



SECURITIES SERVICES EVOLUTION

Disruption and transformation in financial market infrastructures

Securities Services



Foreword



Okan Pekin
Global Head of Securities Services, Citi

With a presence in more than 100 markets around the globe, Citi Securities Services has a unique connection with thousands of participants across the industry. This paper has leveraged those relationships to deliver insights into the current state of market infrastructure and securities services. Asset managers, banks, broker dealers, custodians, institutional investors and financial market infrastructures have all kindly contributed their time and expertise to make this research as comprehensive as possible and we would like to extend our thanks to them all.

The pandemic has changed many things in financial markets, as well as other walks of life. In securities services, we find that it has accelerated and condensed many existing efficiency and digitization initiatives. However, as we have found through extensive dialogue with our partners and clients, it has also given rise to a whole new set of previously unforeseen challenges. Through periods of higher volatility, the pandemic has also caused market participants to re-examine how the settlement process could be accelerated and simplified to reduce risk.

The sheer diversity of views expressed by those contributing to this paper – both by geography and entity type – highlights the complexity of the global securities landscape. Simplifying processes to deliver a more globally consistent and higher quality client experience is at the heart of Citi's Securities Services offering, as is anticipating changes and delivering responsive solutions to maintain that client experience going forward. These changes are numerous and multifaceted, but in time may deliver enormous efficiency gains and cost savings.

We hope you find this paper insightful and informative.

Executive summary

The global securities landscape is on the verge of transformation, with new technologies and digitalization efforts poised to deliver major efficiencies and potential savings. This represents a radical change for an industry historically fragmented in terms of technology, operating models and process inconsistencies.

The periodic volatility and remote working caused by the pandemic have been a catalyst for this change. The pandemic has also highlighted the need for market participants, regulators and financial market infrastructures (FMIs) to co-operate on key initiatives, such as digitization and digitalization.¹ Appetite for both is clearly increasing as their potential to transform the industry becomes more widely acknowledged by market participants and FMIs alike.

In the early days of the pandemic, high market volatility and volume underlined the critical role that FMIs and securities services providers play. The focus now is on how increased automation can deliver even greater resilience and efficiency, while simultaneously reducing risks and costs.

Settlement compression

Against this backdrop, settlement compression has once again become an important consideration for all involved, along with the associated trends of digital assets, technology and digital transformation. All these are now attracting attention and investment from the FMIs interviewed for this paper, as well as considerable interest from the market participants surveyed.

The forthcoming shortening of the US settlement cycle to T+1 is one reason for this growing interest, recent periods of high volatility another. FMIs see the major benefit of reducing settlement cycles as risk reduction, which will in turn enable lower margin requirements and the release of capital that can be more efficiently deployed elsewhere. For example, most FMIs felt that some of this capital could be used to fund more trading activity, thus driving better liquidity. However, while most FMIs felt that these gains would apply to T+1, they would not apply to T+0 or atomic settlement because of the loss of netting benefits and the need to fund gross settlement.

Although this is clearly an area of growing interest, there has not been much pressure from market participants to shorten settlement cycles, though this will probably change as nearly half of the market participants surveyed expect T+1 to arrive within the next five years.

When they transitioned from T+3 to T+2, some FMIs invested in technology that would allow them to handle any future shortening of the settlement cycle. As such, they did not view technology as a barrier for settlement compression, whereas almost 50% of market participants indicated that upgrading legacy technology would be key. Instead, FMIs felt that business process efficiency and the alignment of processes among participants posed far greater challenges, noting that these had also been demanding during the previous transition.

Other topics discussed included the duration of operating hours and alignment with cash settlement systems. Neither FMIs nor market participants saw these as potential roadblocks to settlement compression and some FMIs have already instituted additional intraday settlement cycles to preclude any such issues. However, several Asian FMIs observed that time zone differences might make it difficult for US and European investors to source FX cost-effectively.

Digitalization

The biggest opportunities to transform our industry however, lie in digitization, digitalization and digital transformation. The market is responding in various ways: market participants and FMIs are actively participating or exploring use cases



in digital assets, distributed ledger technology (DLT), digital asset initiatives,² tokenization and fractionalization. In the case of FMIs, these were primarily for traditional assets, but they stressed the wider possibilities of using digital assets for less liquid markets, such as real estate or art.

The appropriate legal and regulatory infrastructure was also seen as absolutely critical to the success of digital assets, not just on a per country basis but also collaboratively and ultimately globally. Without this, many of the potential benefits and efficiencies could be lost. This view on regulation also applied to the success of atomic settlement, particularly in the context of creating a global settlement layer that would support all asset types with fungibility. On the future use of atomic settlement, both FMIs and market participants were positive, with market participants slightly more optimistic on the timeline to production.

As the industry responds to these changing dynamics, it must do so in a way that does not compromise existing services. The ability to service both 'old' and 'new' assets will be essential. In the short term, most FMIs favored separation between their existing and any new infrastructures for traditional and digital assets, while acknowledging that integration was probably ideal in the longer term.

Technology and digital transformation

The FMIs interviewed were also pragmatic about how DLT could be applied to solve their real-world challenges. While a DLT-based market infrastructure was viewed positively by both FMIs and market participants in terms of efficiency and cost reduction, the FMIs were less convinced that DLT was key to shorter settlement cycles. They also saw DLT as being a challenging technology to implement, partly due to a lack of large-scale precedent in traditional markets and partly as a result of the absence of a dominant set of common standards. Other technologies such as artificial intelligence (AI) and machine learning (ML) are already being deployed by FMIs for market surveillance activities or to gain internal efficiencies. There is further potential for both technologies, especially in conjunction with DLT, in areas such as reducing settlement fails and risk-adjusted trade pricing.

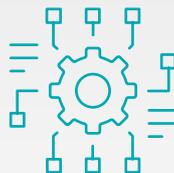
It is clear that new technologies are redefining the future of post-trade but this evolution will not take place overnight. The insights from this whitepaper reveal a post-trade environment that is complex and full of innovation and activity. Technology adoption continues apace and there is clearly a strong focus on speed, efficiency and supporting an extension of asset classes, while simultaneously minimizing risks and costs.

Key takeaways



1

The post-trade landscape is fragmented and FMIs are on differing journeys to settlement compression, with risk mitigation seen as the primary benefit. However all FMIs have invested heavily and continue to invest in ensuring their systems are future proof (whether utilizing existing or new technology).



2

Digital assets are increasingly in demand from investors and FMIs are developing new products, services and infrastructures for this evolving digital asset ecosystem.



3

Digital transformation is a major priority for all FMIs with the potential to deliver significant cost and efficiency benefits, both internally and for market participants.

Methodology

This paper is based upon data gathered from both financial market infrastructures (FMIs) and other market participants across Asia-Pacific, Europe, North America and Latin America. The geographic breadth and broad spectrum of firms that participated has helped generate quantitative and qualitative insights into ongoing developments across the securities markets ecosystem.

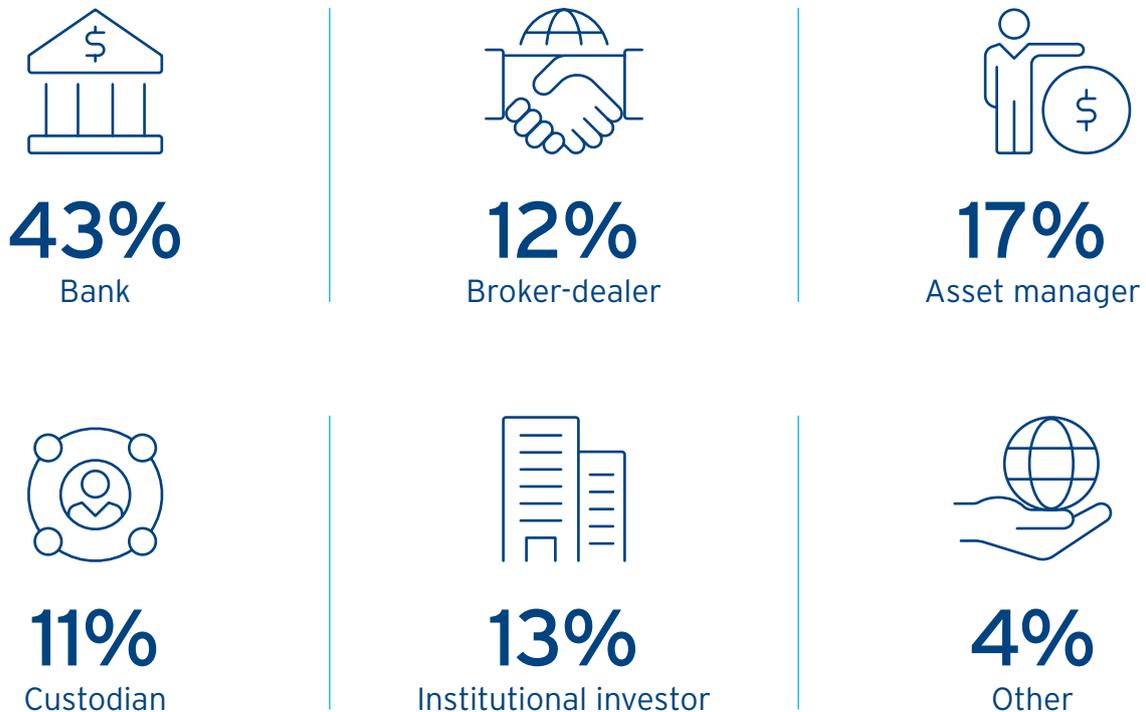
FMIs

A total of 15 leading FMIs (12 traditional,³ 3 non-traditional) participated in one-on-one in depth interviews which took place between 28 July and August 19 2021. Traditional FMIs interviewed included exchanges, centralized securities depositories and clearing houses. Non-traditional FMIs interviewed included a digital exchange, a digital asset custodian and a fintech.

Market participants

In order to gauge the sentiment of market participants across the industry, Citi Securities Services collaborated with Global Custodian to survey almost 400 individuals around the globe via an online poll that ran between 3 August and 1 September 2021. These included, among others, a broad mix of custodians, banks, broker dealers, asset managers and institutional investors (see Figure 1a and 1b).

1a Market participant breakdown



Introduction

The securities industry is on the brink of transformational change. New technologies and digitization look set to usher in not just greater consistency and efficiency, but also completely new asset types and trading opportunities. This in turn calls for greater collaboration among market participants, regulators and FMIs which will ultimately streamline processes and mitigate potential risks.

The pace of change has been further accelerated by the pandemic, which has magnified three trends that are becoming the driving force of change in today's post-trade environment:

Settlement compression

T+2 has become the common standard over the past few years, although the planned transition to T+1 in the US, together with recent volatility spikes, have made it the subject of renewed focus.

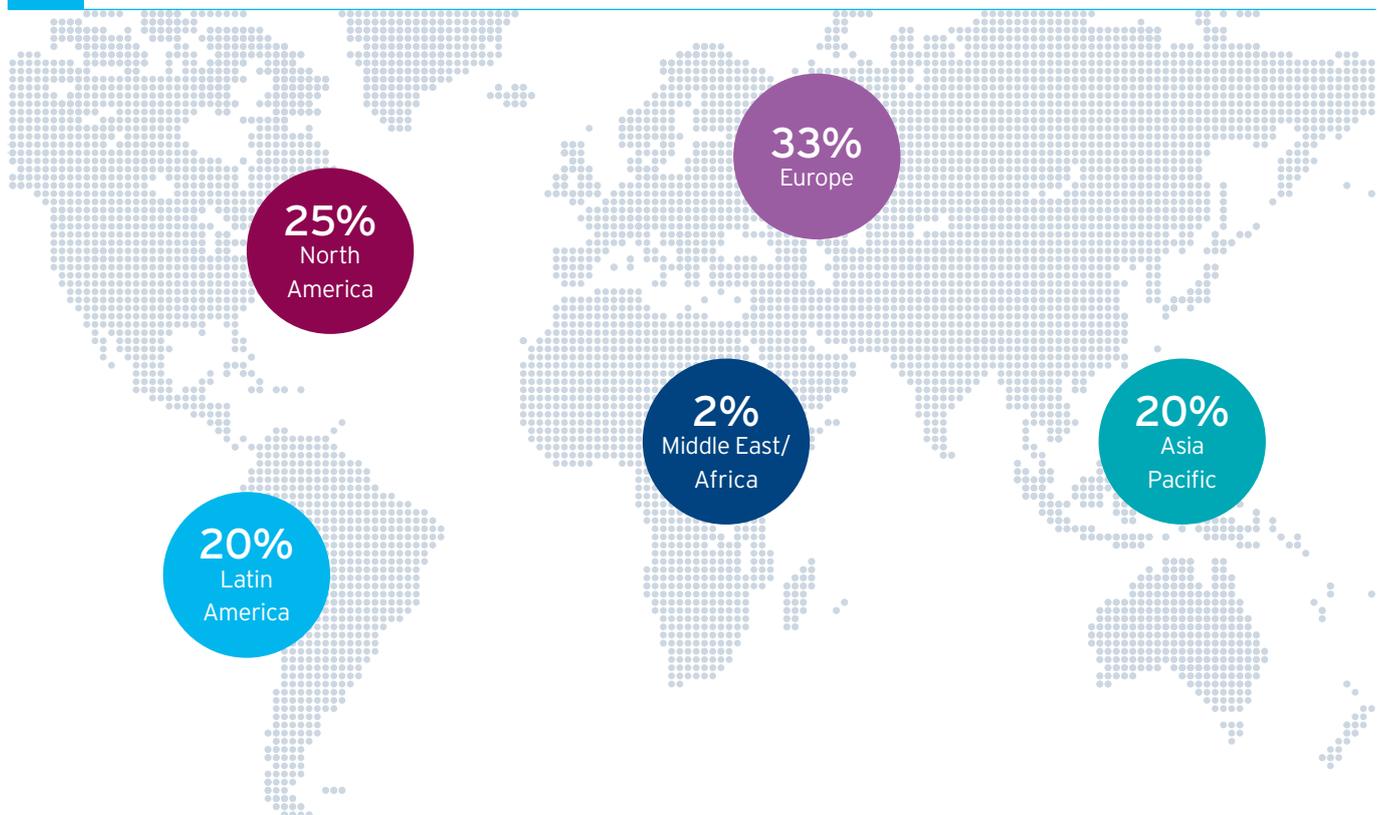
Digitalization

Demand for digital assets is growing rapidly, as is the debate over how to structure and settle trades for all types of assets, whether digital or traditional.

Technology and digital transformation

Technology and digital transformation are becoming ever more critical for the smooth and effective operation of securities markets.

1b Geographical breakdown of market participants



Settlement compression

While most major markets have been on a T+2 settlement cycle (see Figure 1c) for some time now, the question of further compression is now back on the agenda due to two primary factors. One has been an increased number of systemic and idiosyncratic high volatility periods over the past two years, caused by the global pandemic and meme stocks⁴ such as GameStop and AMC. The other is the proposed transition to T+1 in the US (also partially driven by volatility), with the projected timeline currently suggesting completion in 2023. In view of the global influence of US markets, this change is being closely monitored and could well be followed by other markets around the world.

“When that happens you naturally try and think about the ways in which you might be able to safely reduce that risk and the margin requirements to mitigate the spikes. One of the most obvious ways is to shorten the settlement cycle.”

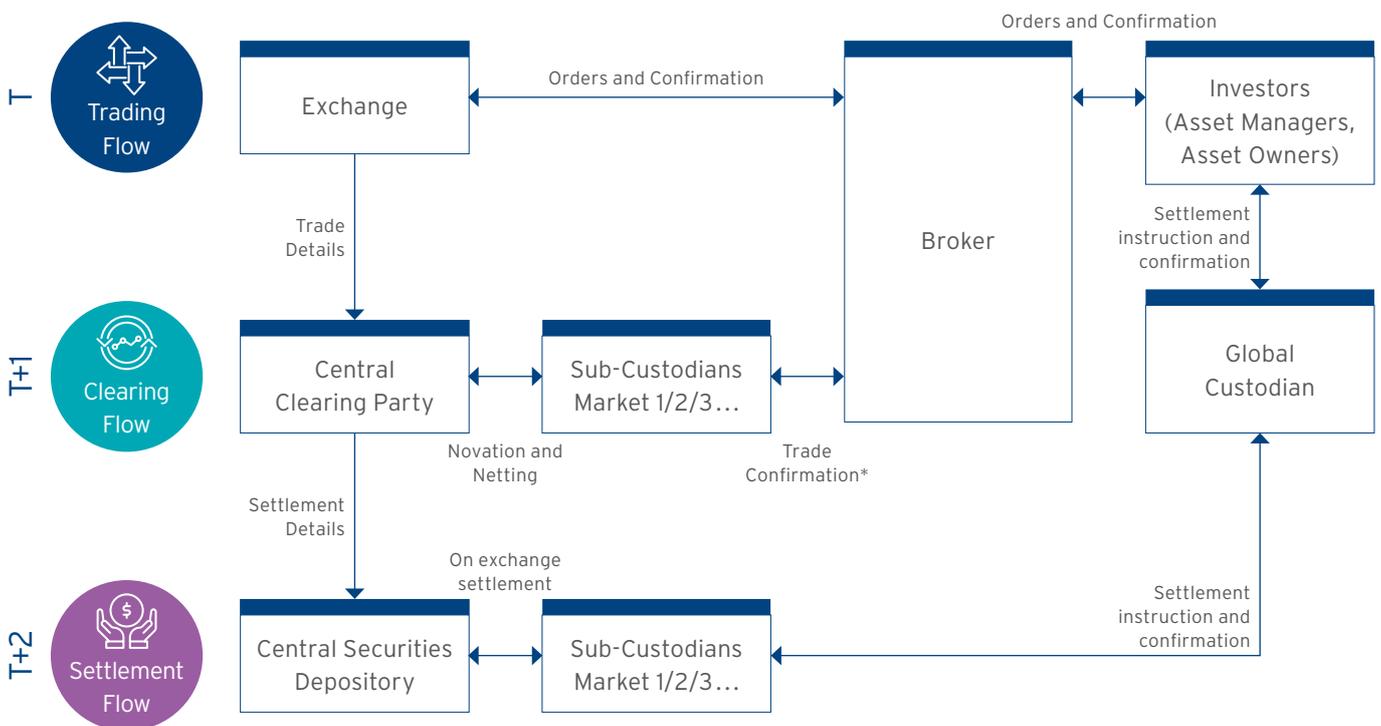
John Abel, Executive Director of Clearance and Settlement, Product Management, DTCC

Risk and margin reduction: releasing capital

The possibility of reducing counterparty risk (and the period of counterparty exposure) through settlement compression was a view shared almost universally by the FMIs that were interviewed. Periods of volatility that caused spikes in risk-based margining, and the resulting potential to cause counterparty failure, were clearly a cause for concern.

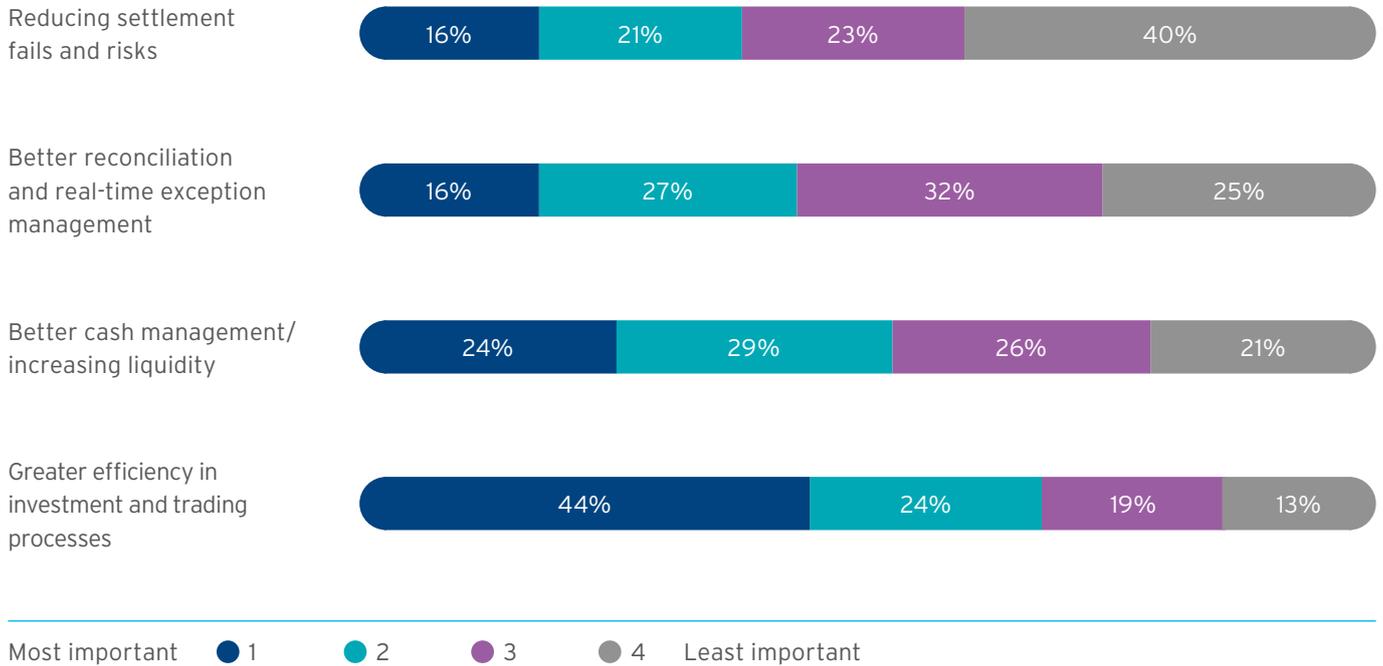
This was a view shared by other FMIs who were similarly united in their view that the most obvious benefits of shortening the settlement cycle to mitigate risk were the attendant reduction in margin requirements and improvements in capital efficiency. The overall scale of this opportunity is considerable when one considers the amount tied up in margin today and the potential impact on volatility-based margin calculations.

1c A typical T+2 settlement cycle



*Note: The trade confirmation with Central Clearing Party can be completed by either broker or local custodian as a delegate.

2 What would be the greatest benefit of a shortened settlement cycle for your organization?



For instance, in the US, the DTCC believes that a move to T+1 could bring a 41% reduction in the volatility component of the National Securities Clearing Corporation margin.⁵ In Brazil, B3 estimates a 50% reduction in margin calls for its cash market for a one day reduction in the settlement cycle. Others felt that a shift to T+1 could actually reduce margin requirements by even more, with one FMI anticipating a possible ~60% reduction. These reductions could be of considerable value given forthcoming changes in bank capital requirements.

“Balance sheet and capital efficient trading models are becoming more important with Basel IV on the horizon. If you can reduce your capital requirements as part of trade and settlement then you can make your balance sheet go further for a given trading volume.”

Peter Golder, Chief Commercial Officer, SDX

Liquidity benefits and other gains

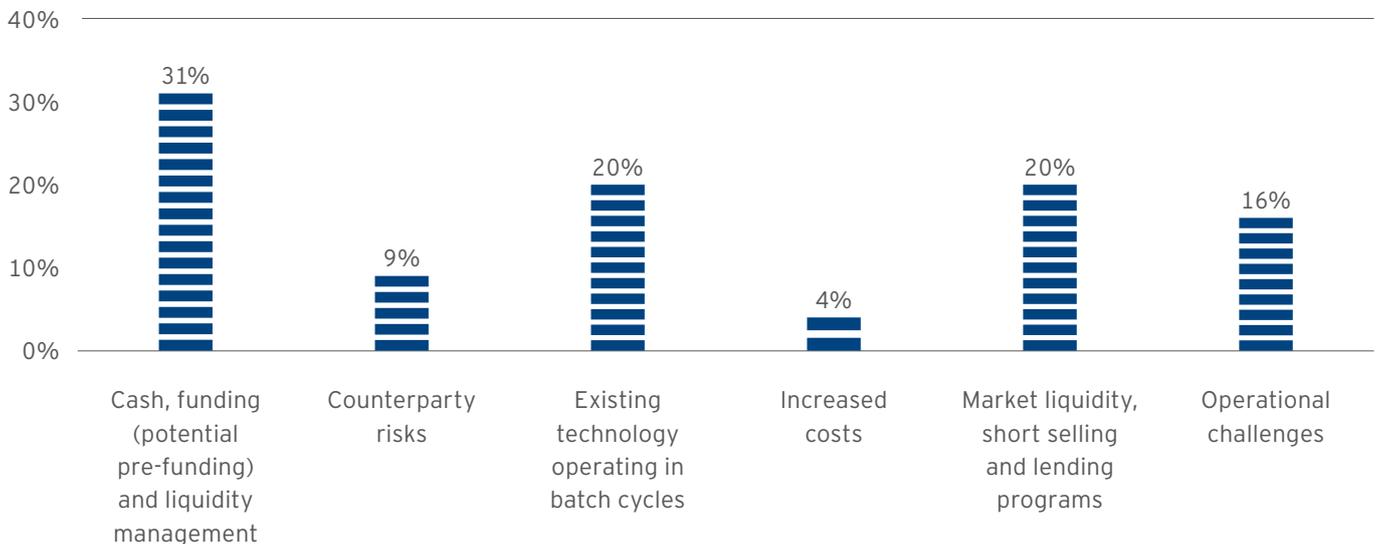
Any reduction in margin requirements (however large or small) as a result of settlement compression raises the question of how the capital freed up might be redeployed.

With varying degrees of certainty, most FMIs thought it a reasonable assumption that investors would recycle it into increased trading activity, thereby improving liquidity and potentially reducing dealing spreads.

However, restrictions in some markets on the trading activities of non-domestic investors might mean any liquidity improvements there would be limited. For instance, in certain markets, only domestic investors can day trade, so any additional capital from overseas investors could only increase T+1 trading activity. Local market practice for certain activities might also limit the liquidity gain for cash equities. For example, in India, short positions are primarily expressed via single stock futures rather than the cash market.

While risk reduction and lower margin/capital efficiency were seen as the primary driver and benefits of compressing the settlement cycle, there are several other possible advantages. The first is that the necessary automation investment required to support a shorter cycle would also reap operational efficiencies and greater straight through processing (STP) rates. This was also the top ranked benefit identified among market participants, with 44% regarding greater efficiency in the investment and trading process as the most important benefit of faster settlement for their organization (see Figure 2).

3 What would be the main challenge of a shortened settlement cycle for your organization?



Achieving a shortened settlement cycle that can deliver these efficiencies requires trading and investment processes to be streamlined and straight through processed end-to-end. In practice, this necessitates a large number of activities and their interconnections being streamlined and automated, including:

- Hand off from front to middle office
- Trade allocation and confirmation
- Instruction generation and matching
- Funding and cash flow management
- FX booking
- Lending for fails coverage
- Reconciliation
- Exception management

While these changes are achievable, they do underline the fact that some market participants will need to make appreciable effort and investment to prepare for any further reduction in settlement cycles.

Another advantage is that in a T+2 cycle, all systems need to have the capacity to cope with three days' worth of data while trades settle. A reduction in the settlement cycle would therefore also reduce the volume of data, thereby freeing up additional capacity that could be used to handle future increases in trading volume without additional investment. It was also observed that shorter settlement times should also reduce the need for capital in the central counterparty and that this might result in a reduction in fees for participants (and a reduction in earnings for FMIs).

Netting: so far, but only so far

However, while margin reduction/capital efficiency were seen as the major potential benefits of shorter settlement cycles, interviewees were careful to draw a very clear distinction in this respect between a transition to T+1 and T+0. It was acknowledged that in a T+0 environment there was no need to post margin, because by the time it was required, settlement would be complete. However, the overriding factor would be netting – or rather the lack thereof.

“One of the things that will be impossible in a T+0 environment is netting off across all your positions. From the CCP perspective, you don't get any benefit unless you can multilaterally net and this becomes very difficult on T+0, so whether a market participant is buying or selling, they will have to have either available cash or available securities every time they trade to ensure settlement. Our compression rate at the moment is about 180 to 200 executions per settlement and all that compression happens at the end of the day. That may not happen in a T+0 environment, because you're functioning on a real-time basis instead.”

Alex Kronic, Head of Equities, LCH, Ltd

Similar levels of netting benefit were reported in other markets, so collectively the loss of this gain and the huge increase in the amount of gross funding required in a T+0 scenario would make a significant reduction in market liquidity likely, versus the probable increase FMI's anticipated in a move to T+1 (see 'Liquidity benefits and other gains'). There was a general sense that some market participants were already very efficient in their collateral management.

"We are seeing a clear shift towards optimizing collateral, for instance putting collateral in T2S to create liquidity for the overnight settlement and then reusing it later in the day in perhaps the US market."

Samuel Riley, Head of Investor Services and Financing and Member of the Clearstream Executive Board

However, other participants will probably have to improve their funding processes and collateral management, in order to move to just T+1. Some FMI's are working on, or already offer, tools to assist participants with this, such as Clearstream with HQLA^x, which enables users to tokenize different assets and swap them to maximize collateral efficiency.

Market participants had a less nuanced view than FMI's, seeing funding as potentially the greatest obstacle/challenge for any reduction in settlement cycle, both in general (see Figure 5) and specifically for their own organization (see Figure 3).

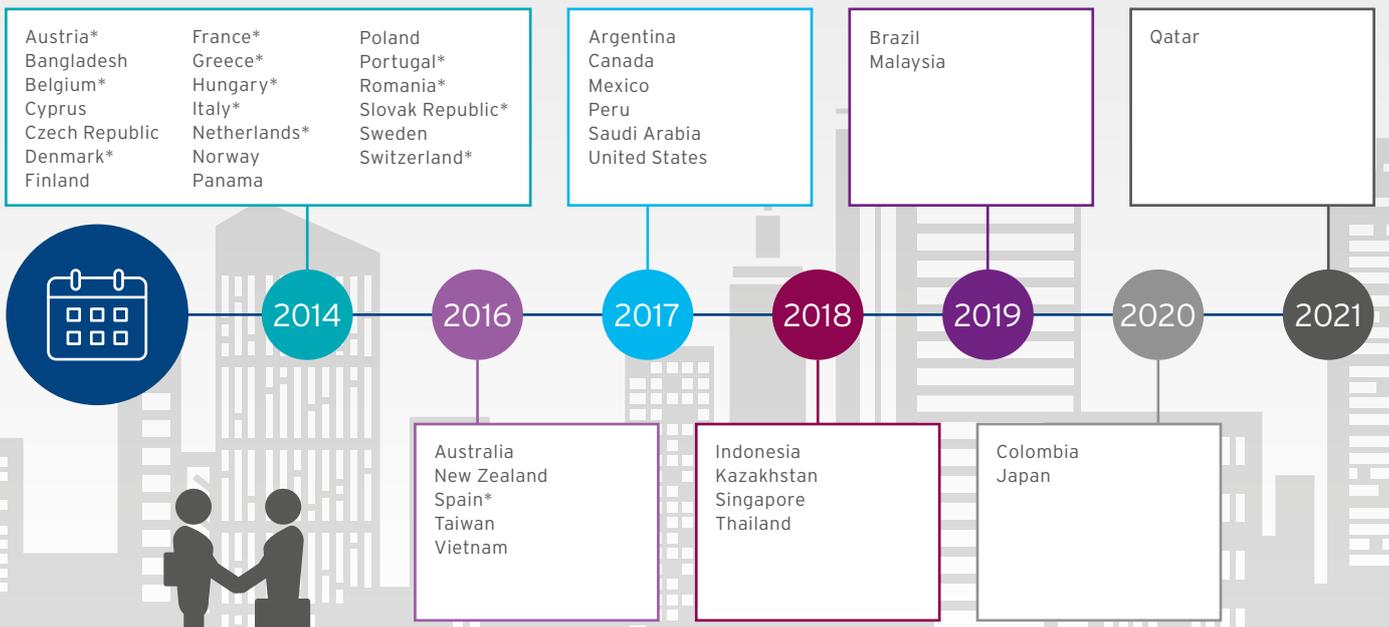
The *status quo*: little pressure but much preparation

Despite the drivers and benefits outlined earlier, traditional FMI's are not yet actively working on settlement compression for the bulk of their securities processing activity and are mostly continuing to operate on a T+2 basis. The primary reason for this is the current lack of demand from market participants for further shortening, though another factor may well be the future proofing many FMI's undertook when they transitioned to T+2 (see 'Preparation and strategy'). This is perhaps unsurprising given how relatively recently many major markets moved to T+2: out of the 54 markets currently on T+2 in Citi's proprietary custody network, 40 made the transition within the last seven years. Therefore, a lack of appetite for further disruption may well be the reason for participants' contentment with the *status quo*.

The obvious exception, and one that is being most closely monitored by FMI's, is the US. The proposed transition to T+1 settlement from T+2 has – after extensive consultation – been backed by major stakeholders.⁶ In view of its very close linkage with US markets, this timeline is also likely to be adopted by Mexico, with some other LATAM FMI's also expected to follow suit.

Most traditional FMI's do not see it as their role to dictate the pace of shortening settlement cycles, but have instead undertaken a responsive approach to the industry's preferences. This was especially evident in Europe where ongoing time-sensitive projects such as the Central Securities Depository Regulation (CSDR) implementation are currently more of a priority.

Markets Snapshot: T+3 to T+2



* Part of Citi's TARGET2-Securities (T2S) footprint



44% of market participants expect to be on a T+1 settlement cycle in 5 years' time

However, judging by the online poll responses, market participants are anticipating changes in the longer term. When asked what they expected the prevailing settlement timeframe for equities to be in five years' time, only 22% expected it to still be at the T+2 that is commonplace today. The majority (~44%) expected T+1 to predominate, while some (~18%) thought real time immediate atomic settlement would prevail, rather intriguingly appearing to bypass T+0, which only ~16% expected (see Figure 4).

Despite the lack of large scale settlement compression activity, several traditional FMIs have already compressed settlement for some of their markets.

“We are already able to settle at T+0 in Sweden, though volumes are very modest and largely driven by a small number domestic users.”

Roger Storm, CEO, Euroclear Sweden

Another example is HKEX's Stock Connect (plus the complementary Synapse), which already offers T+0 settlement, though not to international investors. Other traditional infrastructures are also working on settlement compression for specific activities or assets, such as IPOs or certain types of bonds.

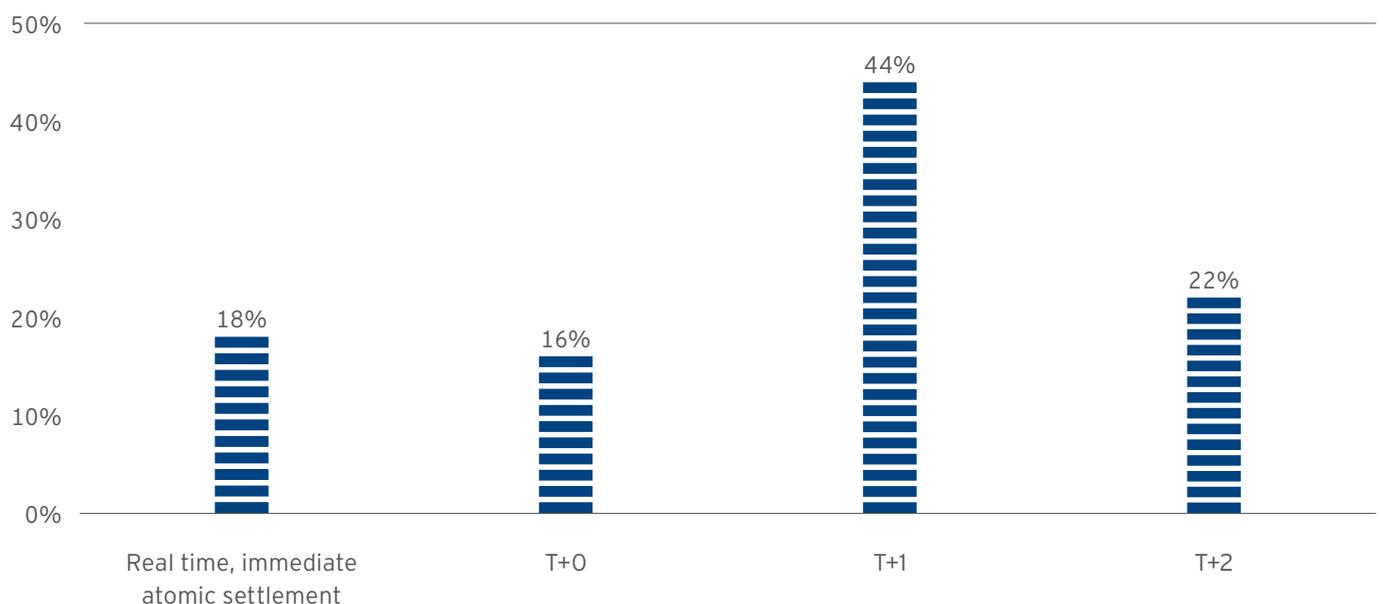
In addition, all traditional FMIs interviewed are actively monitoring the situation in terms of both domestic and international demand, with one or two currently conducting client surveys or consultations. Several are running, or have already completed, proofs of concept for settlement via DLT.

Unlike traditional FMIs, the non-traditional FMIs that were interviewed regard T+0 or instant settlement as a logical immediate objective – BondValue for example is already in production with instant settlement. This difference is perhaps unsurprising given that the non-traditional FMIs are typically dealing with a relatively new rather than long-established type of clientele. As such, they do not have to contend with the legacy processes and technology (and those of their clients) that traditional FMIs have to accommodate.

Preparation and strategy: tech future proofing

Many FMIs had already undertaken considerable contingency planning, including long term research and scoping, when they were completing their previous settlement cycle transitions. They therefore have a head start in the event of rising demand from market participants.

4 In five years time, what do you expect will be the prevailing settlement timeframe for equities?



“When the US moved from T+3 to T+2, we tried to identify areas that might be challenging in the event of future compression and looked at how these might be resolved.”

**Thomas Price, Managing Director,
Operations Technology & BCP, SIFMA**

One positive consequence is that the DTCC already has the operational capability to clear and settle transactions same-day on T+0 with existing technology.⁷ This was also reflected in Indeval’s preparations in Mexico – when it transitioned to T+2 in 2017, it incorporated in-depth planning and a robust infrastructure that would also be capable of supporting a future transition to T+1.

Other FMI projects have also included an element of future proofing, such as LSEG’s recently completed multiyear rebuild of its LCH Ltd EquityClear platform. While the primary motivation for the investment was not compressing settlement, the new system’s additional capacity and flexibility means that it is already technologically capable of supporting shorter settlement cycles. Another FMI also noted that the original design flexibility of their heritage mainframe and COBOL based system meant that they were already capable of delivering T+0 settlement.

This future proofing is also a trend in current projects, such as the ASX’s DLT-based replacement for its CHES equities clearing and settlement system. The exchange consulted on settlement compression when scoping the new system’s requirements, but this was more focused on having the

optionality to reduce settlement times rather than making an immediate transition. As a result, the new platform will already have the ability to support shorter settlement cycles as and when they are required.

Operating hours: to extend or not to extend

A potential knock-on effect of shorter settlement cycles is the need for FMIs to extend operating hours, but most didn’t see the need to do so. This was also largely reflected by market participants, where only 6% felt that payment and settlement infrastructure operating hours would be an obstacle to achieving further reductions in the global settlement cycle (see Figure 5). Nevertheless, there were a few caveats involving different time zones for certain settlement activities.

Some FMIs have already undertaken work that should make the extension of operating hours unnecessary when settlement compresses. For example, SGX undertook a major upgrade of its custody and settlement systems in 2018 and future operating hours were taken into account as part of that. More recently, it has introduced a new intraday settlement cycle that provides more certainty in terms of settlement by giving participants an opportunity to take corrective actions to avoid failed deliveries. This new cycle currently accounts for more than 90% of total settlement activity.

ASX is following a similar approach with its new platform. It currently operates a single settlement cycle with a cut off at 11.30am Australian Eastern Standard Time. However, its new CHES replacement will enable users to settle real-time delivery versus payment⁸ (DVP), after the main settlement cycle.

5 What is the greatest obstacle to achieving further reductions in the global settlement cycle?



● Cash, funding & liquidity management	26%
● Lack of harmonization of industry standards	11%
● Legacy technology	22%
● Market liquidity, short selling & lending programs	15%
● Payment & settlement infrastructure operating hours	6%
● Regulation	20%

Cash settlement systems: no immediate issues

The capabilities of cash settlement systems are inevitably an integral consideration when shortening settlement cycles; there is little point switching to T+1 if the cash settlement system is still on T+2. At least in the immediate term, this doesn't appear to be a major issue for most FMIs. While several mentioned the potential issues around FX settlement times outlined earlier, they were generally unconcerned about domestic cash settlement, as they were already taking advantage of existing real time gross settlement (RTGS) or instant payment systems and using the relevant direct debit capabilities should a shortfall occur with a particular participant.

However, for settlement at T+0 or shorter, some practical issues could arise. For instance, one FMI noted that while one could theoretically clear EUR 24x7 in Europe, in reality, cut off times would make this impossible. On a more positive note, a possible solution to the need for instant cash settlement in securities transactions is the use of central bank digital currency. On this point, one FMI has already engaged in detailed discussions with the French and Swedish central banks about the use of central bank digital currency for securities settlement and possible proofs of concept. *(The Swedish central bank has already published a paper that mentions the possible use of the e-krona in securities settlement.⁹)*

Regulation: enabler or obstacle?

Views on regulation as an enabler or obstacle to a transition to T+0 ranged across a broad spectrum. A small majority of FMIs saw it as an enabler, such as the introduction of legislation supportive of shorter settlement cycles, while others noted that they had only observed the transition to a more positive role in recent years. Several regulators were also commended for engaging proactively on these topics and generally seeking to facilitate changes and technology that would promote efficiency while maintaining orderly markets. Others however felt that regulators in general should be driving the process of compressing settlement, rather than leaving it to the marketplace. A few definitely saw regulation as a major obstacle and cited examples of regulators insisting upon paper/manual processes that could be easily digitized to reduce risk and improve efficiency. Market participants were also slightly negative on regulation, ranking it as the third most important obstacle to further reductions in the global settlement cycle (see Figure 5).

Challenge: process efficiency and alignment

Given that many of the FMIs interviewed already have technology capable of supporting settlement compression, it was not viewed as a major challenge. This sentiment however was not mirrored by the market participants, with the majority (~46%) indicating that upgrading or

re-platforming of their own legacy technology would be the main key factor (see Figure 6).

Instead, the greatest challenges from a FMI perspective were business process efficiency and alignment, in contrast to market participants of whom only 10% saw improving and simplifying processes as the primary key factor in enabling a T+1 or T+0 environment (see Figure 6).

On the one hand, FMIs felt all participants (including themselves), needed to refine their individual internal processes so they would be capable of supporting faster settlement. Instead of simply trying to accelerate existing business processes to accomplish this, in some cases new processes employing better transaction practices would need to be designed and implemented.

However, on the other hand, these processes would need to be aligned consistently across all participants and backed by a common understanding of the general (as opposed to entity-specific) processes involved. This was a significant challenge when markets transitioned from T+3 to T+2 and there was some expectation that this would be even more demanding when shortening from T+2.

A related coordination challenge mentioned by several FMIs was ensuring that all participants were ready to go live at the same time.

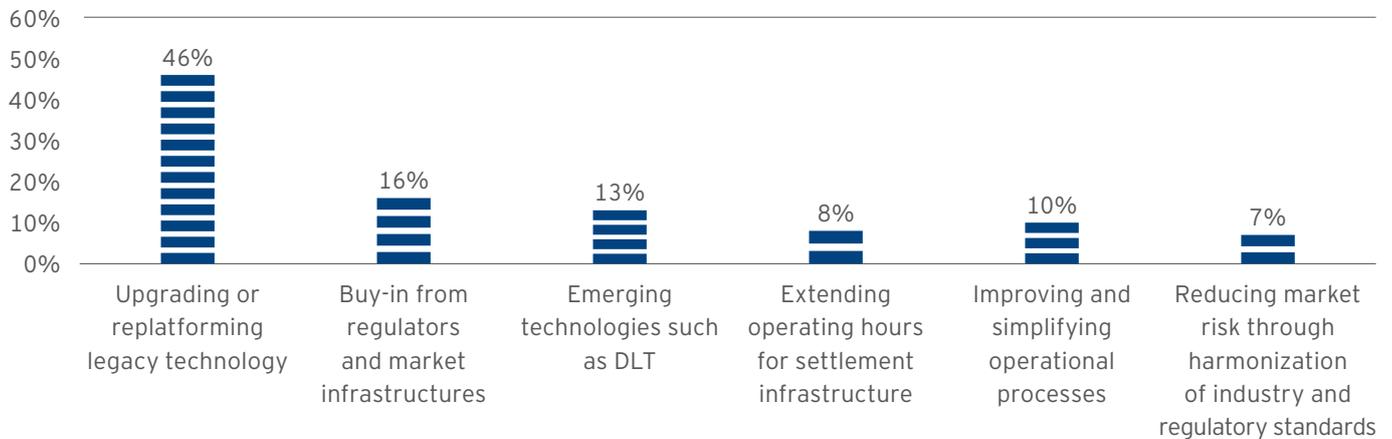
"I think aligning all participants to launch at the same moment is the biggest challenge. That has definitely been the case for us in the past. If just one participant is lagging the clearing house, that creates a problem for the whole market."

Daniel Demattio de Oliveira Simões, Managing Director of Clearing and Settlement, B3

When attempting compression just to T+1, the impact on the interaction and timing of individual processes within the overall settlement procedure was also seen as a potential challenge by FMIs. In a situation where a large number of institutional trades are confirmed and affirmed on T+1 today, some way has to be found to push those confirms and affirms onto the night of the trade date (T+0). But that in turn has an impact on when output can be produced for members who require it for their own internal calculations.

Some activity-specific processes were highlighted as potential issues. For instance, there could be a significant impact on stock loans in terms of timing. When would notification be given to the borrower? How would the borrower get securities confirmed and returned to the lender by the settlement date? Similar considerations and issues would arise with other activities, such as the creation and redemption of ETFs.

6 What will be the key factors in enabling a T+1 or T+0 environment?



Time zones and FX: temporal squeeze

A challenge raised by several Asian FMIs was the role of time zones across different geographies. Today, investors based in later time zones (especially US ones) are nominally settling on T+2, but in reality, they are effectively settling on T+1 in Asian markets. This was an additional reason for these investors to be lukewarm about further compression in Asian markets, as a shortening just to T+1 would effectively require T+0 preparation.

For example, in India (where the securities regulator SEBI has just given exchanges the option of settling at T+1 rather than the current T+2) a switch to T+1 would effectively move the confirmation cycle for US clients to end of day T+0. This would leave a very small window for clients to perform trade match off and allocation, and confirmation to their custodian. Other considerations include less time for transaction repairs and liquidity challenges around FX.

“You still see trades with the potential to fail requiring manual intervention. Especially when trades are being instructed from the US, you don’t have much time to address such issues.”

Daniel Hildebrand, Head of Digital and Depository Services, SGX

“With the bulk of FX liquidity being at spot (which settles at T+2), any further securities settlement compression would leave international investors with the need to source local currency for T+1 or T+0 settlement. The impact of funding and FX need to be considered.”

Glenda So, Managing Director, Head of Post Trade, Post Trade Division, Hong Kong Exchanges and Clearing Limited



While FMIs may not feel it is their role to drive the compression of settlement, they are nonetheless doing the preparatory groundwork for it. Possibly because some of them are already partially future proofed technologically, they do not see technology as much of a barrier to shorter settlement cycles, instead being far more concerned about process alignment across participants.

Digitalization

The digital assets ecosystem has grown significantly over the last few years, prompted by new investor behavior that has given rise to an explosion of digital transaction networks and disrupted the traditional capital markets.

According to the [Fidelity Digital Assets™ 2021 Institutional Investor Digital Assets Study](#) ~70% of institutional investors expect to buy or invest in digital assets in the future, while more than 90% of those with an interest in digital assets expect to have an allocation in their institutional or client portfolios within the next five years.¹⁰

Activity and opportunity: plenty of both

Institutional demand for digital assets was also reflected in Citi's online survey where 88% of respondents stated that their organization was either actively participating or exploring use cases in digital assets, blockchain or DLT (see Figure 7).

FMI interviewees were similarly engaged with digital assets, with all of them already live with, or working on, digital asset initiatives,¹¹ tokenization and fractionalization. While at present these mostly involved digitizing traditional assets, some FMIs were keen to highlight the broader potential of extending into other often less liquid markets, such as syndicated lending, real estate or art. Apart from expanding the range of readily-tradable assets, tokenization and fractionalization would also enable portfolio trades that would hitherto have only have been possible in very large size due to the high price of individual assets.

Furthermore, as digital assets can capture all the data pertinent to the asset within them, this provides greater transparency and automation opportunities, thus making due diligence and transaction workflows more efficient. For example, with syndicated lending, the digital asset might actually show that the underlying asset backing the syndicated loan was a specific physical asset (e.g. a wind turbine).

Rather than focus on a single approach to digital assets, some FMIs have adopted a multi-strand methodology for digital assets. For instance, SGX has explored three distinct avenues:



An investment in the DBS Digital Exchange which includes:

- **Security Token Offerings** – A regulated platform for the issuance and trading of digital tokens backed by financial assets, such as shares in unlisted companies, bonds and private equity funds.
- **Digital Currency Exchange** – Cryptocurrency trading that will facilitate spot exchanges from fiat currencies to cryptocurrencies and vice versa.
- **Digital Custody Services** – An institution-grade digital custody solution to meet the increasing demand for secure custodial services tailored for digital assets under their prevailing regulatory standards.



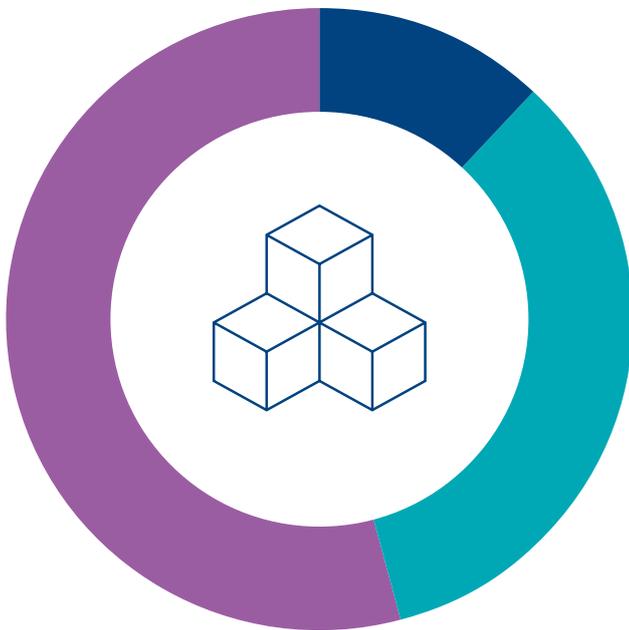
Project Hash: a proof of concept for bond issuance, not on a ledger-based system, but instead a smart contract described in Digital Asset Markup Language (DAML). This has now been officially launched as a JV with Temasek named Marketnode.



Project Ubin: a project initiated by the Singapore government and regulator to explore digital technology. SGX conducted a successful proof of concept involving a DVP settlement across two separate ledgers (one for security tokens, one for stable coins).

7

Is your organization currently engaging in digital assets, Blockchain or DLT?



● No plans in the foreseeable future	12%
● No. But we are actively exploring use cases for the near future	34%
● Yes. We are active participants in this space	54%

Success factors: the role of government

Despite the opportunities inherent in digital assets, all non-traditional FMIs (and some traditional ones) stressed the importance of national government support by passing securities laws that made necessary provisions. Switzerland's Distributed Ledger Technology Act and Germany's Electronic Securities Act were both cited as good examples. More generally, government initiatives to facilitate innovation, such as through the use of sandboxes, were seen as vital to further development. Without such legislative and practical support, much of the benefit of digital assets would be foregone.

A further need mentioned by several FMIs was collaboration. In their view, digital asset initiatives should ideally be a collective global endeavor across FMIs, in order to maximize the benefits and liquidity of digital assets. This collaboration was also seen as particularly important in terms of regulation, with a need for regulators to coordinate across borders and agree on global standards for digital assets (and other emergent technologies). "A digital asset with no jurisdiction – how do you regulate that?" said one FMI.

"As yet, nobody is talking about an industry standard internationally for a globally regulated digital exchange, which misses out on many of the potential benefits such as interoperability and economies of scale." Anonymous

In this context, the value delivered by legislation such as Germany's Electronic Securities Act or Switzerland's Distributed Ledger Technology Act is obviously constrained to a national level and forgoes possible efficiencies, such as netting off of positions against those in other jurisdictions, thereby increasing capital requirements and costs.

Digital asset infrastructure: separate or integrated?

One of the questions yet to be fully answered was the interaction between digital and legacy asset infrastructures. Would FMIs build digital asset infrastructure alongside existing legacy asset infrastructure, or build one infrastructure that could handle both asset types?

The majority of FMIs felt building alongside was the preferred option. Of those that thought a single consolidated infrastructure was preferable, the majority acknowledged that (in the medium term at least) a parallel infrastructure would be required.

“You have to build a new infrastructure, but it has to be able to talk to your legacy asset infrastructure. That’s because there will be a period of perhaps up to a decade when the systems will be transitioning from one to the other.”

Rahul Banerjee, CEO and Co-founder, BondEvalue

Meanwhile, some FMIs have already been able to use their legacy asset infrastructure to handle digital assets, with B3’s Hashdex ETF, launched in April, being an example. However, B3 is not committed to this approach and has indicated that it might opt to use a different platform in the future for digital assets.

Immediate atomic settlement: the critical role of regulation

Immediate atomic settlement¹² was seen by several FMIs as primarily being part of achieving a global settlement layer where customers could settle any type of transaction for all types of assets, both traditional and digital, that would also

50% of market participants believe atomic settlement is achievable within 5 years



be completely fungible. However, regulation was seen as one of the main challenges to this transition, including the issues surrounding regulatory jurisdiction and collaboration mentioned earlier (see ‘Success factors’). More specifically, how could regulated instruments from different jurisdictions and regulators be placed on the same settlement layer so they settled instantaneously? Some FMIs were quite pessimistic about how this might be resolved because of the sheer range of regulatory stances, from extreme conservatism to proactively supportive, that would need to be reconciled. Several were also unsure about how atomic settlement could function properly where controlled currencies were involved.

However, in the shorter term, the prospects for traditional assets being settled separately on an immediate atomic basis were seen as positive, according to a proof of concept conducted by the Chilean central securities depository (CSD), DCV with the Central Bank of Chile. The majority of FMIs felt that technology was already mature enough to support this, with several mentioning that they did not see questions such as those over scalability as

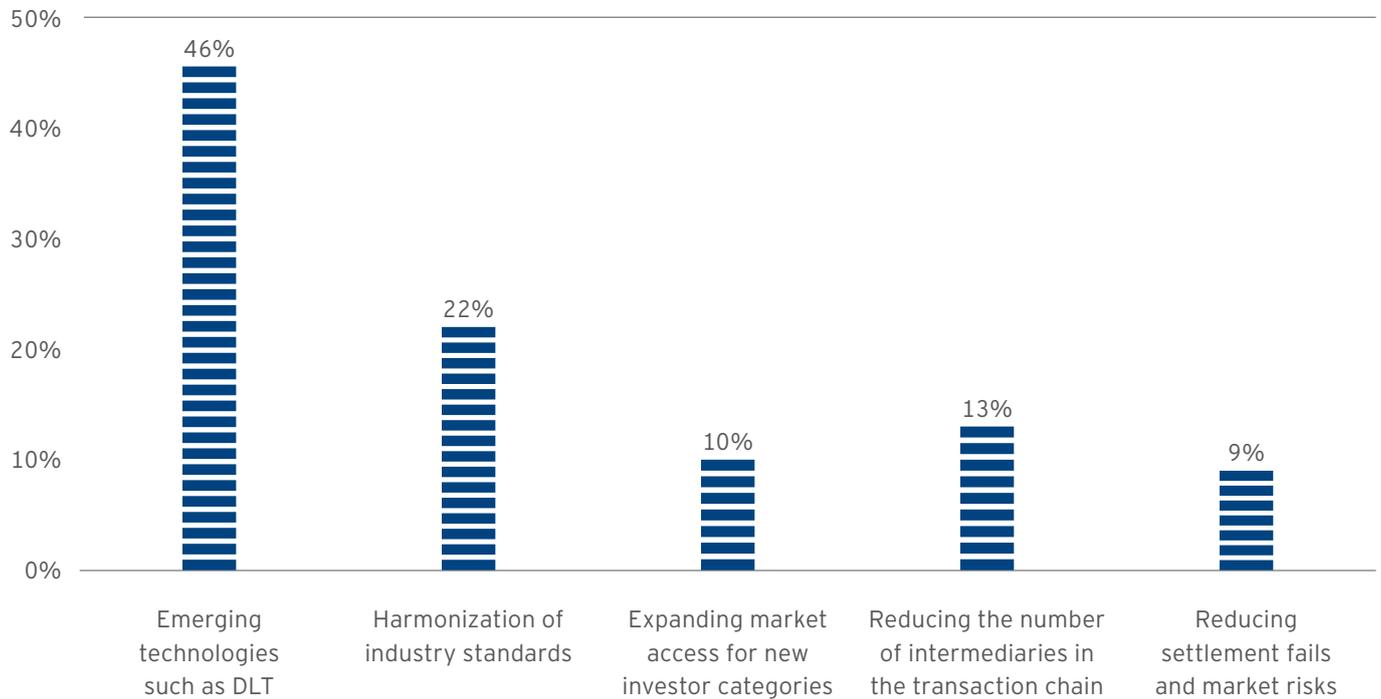
8 Atomic/immediate settlement is...



● Achievable in the near future (within the next 5 years)	50%
● Achievable, but only in the longer term (>10 years)	43%
● Not achievable	7%

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What will be the key factors in enabling atomic/immediate settlement?



likely to be long term issues. Nevertheless, most of those that expressed a view as to timeline thought it would be five to ten years before this was commonly available in a production environment at full scale. They also saw it as a gradual process, probably first involving asset classes that were simpler and with less inherent risk (such as commercial paper).

The majority of market participants were more optimistic on the timeline for atomic settlement, with 50% thinking it was achievable within five years, while 43% took a longer

view and expected it to take ten years or more (see Figure 8). They also strongly favored emerging technologies such as DLT in enabling atomic settlement, with ~46% ranking it as their first choice (see Figure 9).

As with a transition to T+0, the loss of netting was seen as a major challenge to atomic settlement and also likely to result in reduced market liquidity. Similar related obstacles were highlighted, such as asset managers needing to know before executing a trade which fund would carry the trade and would therefore have to provide the pre-funding.



Digitalization is a major trend for both FMIs and market participants, with plenty of activity across digital assets, tokenization, fractionalization and DLT. FMIs are mostly still working on digital assets in the context of traditional assets, but can also see potential for less liquid markets, such as real estate. However, they regard a harmonized legal/regulatory infrastructure as vital to fulfilling the full potential of digital assets.

Technology and digital transformation

The recent successful testing of a settlement interface for electronic securities by Deutsche Börse, Deutsche Bundesbank and Germany's Finance Agency was yet another reminder of the impact advances in technology are having on the settlement process.¹³ In that case, settlement was conducted using DLT, but other recent examples have also combined various technologies to facilitate settlement, for instance the recent settlement of a digital OTC derivative using cloud technology plus DLT.¹⁴

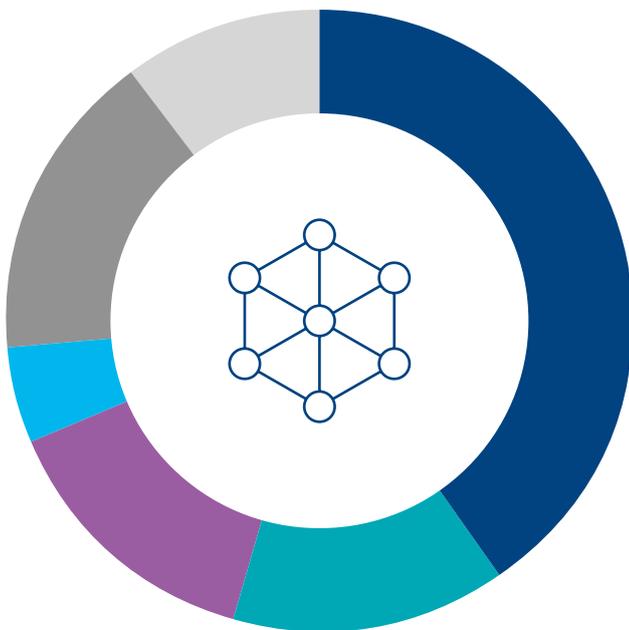
These are not isolated examples, but more the tip of a technological iceberg. Elsewhere, examples include organizations using a combination of multiple technologies to improve the client experience, such as an AI/ML tool to read and understand incoming emails and then prepare automated responses after extracting relevant information. These activities resonated with the FMIs interviewed, who were also conducting a broad range of activities across research, proofs of concept and live production projects using some or all of these technologies.

DLT: high profile and high volume?

The ASX's DLT-based replacement for its CHES settlement system reflects DLT's advancing credibility for high resilience/performance settlement systems. Elsewhere, DCV is working on a model for bond issuance through DLT with payment outside of DLT, which is expected go live in the next year or so. While other FMIs have not yet committed to using DLT for their core systems, several are already evaluating it and commented positively on its various features, such as providing a single authoritative data source.

The lack of scalability has historically been an issue for distributed ledgers, such as blockchain, but this is no longer the case.

10 What technologies do you think will be core to a successful transition to T+1/T+0?



● DLT	40%
● AI/ML	14%
● Cloud	14%
● Robotics	5%
● Upgrade of existing infrastructures	17%
● APIs (Application Program Interface)	10%



40% of market participants ranked emerging technologies such as DLT as being core to a successful transition to a shorter settlement cycle

“A significant problem until about three years ago was getting chains scalable enough to handle the potential volume. However, some very smart developer communities have been working on this and so some blockchain products are already capable of processing at transaction rates similar to the major card processing networks.”

Alessio Quaglini, CEO, Hex Trust

However, FMIs did not see DLT as necessarily essential for settlement compression, although some did draw a distinction between T+1 and T+0 on this, only seeing a role for it in attaining the latter. Meanwhile, those with existing (non-DLT) technology already capable of supporting T+0 were understandably less convinced of the need for DLT to compress settlement. Market participants took a different stance however, with ~40% of them ranking emerging technologies such as DLT first as being core to a successful transition to a T+1 or T+0 environment (see Figure 10).

Though FMIs were mostly positive on the potential for DLT, they pointed to a number of possible structural consequences of adopting it. These included the implicit removal of intermediaries, particularly in the context of disintermediation. The removal of intermediaries could also introduce additional risks to the system because services currently provided by those intermediaries would either have to be offered by others or discontinued. Some FMIs pointed out that the current chain of intermediaries to some extent served as a buffer in stressed market conditions and this buffer effect would also be lost with DLT, while others felt that DLT could even make certain activities, such as securities lending, no longer feasible.

When it came to actual implementation, DLT was widely seen as being the most challenging to implement out of all the technologies discussed. Two common reasons cited were the lack of any large scale financial implementation as a precedent from which to learn (which was one reason many FMIs were following the ASX's progress closely) and the lack so far of any dominant, common standards to deliver the network effects financial markets and infrastructures rely upon for efficiency

and interoperability. Apart from the lack of a common standard, there was the additional consideration that all participants would need to implement whichever DLT model was adopted.

Several FMIs underlined that this technology adoption hurdle was often a major cause of delay and cited various examples, but noted this wasn't just a case of foot dragging for the sake of it. Or as one FMI put it: “There will be resistance in the industry and that won't just be because people don't want to change the way they operate, but because they cannot afford to change the way they operate.”

This view is understandable when one considers the sheer size and number of interconnecting organizations in the post trade space. Therefore, while implementing DLT should deliver long term benefits, in the short term it creates significant downstream costs for the whole ecosystem.

AI/ML: more to offer

Most FMIs are already using artificial intelligence and/or machine learning, typically to achieve internal efficiencies, but again none saw it as critical to compressing settlement. However, it could have the potential to become increasingly valuable in the context of settlement efficiency, especially in conjunction with DLT, or more specifically the centralization of data implicit in DLT. As all the authoritative data is contained in the distributed ledger, AI/ML would have far more complete and coherent data sets to work with than at present, where multiple intermediaries, each with their own set of records, pass transactions among each other. Although a few FMIs are already using AI/ML for detecting nefarious activities, such as money laundering or market manipulation, the access to more holistic data was seen as a major advance in this regard – as well as more generally further reducing manual activities with AI/ML.

Some European infrastructures thought AI/ML had potential for reducing settlement fails in the context of CSDR. One example mentioned was recognizing which counterparties were best/worst to trade with in terms of settlement failure and basing risk-adjusted trade pricing on the back of that. Another example was if the same stock was held in two different locations (e.g. the US and Germany) how the relative 'geographical settlement risk' might be used by AI/ML to guide differential trade pricing.

Cloud computing: complementing efficiency

While cloud computing was not seen as critical to settlement compression by FMIs, it was seen as highly complementary to settlement efficiency. For instance, one CSD has created a data lake hosted in the cloud, which will enable better management of client requests, as well as supporting tools to assist clients in maximizing settlement efficiencies and minimizing CSDR penalties.

LCH also highlighted the enormous investment leading cloud providers had made and how that in practice that might mean cloud would be perceived as possibly equal in terms of resilience to in-house data storage. Ultimately, that could mean core DLT technology being hosted in the cloud rather than on dedicated in-house hardware.

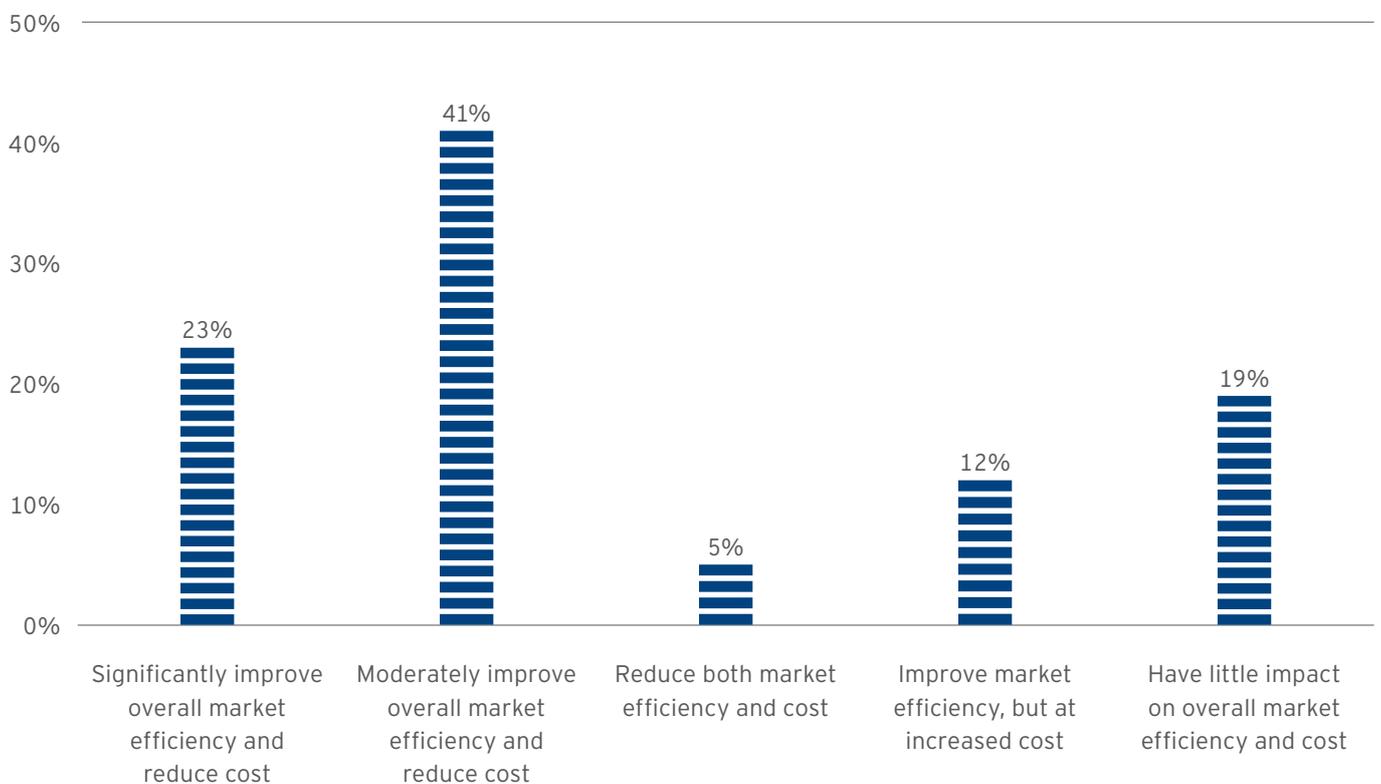
Cloud computing was seen as relatively easy to implement, as many participants have already bought into the concept. However, regulatory restrictions on the physical location of data have proven to be a barrier to implementing the cloud in certain jurisdictions.

Technology gains for market participants: FMIs' views

FMIs saw DLT, cloud and AI/ML benefiting their market participants in various ways, with cost savings high on the list. One FMI had this made clear to them, when discussing DLT technology with a bank client and found the execution team turned up, but no one from the middle or back office. The execution team were keen to reduce costs and so had attended *en masse* because they saw DLT as a means of achieving this. This resonated with the poll results, where 64% of market participants felt that DLT would significantly or moderately improve overall market efficiency and reduce cost (see Figure 11).

Efficiency gains were seen as being of similar importance to cost savings. Cloud in conjunction with AI/ML was a good example of this by enabling very high volume scalable analysis and decision making. JPX also shared that while DLT had been the main topic of technology conversations with its market participants, this had more recently been superseded by AI/ML.

11 A DLT-based market infrastructure would...



A few FMIs felt that the process improvements inherent in a shorter settlement cycle, rather than any particular technology, would deliver the greatest benefits to market participants and that these might ultimately influence the price at which trades were done.

Technology continues to have a significant impact on the overall settlement process, however as mentioned above, FMIs were relatively sanguine about its significance as a factor in reducing settlement cycles. A much higher priority cited by most traditional FMIs was the need to get buy-in from clients and coordinate them all in any migration to new processes and settlement timelines.

While technology is ultimately only an enabler, market participants responding to the poll nevertheless saw it as the main priority, with nearly 50% regarding upgrading or re-platforming legacy technology as the most important factor in enabling a T+1/T+0 environment (see Figure 6).

Digital transformation: accelerated reality

Digitization is poised to transform the securities services industry and the recent pandemic clearly accelerated the pace of transformation. Almost overnight, the benefits of digitization moved from theoretical, to practical and essential.

This sentiment was echoed by interviewees who were clear that digital transformation was a major priority for their organizations – several of them had dedicated management/departments devoted to this. Some had even conducted in-depth analyses of working processes as part of their pandemic response and had been surprised at the number of paper processes and documentation they discovered. Digitizing internal documentation had therefore been a priority but also a relatively easy win.

However, digitizing external documentation/processes was generally perceived as adding the greatest value. One example of this has been SGX's drive to digitize all interactions its CDP depository subsidiary has with its retail and direct corporate

clients. It has introduced SGX Investor Portal to replace previous paper processes, which appreciably streamlines investor activities ranging from updating personal details, to participating in corporate actions.

Government and regulatory support is key to this, particularly in activities that involve identification. In the case of Singapore, government initiatives such as Singpass, Myinfo and SGFinDex have all materially supported SGX's digitization efforts, allowing it to complete account opening within 15 minutes and significantly reduce call center talk time. However, a number of FMIs countered this by observing that in their cases, extreme caution on the part of local regulators posed challenges to their digitization efforts and effectively enforced the retention of inefficient manual/paper processes.

APIs were also cited by FMIs as an important aid to digital transformation by accelerating processes and removing manual intervention, with several of them running projects to increase the uptake of APIs by their participants. Agile methodology¹⁵ was also raised as an important tool in digital transformation, especially when contrasted with the traditional approach of pursuing large monolithic projects involving multi-year timelines.

As one exchange put it: "Using agile we are achieving multiple deliveries with each one focused on the best solution available at that point in time, rather than what was the best three or four years ago."

While most FMIs focused on the technology required to support digital transformation, Monte Titoli (part of Euronext group) made a point of stressing the cultural change also required. In its particular case, that involved a large investment in training and education over a three year project, but was seen to have delivered value because, by changing the collective mindset, the organization was able to innovate far faster and deliver more efficient processing to clients. It also meant that the concept of continuous change and improvement had become naturally engrained.



FMIs see DLT as having promise in terms of efficiency but, unlike market participants, only some see it as crucial to shorter settlement cycles and even then only for T+0 and atomic settlement. They see DLT as challenging to implement in comparison with other technologies they also regard as promising, such as AI/ML and cloud. Digital transformation is top of mind for all FMIs interviewed, but regulation was again mentioned as a possible obstacle to this.

Conclusion

The market volatility at the beginning of the pandemic underlined the critical role that FMIs have in ensuring the stability of the global financial system. As part of that role, FMIs are already looking at how they can further reduce risk by shortening settlement cycles and adopting new technology, as witnessed by DTCC's planned transition to T+1, plus its DLT project that has the potential to deliver T+0.

Most FMIs are in a stronger technological position than market participants to make this transition, as they had already future proofed their technology during their previous transition (from T+3 to T+2). In addition to DTCC, other FMIs are also working on a number of DLT-related projects. While they appreciate its potential for faster settlement, they see a more valuable role for it in conjunction with other technologies (e.g. AI/ML and cloud), for instance to reduce settlement failures.

Despite their considerable investment in new technology, FMIs are very clear that it is a means to an end, not an end in itself. For them, the priority is to design and implement the most efficient business processes and then leverage technology to support those processes in the most efficient way possible.

To that end, they are very aware of the need for standardization to ensure interoperability and maximize the network effects that will deliver efficiency gains, cost savings and future flexibility.

Market participants are clearly aware of the need for them to keep pace with this digital transformation and while this may be neither easy nor inexpensive, those that do not advance digitally may ultimately find themselves displaced.

While the long term trend is towards greater standardization of global standards, in the medium term at least, markets and regions will continue to progress at varying speeds depending on specific priorities and the regulatory environment. On that note, FMIs see the role of regulators and legislators as absolutely critical in providing the necessary framework to facilitate progress.

Collectively, our interactions with FMIs and market participants reveal a securities industry in a highly positive state of evolution. Much preparation is underway and there is growing acceptance of disruption (both technological and process) as a positive in shaping the future of securities markets.

- ¹ Digitization: convert data (e.g. in document form) to a digital format. Digitalization: convert business processes to use digital technologies, rather than analogue or offline systems such as whiteboards.
- ² DTCC's Project Ion and Project Whitney: <https://www.dtcc.com/news/2020/may/18/dtcc-unveils-proposals-to-explore-further-digitalization>
- ³ Traditional FMIs were defined as long standing exchanges, centralized securities depositories and clearing houses.
- ⁴ A stock that has gone viral online, attracting the attention of retail investors.
- ⁵ <https://www.dtcc.com/news/2021/february/24/dtcc-proposes-approach-to-shortening-us-settlement-cycle-to-t1-within-two-years>
- ⁶ The Securities Industry and Financial Markets Association (SIFMA), the Investment Company Institute (ICI), and The Depository Trust & Clearing Corporation (DTCC)
- ⁷ <https://www.dtcc.com/dtcc-connection/articles/2021/august/20/accelerating-settlement-why-t1-settlement-is-right-approach-at-this-time>
- ⁸ <https://www.bis.org/cpmi/publ/d00b.htm?selection=26&scope=CPMI&c=a&base=term>
- ⁹ https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200618/2020_2-e-krona-design-models-pros-cons-and-trade-offs.pdf
- ¹⁰ <https://www.fidelitydigitalassets.com/articles/digital-asset-survey-2021>
- ¹¹ DTCC's Project Ion and Project Whitney: <https://www.dtcc.com/news/2020/may/18/dtcc-unveils-proposals-to-explore-further-digitalization>
- ¹² The transfer of two assets linked so as to ensure that the transfer of one asset occurs if and only if the transfer of the other asset also occurs. Settlement is therefore conditional, so the outcome is either a full and successful exchange or assets, or no transfer taking place at all.
- ¹³ <https://www.bundesbank.de/en/press/press-releases/dlt-based-securities-settlement-in-central-bank-money-successfully-tested-861444>
- ¹⁴ <https://www.marketsmedia.com/first-fully-digital-settlement-of-otc-derivative-in-germany/>
- ¹⁵ Agile methodologies use incremental and frequent deliveries of small segments of functionality, delivered by small cross-functional self-organizing teams, involving frequent customer feedback and course adjustment as required.



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