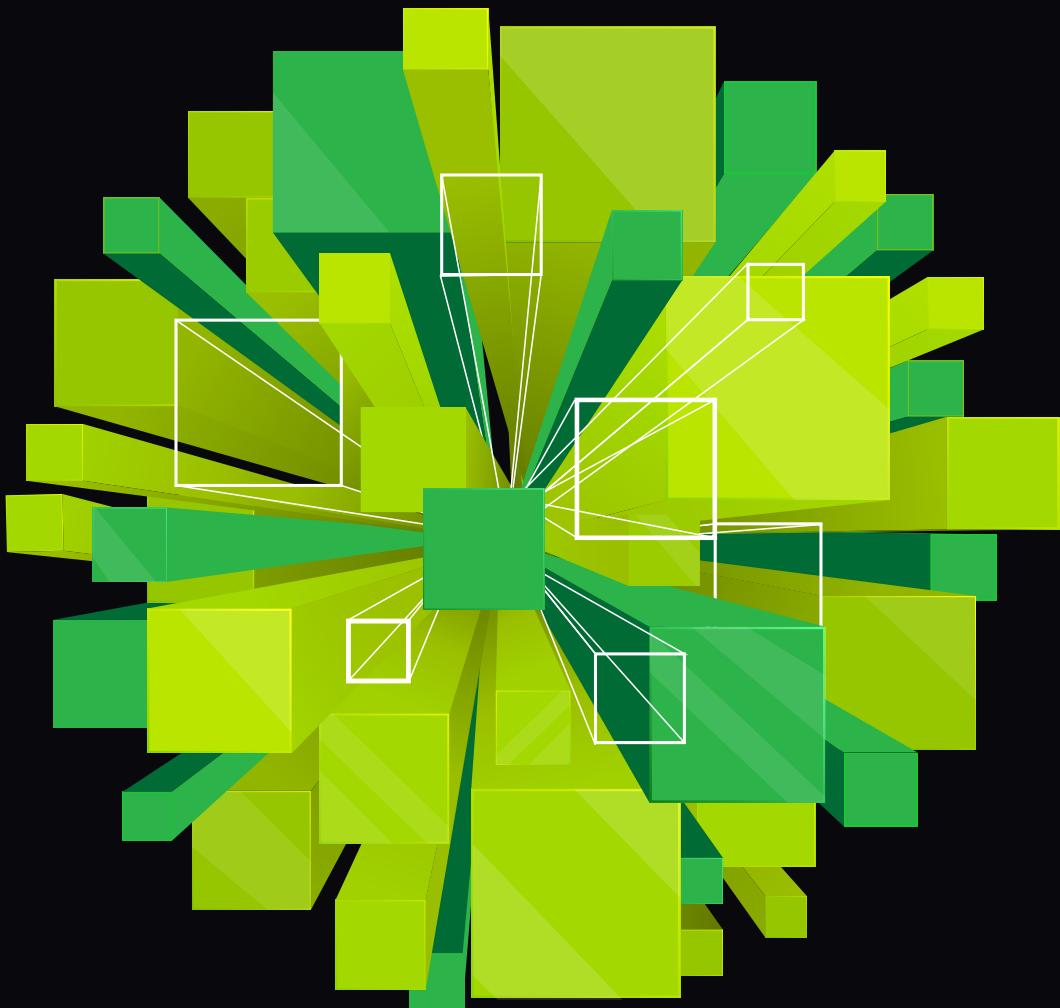


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Taking blockchain live

The 20 questions that must be answered
to move beyond proofs of concept

In 2016, blockchain took giant steps forward in gaining wider acceptance, especially in areas such as cross-border payments and post-trade in capital markets. However, as Deloitte's Eric Piscini pointed out earlier this year in CoinDesk, the fear is that if you "poll anyone in the financial services industry, they will likely tell you that the technology is still in need of its break-out moment. If significant headway isn't made—or real value delivered, whether in cost savings or new revenue generation—by the end of 2017, I suspect the technology will risk developing fatigue in executive suites." So, despite a unanimous consensus about blockchain benefits, why haven't we yet seen any use cases go live at scale?

Blockchain offers very unique transformative features such as immutability, transparency, and autonomy.¹ The potential to rewire the foundations of transaction fabrics we

use daily is significant. Similar to when we rewired power, transportation, and information fabrics, it will take courage and time to change the ways we transact today. Blockchain will be bigger than you can imagine, but will be harder than everybody expected.

Between Deloitte's blockchain team—now comprised of more than 800 professionals across 20 countries—and Blockchain Labs in Dublin and New York, we have developed over 30 proofs of concept (PoCs) and have designed countless commercialization strategies with clients.

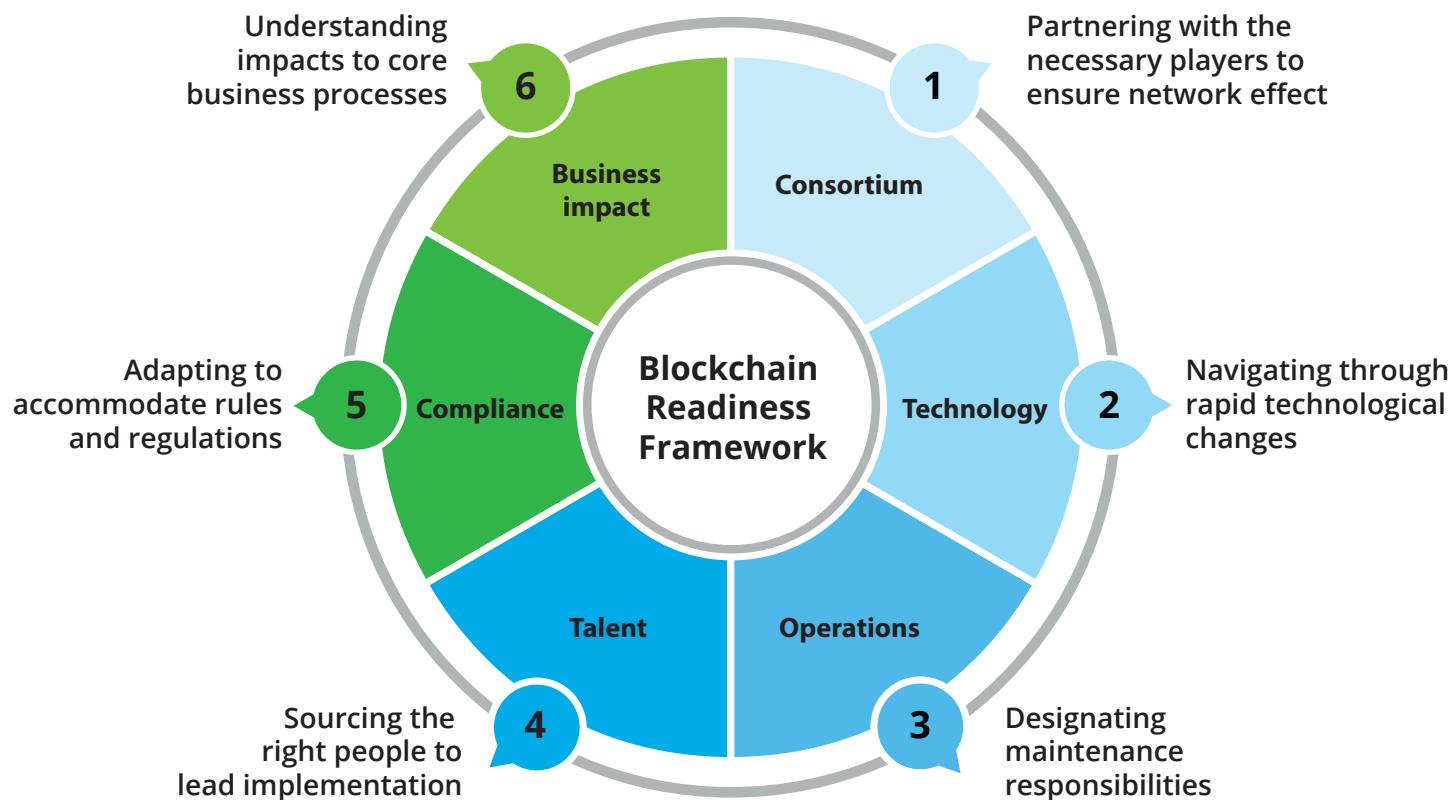
We have found that there are 20 essential questions, summarized within Deloitte's Blockchain Readiness Framework, that must be asked (and answered) to help determine either failure in an abandoned PoC or a successful new technology innovation,

thanks to blockchain. By addressing these questions early, the chances of successfully harvesting the benefits of blockchain increase dramatically.

Designing a winning blockchain commercialization strategy

In order to guide conversations, we identified a series of considerations and key questions, as outlined in our Blockchain Readiness Framework, to help define a winning commercialization strategy. Organized into six categories, each question serves as a mechanism to further evaluate the opportunity at hand.

By addressing these questions early, the chances of successfully harvesting the benefits of blockchain can increase dramatically.



Consortium considerations

In order for us to consider a blockchain solution to be high-potential, it must involve multiple parties across an industry. Consortia are necessary to align incentives for participation, outline roles and responsibilities, and orchestrate and support the blockchain. A recent study concluded that there are over 25 global consortia in existence today comprised of over 550 total participants.²

In late 2016, Deloitte conducted an online survey of 308 senior executives at organizations with \$500 million or more in annual revenue to better understand corporate sentiment and activities towards blockchain. When asked what would trigger widespread adoption, 43 percent stated that an industry-led, private sector consortium putting a blockchain solution into production would be the tipping point.³

To develop a winning strategy, institutions should carefully evaluate key players in their target ecosystem while, in parallel, identifying who must be included as part of the product development lifecycle. The latter half of that evaluation, which we refer to as the Minimum Viable Ecosystem, is essential when considering the transition from experimentation into commercialization. An experimental blockchain can be simulated without the Minimum Viable Ecosystem, but a commercialized solution cannot be sustained without it.

Background: Trade finance

Our blockchain-based trade finance solution capitalizes on the digitization of trade to enable the codification of trade agreements into a smart contract. Triggers within the smart contract are used to bring operational efficiencies to today's paper-based processes. This can help to reduce the number of fraudulent transactions and bring increased liquidity to suppliers.

Has the target operating model been defined?

Too often, the initial focus for a blockchain solution is solely on technology aspects rather than how it should function. Without clear operating and governance models in place, critical decisions (e.g., liability models and trusted oracles) cannot be agreed upon across parties.

Prior to selecting an operating model, a consortium's goals should be identified and agreed-upon. The more formal the working arrangement, the more aligned the goals will need to be.

In order to buildout our trade finance use case, for example, we have to choose between the following three operating models:

- **Private:** All participants from the private sector pool form a new entity, which operates the solution on everyone's behalf; the public sector is involved from a regulatory perspective
- **Public:** All participants within the consortium meet regularly for activities, including technology standard definition, data, governance, and, ultimately, deployment
- **Hybrid:** Participants from private and public sectors collaborate to form a partnership that hosts, operates, and monitors the platform

The hybrid model allows each involved financial institution to share ownership of the platform with support from the regulator, which faces the potential complication of a government entity involving itself in the private sector. Each use case has differing needs, though, so this decision should be made carefully after thorough due diligence, as it will impact overall ownership.

How is the consortium operating on a day-to-day basis?

Establishing the consortium's structure for managing day-to-day operations is critical

since mitigating inefficiencies can preempt critical issues that impede commercialization.

Within trade finance, a working group was established as a predecessor to a consortium. The group's sole purpose was to assess potential feasibility and effectiveness of blockchain. In order to function efficiently, the overarching government entity led bi-weekly meetings to report progress, and address key decisions and concerns. The team learned that one-on-one meetings should be periodically held with each participant to ensure all voices are heard.

While check-in meetings do not need to be conducted daily or weekly, it is important for the operating entity to understand each participant's distinct standpoint and motivation to help obtain consensus across the consortium.

Who is liable when issues arise within production?

While blockchains are inherently distributed, a designated entity must oversee the solution from a technology and management perspective. For example, if a software exploit is identified, or if an update causes performance issues, participants of the network cannot be directly held liable. Determining who should own liability is more easily achieved following the identification of a target operating model.

Within the trade finance use case, participating financial institutions preferred a hybrid model, in which the government entity would own liability of maintaining the blockchain solution (a private model, in which the newly-formed entity would be liable, was also suitable). Irrespective of the operating model selected, the chosen entity must swiftly address risks and issues to avoid significant impacts to the blockchain solution and its users.

Consortium sizing

When establishing a consortium, a balance is needed to achieve sufficient diversity and representation, without diluting the overarching goal.

For example, in addition to banks, a trade transaction should include regulators, corporations, and shipping carriers.

What is the process for members to join and/or leave?

Joining (and, conversely, leaving) a blockchain network is not as simple as provisioning a user account. Within permissioned blockchains, for instance, entities hold a certain stake within the network; adding new members would mean that stakes would need to be reassigned or redistributed. If a cryptocurrency is involved, what would happen to assets if a member leaves the network?

If a cryptocurrency is not involved, as is the case within trade finance, data ownership becomes the critical component. This concern can be further amplified depending if information is maintained on- or off-chain.

Reassignment of intra-blockchain assets aside, the consortium's operating model helps dictate the complexities and processes associated with entering or leaving (i.e., is a formal vote conducted or does a designated body make the decision?). If the blockchain solution is privately owned by banks, for example, there is typically a desire to be restrictive; however, if led by a government entity, anti-competitive laws may loosen guidelines.

Technology considerations

The rapidly-growing technology community offers many options when selecting a blockchain platform. Factors that should be considered include consortium size, data sensitivity, scalability, and performance.

However, technology decisions that need to be made extend far beyond the platform since it is likely to interface with numerous legacy systems and trusted oracles. As part of our blockchain survey, 25 percent of respondents stated that replacing or adapting existing legacy systems is impeding their organization from investing more in blockchain technology.³

Any consortium implementing blockchain must understand how it will integrate with their participants' technology architecture, maintain stability during underlying protocol updates, and develop the proper strategy to ensure end-to-end testing validation.

Background: Cross-border payments

Our cross-border payments solution enables near real-time payments across geographies by enabling direct interaction over blockchain-based payment rails between transacting entities. Built using a micro-services architecture and APIs that can easily integrate with multiple platforms, it is built for financial institutions to enable P2P and B2B payments.

Have all architecture decisions (e.g., legacy systems) been solved?

A blockchain solution is rarely just that—greatest value is achieved when it is part of a greater network alongside legacy components (e.g., relational databases and web applications). This requires a consortium's entities to decide how blockchain fits and interfaces with them.

As part of our cross-border payments use case, our key architectural insights included leveraging an open API architecture, and adopting both middleware and interoperability layers, to facilitate orchestration between blockchain-based payment rails and banking infrastructure.

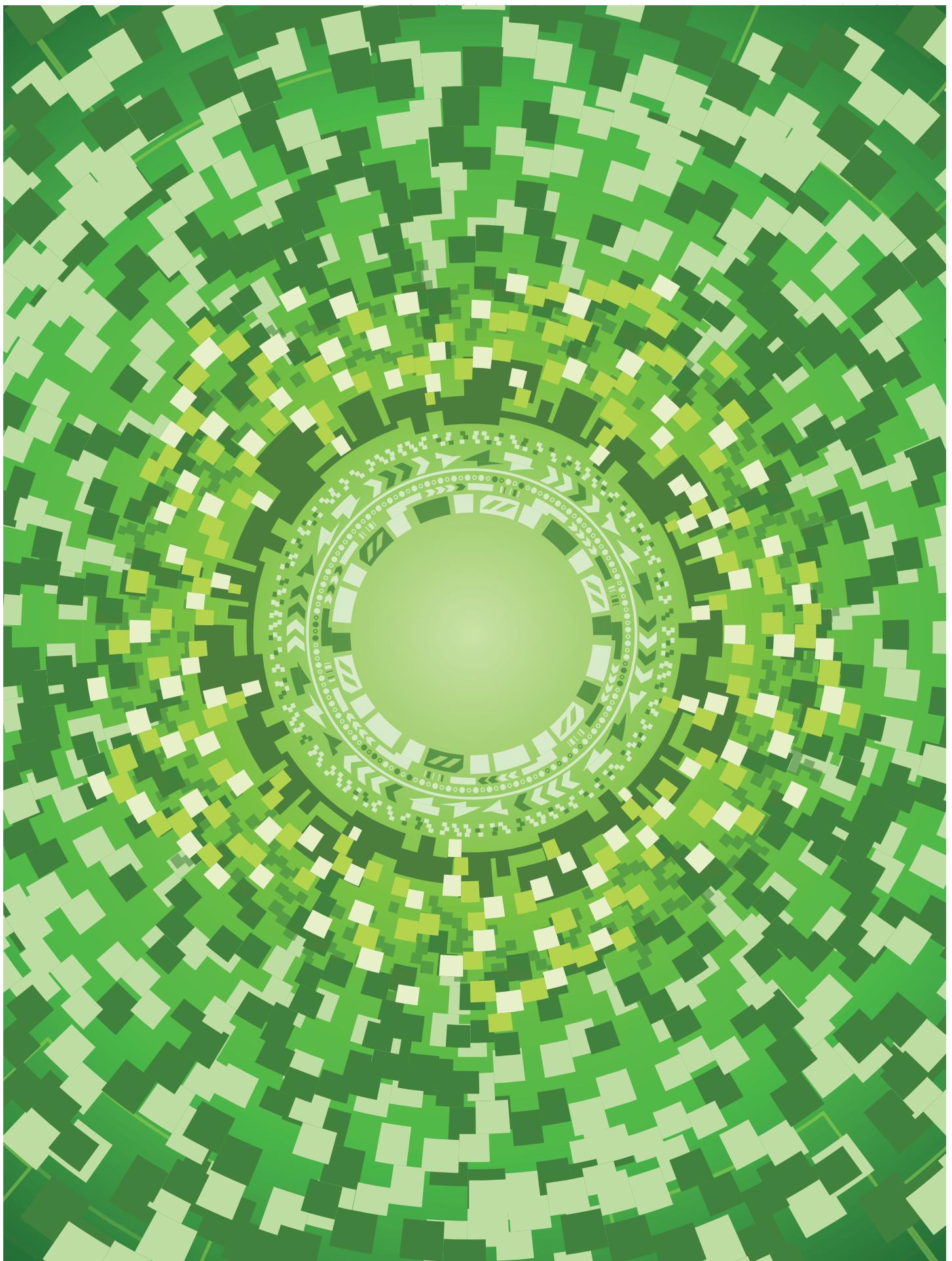
The interoperability layer manages the generation, mapping, and allocation of private and public keys provided by the blockchain service provider, while also encrypting and decrypting private key values when interfacing with the respective data store. Additionally, by coupling tiered and micro-services architectures, data could be extracted easily, while making external system integrations more feasible.

While optimal architectural layers will vary between use cases, designing a strong foundation promotes the success rate of blockchain commercialization.

What impact do protocol updates have on stability?

Given how young blockchain is as a technology, it is not surprising how rapidly each solution is being updated. Even the most mature protocols can see significant updates as frequently as every six months. When commercializing a blockchain solution, the impact of updates on interoperability and uptime should be kept in mind. To mitigate potential impact, the blockchain solution's architecture should be designed with a high degree of flexibility.

Within cross-border payments, recent protocol changes caused a shift from a trustless to trusted platform, forcing us to re-evaluate at-risk profiles. While this particular use case benefited from enhanced privacy and increased scalability, we were forced to reconsider partnerships within the blockchain ecosystem once regulations were established. While such changes were not detrimental, they highlight the importance of selecting a mature platform and implementing a flexible architecture to avoid potential breakages.



Crop insurance

Farmers often purchase crop insurance to hedge against weather risk. If it doesn't rain for a period of time, they can file a claim with their insurer to get reimbursed for damages—each weather source can have deviations, potentially impacting insurance payouts.

How are oracles defined and agreed upon across all members?

A blockchain solution often requires integration with trusted external data sources, known as oracles. For example, a smart contract that supports autonomous crop insurance requires a trusted oracle to feed the blockchain with weather data for that region. It must be trusted by the entire network to avoid undermining the network's credibility. Selection can be further complicated in use cases in which standards have not been formally defined.

Our trade finance use case benefited from defined standards by global bodies for existing, paper-based trades; however, data standards for the global exchange of digital documentation are still nascent. In such instances, an opportunity exists for consortia to define foundational standards for a digitized future.

Has all testing (e.g., security and reliability) been completed?

Blockchains are unique to other technology deployments since not all threats are fully understood yet. Any smart contract or application must be thoroughly tested to maintain integrity of the blockchain alongside integration with legacy components and trusted oracles. Extensive network testing must also be performed across nodes to ensure security.

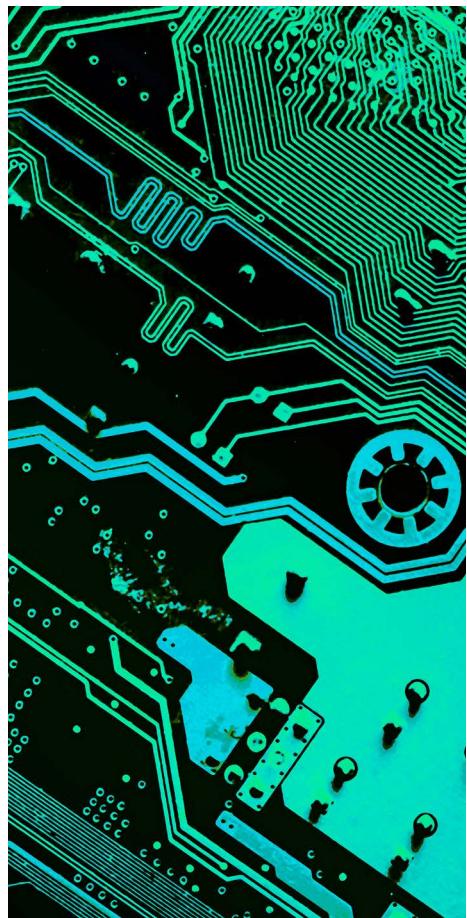
Within cross-border payments, testing security features was critical. Because our team was located across the globe, all deployment, communication, and documentation was maintained on the cloud

to facilitate agility and enable comprehensive testing. The most important aspect, based on our experience, was iterative user acceptance testing (UAT). Our team conducted UAT every three weeks, which allowed a point-in-time evaluation on whether current work was aligned with expectation. The advantage of frequent UAT cycles was timelier course correction throughout development and testing. Consistent testing approaches also helped address the foundational challenge with such an innovative solution—since it keeps evolving, there are constantly new enhancements to evaluate.

Are well-defined goals and key performance indicators (KPIs) established?

Blockchain should not be implemented for the sole purpose of utilizing a breakthrough technology. Clear goals, and their corresponding KPIs, should be defined within a consortium.

Based on conversations within our Blockchain Labs, common KPIs include transaction speed, hash rate, and processing time. However, KPIs should be specific to each use case and directly aligned with the business problem attempting to be solved. For example, in addition to improving processing time and lowering transaction costs, we wanted to track customer experience improvements within our cross-border payments use case. While difficult to track, the team passionately believed it was critical to develop creative metrics to assess customer satisfaction.



Operations considerations

A commercialized blockchain solution will significantly impact the day-to-day operations of certain functions within an organization. In a consortium-driven model, all operational decisions will, by nature, be a group decision, which presents a unique set of challenges. As part of our blockchain survey, 32 percent of respondents stated their organization lacks the in-house capabilities required to promote greater investment in the technology.³ This implies that consortia have the added challenge of agreeing upon operational guidelines, best practices, and which organizations to engage with for third-party support.

While daunting to get started, learnings may be gathered to harvest the benefits of blockchain from the 25+ existing global consortia or from successful consortia established prior to blockchain, such as payment associations, capital market platforms, and monetary authority-driven business ventures.

Who is managing the platform and making decisions to update it?

Decisions to update a blockchain network have significant downstream impacts, particularly as the number of users reaches critical mass and the platform matures. The entity managing the platform and making updates should be universally trusted across the consortium—potential consequences otherwise could be widespread and catastrophic.

Similar to any conversation involving multiple stakeholders, diplomacy, and patience is required when making decisions for the blockchain solution. Within RegChain, all decisions were made collaboratively. To facilitate consensus on change decisions, all

fund administrators were heavily involved in a working group to define business requirements. However, involvement by all parties was jointly overseen by Deloitte and a financial institution to avoid stalemates and resolve disagreements.

How can the platform be updated in production?

Any consortium should employ significant quality assurance efforts in a development environment prior to performing platform updates. Downtime is detrimental regardless of the use case, so any approach to updates should be engineered with that consideration in mind.

To address this, RegChain created a tactical steering committee to support the establishment of a clear governance model for updates. If any issues or changes arose, the steering committee mitigated the issue through consensus. Rather than being reactive, it is important to find an oversight entity to impose guidelines and processes to handle situations such as platform updates.

Who is supporting the various layers of the platform (24/7)?

The developed blockchain solution must be constantly running and fully supported in case issues or exploits arise. A trusted party with extensive knowledge of the platform, its users, and the use case should be selected to ensure the blockchain is up at all times. Similar to electing a protocol provider, it is wise to choose a mature and reputable support provider.

To vet potential platform support providers, RegChain sequentially held discussions among the steering committee, regulators, and potential technology support vendors to ensure requirements were clearly understood and incorporated.

Background: RegChain

RegChain streamlines traditional regulatory reporting processes by acting as an “industry black box” for safe storage and review of large volumes of regulatory data. This capability also includes a smart contract that automates the execution of regulatory reporting. While focused on money market and investor fund reporting, this is extensible to any regulatory report that can be codified into a smart contract.

Talent considerations

Existing organizations looking to implement blockchain have found talent acquisition to be challenging. The number of qualified blockchain professionals is not able to keep up with the market's growing demand. As part of our blockchain survey, 26 percent of executives confirmed that they have already begun hiring staff or retaining consultants with blockchain experience, with an additional 49 percent stating that they will begin investing at some point in the future (as early as this year). Less than 10 percent of respondents stated that they will not be hiring staff.³

Within a commercialized blockchain solution, talent must be in place to manage functionality, implement updates, and support participants. A combination of internal and external teams is most effective to leverage knowledge of the internal ecosystem and third-party platforms, and to enable two-way dialogue between the consortium and selected technology partners.

Is the right team available to manage the platform?

Possessing the proper functional and technical knowledge of the blockchain solution is essential to facilitate effective long-term management and sustainability. The functional team must fully understand blockchain's impact on business functions, and the technical team must fully understand how the platform operates to support functional goals. For both teams, sourcing decisions must be carefully made to construct the ideal team. Resources may be sourced either by identifying in-house talent, contracting from a vendor team, or both.

Our cross-border use case team utilized a hybrid approach that allowed in-house talent to focus on user journey, user experience, and legacy integration. The end-to-end

design and integration to the vendor platform was co-developed with the vendor team who had in-depth blockchain platform knowledge. While the level of a vendor's involvement within a project may vary, it is typically beneficial to engage the vendor team upfront and throughout all phases of the design and development journey. Typically, the vendor team is fully embedded into the project during the design phase and then available ad-hoc as needed. Ultimately, however, sourcing decisions are dependent on a variety of factors, including, existing contracts, vendor platform complexity, maturity of available APIs, and availability of in-house resources.

Is the necessary talent and training available to be sustainable?

Though support from external vendors can contribute to long-term success of a blockchain platform, internal talent development is equally important to maintain sustainability. Institutions should be prepared to simultaneously train internal resources and aggressively seek talent externally.

For example, our cross-border payments team educated all resources on topics ranging from payments subject matter to blockchain fundamentals to micro-services architecture; this allowed the team to work more cohesively and led to fewer defects and changes throughout the project since the entire team understood end-to-end functionality. Moreover, as team members moved to different roles or new projects, it was easier for the team to cross-train and pick up the required skillsets.

To develop well-rounded talent, training encompasses business model and operational implications such as risk, internal processes, and regulations. Often times, technology training is the easiest component when compared to everything else.

How stable are the involved third parties to support the platform?

Institutions must be prepared to engage and collaborate with third-parties to successfully commercialize a blockchain solution—they may support the platform directly or be involved tangentially. Either way, these organizations, and the talent within, are critical. To facilitate involvement, it is beneficial to have continued engagement and communication with vendors. A successful vendor relationship, in most cases, is a relationship that fosters mutually-beneficial knowledge transfer to ideate on potential enhancements and new features. Having a successful vendor relationship is just as critical as having the appropriate in-house talent.

Compliance considerations

As regulatory bodies around the globe continue to evaluate blockchain, it has become even more critical to understand compliance considerations. As with any large-scale technology deployment, consortium participants must ensure they comply with all regulations, or else risk penalties.

When asked within our blockchain survey, 48 percent of executives responded that federal regulations supporting the use of blockchain would be the tipping point for widespread adoption. Similarly, 33 percent stated that regulatory issues are preventing their organization from making a greater investment in the technology.³

In addition to regulation, complying with modern security standards will also prove to be critical in any commercialized blockchain (particularly if sensitive data is involved).

Background: Reinsurance

Our reinsurance solution enables complex agreements to be mirrored on blockchain by generating smart contracts that capture key economic terms. In addition to being capable of supporting multiple organizations, its contracts follow ownership-based data visibility and security constraints to ensure confidentiality and establish an open, negotiation-friendly marketplace.



Are security certifications and reviews necessary?

If a blockchain solution handles sensitive data of any kind, all corresponding security certifications must be acquired (e.g., HIPAA if PHI is involved). To clearly understand what certifications and reviews are necessary, the solution's requirements (e.g., penetration testing of all nodes, documenting data integration points, and data export formats) should be clearly defined. Engaging with an organization that specializes in cyber risk can help ensure these requirements are sufficiently met.

As part of our reinsurance use case, a formal security review for the entire network had not yet occurred since defining universal security standards for the entire consortium was still in progress. However, each member of the consortium had its own organization-specific security policies that needed to be met. The consortium, as a result, was well positioned to leverage existing security processes while overarching compliance requirements were developed and documented.

How is regulatory compliance achieved?

While regulatory compliance continues to evolve at a rapid pace, it is ultimately intended to promote business relationships. Despite the complexities, blockchain is well suited for reducing overall compliance costs, thanks, in part, to all data being integrated and transacted on a distributed ledger.

The reinsurance use case found that key components to regulatory compliance were data- and process-related. For example, data export functionalities were required throughout the solution to stay compliant. Non-functional requirements also had to be met, including undefined data for extraction, extensive formats once the data is defined,

and the ability to extract data at any level of detail. Adopting data interchange formats, such as ACORD, also helped towards achieving compliance.

Requirements for regulatory compliance will inevitably vary based on use case—a one-size-fits-all compliance specification is simply unrealistic.

Is data public, private, and/or obfuscated?

All consortium participants must have thorough knowledge of the data being recorded. If the data is private or sensitive, it should be properly secured and encrypted, or potentially obfuscated from other entities. Our team working on reinsurance, for example, determined that there was not a uniform level of detail for data exchanged between organizations. As a result, data visibility and sharing needed to be dynamic down to the transaction level. This required flexibility in establishing business relationships and data visibility for each individual contract, rather than choosing from predefined and inflexible data sharing rules between participants of a particular transaction.

Business impact considerations

A commercialized blockchain solution will impact many more day-to-day aspects of a business than just operations. A decentralized ledger utilized internally and across the ecosystem will likely have an impact on many departments, including risk and tax. Smart contracts, for instance, are largely unproven from a risk perspective, while many tax implications have yet to be identified by the marketplace.

As part of our blockchain survey, 13 percent of respondents stated they currently use blockchain-based smart contracts

commercially; however, another 46 percent claimed that they would be comfortable contracting with another party using smart contracts instead of traditional, paper-based contracts.³

Executives across the ecosystem must be prepared for the internal impact of modified operations and the external impact of a developing regulatory landscape.

Does your blockchain-based business model expose you to new types of risks (e.g., value transfer, smart contract)?

Across sectors, risk practitioners are very excited about blockchain's promise to help organizations minimize and, in some cases, eliminate the risks posed by current systems. Blockchain is being viewed as the foundational technology for the future of risk management. However, as the technology continues to mature and many theoretical use cases begin to get ready for commercialization, it behooves the industry to start focusing on less frequently discussed questions. For example, how will interacting parties adapt to risks previously offloaded to intermediaries due to the peer-to-peer value transfer ability of blockchain?

It is critical for firms to understand that while blockchain promises to drive efficiency in business processes and mitigate certain existing risks, it poses new potential risks to the firm and market that need to be actively managed. These potential risks can be broadly classified in three categories—standard risks, value transfer risks, and smart contract risks. Standard risks include existing risk domains such as strategic, security, business continuity, and regulatory. While the risk domains are the same, the unique characteristics of blockchain-based business models require innovative approach to mitigate these risks. Furthermore, blockchain introduces completely new types of risks such as value transfer risks and smart contract risks.

Are tax implications taken into account during design and ongoing management?

Blockchain can have an interesting impact on business processes that may present challenges, or opportunities, from a tax perspective. The taxation of business transactions has evolved over time as the industry has progressed from mail to internet to cloud, and now, to blockchain.

Most jurisdictions have well-established rules that govern where income derived from the sale of products and services is earned. This is true for the delivery of traditional, internet, and cloud-based business transactions. With blockchain, however, it is possible that value is attributable to the machine, despite a lack of human involvement. Blockchain-driven decisions and validation may allow income to be sourced differently than transactions that use traditional means of delivery. This also presents a challenge related to state nexus or cross-border permanent establishment if an enterprise has business transactions and value attributable to a new location. An organization may form an opinion about where transactions should be taxed, but those that start generating profits will have all relevant jurisdictions wanting to tax them.

The means by which products and services are delivered may also impact taxability and sourcing from a transaction tax perspective. Many states and countries have produced guidance surrounding transaction taxes associated with internet-based businesses; some parallels may be drawn for blockchain-based transactions, but key differences may drive different answers.

As an example, many organizations attribute value to locations where their people make key business decisions—those with the authority to approve a contract or effect a transaction. This impacts where the value of an organization is taxed and where a transaction is consummated. As blockchain

applications evolve and enable valuable business decisions without the need for humans, this shifts the possibilities of where the enterprise can be taxed. Companies could be subject to income tax, or attract transaction tax (e.g., VAT) in a country where they have no, or very few, employees.

What did we learn in order to be successful?

As our Blockchain Readiness Framework has addressed, a successful blockchain commercialization strategy is feasible only after each respective question within the six categories is thoroughly addressed. Establishing a clear operating model and orchestrating a solid consortium effectively paves the path towards tackling all additional considerations—such as determining who will operate the platform and which party owns the liability.

Our four selected use cases outlined within this paper reinforce the notion that readiness for a commercialized blockchain solution requires significantly more than just a robust technology platform. Blockchain is redefining what it means to transact, so dramatic changes across an enterprise should be expected.

2017 could be the year in which organizations take foundational steps toward commercializing their blockchain solutions. The many experimental PoCs observed throughout the global marketplace served the important purpose of helping us learn what it takes for blockchain to move forward; now is the time to seize these learnings and take blockchain live.

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