TOTAL	COUNT	% OF TOTAL	% OF RATING IBC CATEGORY
Overweight/Buy	1219	36%	305	41%	25%
Equal-weight/Hold	1405	41%	333	45%	24%
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INDUSTRY COVERAGE: Banking - Large Cap Banks

COMPANY (TICKER)	RATING (AS OF)	PRICE* (04/19/2016)
Betsy L. Graseck, CFA		
Bank of America (BAC.N)	O (04/23/2013)	US\$14.45
Bank of New York Mellon Corp (BK.N)	U (11/28/2011)	US\$38.84
BB&T Corporation (BBT.N)	E (01/28/2014)	US\$34.71
Capital One Financial Corporation (COF.N)	O (07/30/2015)	US\$72.80
Citigroup Inc. (C.N)	E (10/26/2015)	US\$45.63
Goldman Sachs Group Inc (GS.N)	O (10/26/2015)	US\$162.65
J.P.Morgan Chase & Co. (JPM.N)	O (12/11/2006)	US\$63.32
Northern Trust Corp. (NTRS.O)	U (11/28/2011)	US\$71.84
PNC Financial Services (PNC.N)	E (07/25/2013)	US\$86.27
Regions Financial Corp (RF.N)	E (02/11/2016)	US\$8.98
State Street Corporation (STT.N)	U (11/28/2011)	US\$60.26
SunTrust (STI.N)	E (12/04/2013)	US\$39.24
Synchrony Financial (SYF.N)	O (09/09/2014)	US\$29.82
U.S. Bancorp (USB.N)	E (12/19/2012)	US\$41.91
Wells Fargo & Co. (WFC.N)	E (12/19/2012)	US\$49.88

Stock Ratings are subject to change. Please see latest research for each company.

* Historical prices are not split adjusted.



INDUSTRY COVERAGE: Banks

COMPANY (TICKER)	RATING (AS OF)	PRICE* (04/19/2016)
Alice Timperley, CFA		
Danske Bank (DANSKE.CO)	O (04/21/2015)	DKr 179.60
DNB (DNB.OL)	E (01/26/2016)	NKr 104.20
Nordea (NDA.ST)	E (03/28/2011)	SKr 79.20
SEB (SEBa.ST)	O (07/23/2014)	SKr 81.15
Svenska Handelsbanken (SHBa.ST)	U (09/21/2015)	SKr 104.20
Swedbank (SWEDa.ST)	E (07/23/2014)	SKr 171.50
Alvaro Serrano		
Banca Monte dei Paschi di Siena S.p.A. (BMPS.M)	U (07/14/2014)	€0.64
Banca Popolare di Milano S.c.a.r.l. (PMIL.M)	O (07/14/2014)	€0.64
Banco Popolare (BAPO.M)	U (07/15/2015)	€6.04
Banco Popular (ES) (POP.MC)	E (02/09/2016)	€2.36
Banco Sabadell (SABE.MC)	U (06/30/2015)	€1.62
Bankia SA (BKIA.MC)	O (09/17/2015)	€0.84
Bankinter (BKT.MC)	U (09/26/2014)	€6.43
BBVA (BBVA.MC)	O (11/24/2014)	€6.02
CaixaBank SA (CABK.MC)	O (01/18/2016)	€2.61
Intesa SanPaolo S.p.A. (ISP.M)	O (01/22/2014)	€2.42
Mediobanca Banca Di Credito Finanziario (MDBI.M)	E (10/28/2015)	€6.58
Santander (SAN.MC)	E (11/13/2013)	€4.17
UniCredit S.p.A. (CRDI.M)	O (01/22/2013)	€3.30
Unione di Banche Italiane SCPA (UBI.M)	E (01/22/2014)	€3.60
Bruce Hamilton		
ABN AMRO Group NV (ABNd.AS)	O (01/04/2016)	€18.30
BNP Paribas (BNPP.PA)	O (04/22/2015)	€45.63
Credit Agricole S.A. (CAGR.PA)	++	€9.75
ING (ING.AS)	U (03/31/2016)	€11.18
KBC Group NV (KBC.BR)	E (08/14/2014)	€47.39
Natixis (CNAT.PA)	O (10/09/2014)	€4.72
Societe Generale (SOGN.PA)	E (12/07/2014)	€34.23
Canset A Eroglu		
Commerzbank AG (CBKG.DE)	E (05/05/2015)	€8.46
Chris Manners, ACA		
Bank of Ireland (BKIR.I)	E (09/18/2014)	€0.25
Barclays Bank (BARC.L)	E (11/20/2015)	168p
HSBC (HSBAL)	U (02/08/2016)	454p
Lloyds Banking Group (LLOY.L)	O (08/08/2013)	68p
Royal Bank of Scotland (RBS.L)	O (08/26/2015)	243p
Standard Chartered Bank (STAN.L)	U (02/28/2014)	542p
Fiona Simpson, CFA		
CYBG Plc (CYB.AX)	O (03/15/2016)	A\$4.32
CYBG Plc (CYBGC.L)	E (03/15/2016)	235p
Huw Van Steenis		
Credit Suisse Group AG (CSGN.S)	E (02/05/2016)	SFr 14.75
Deutsche Bank (DBKKn.DE)	E (10/11/2010)	€15.64
Julius Baer (BAER.S)	E (02/17/2014)	SFr 40.36
UBS Group AG (UBSG.S)	O (01/18/2012)	SFr 15.87

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