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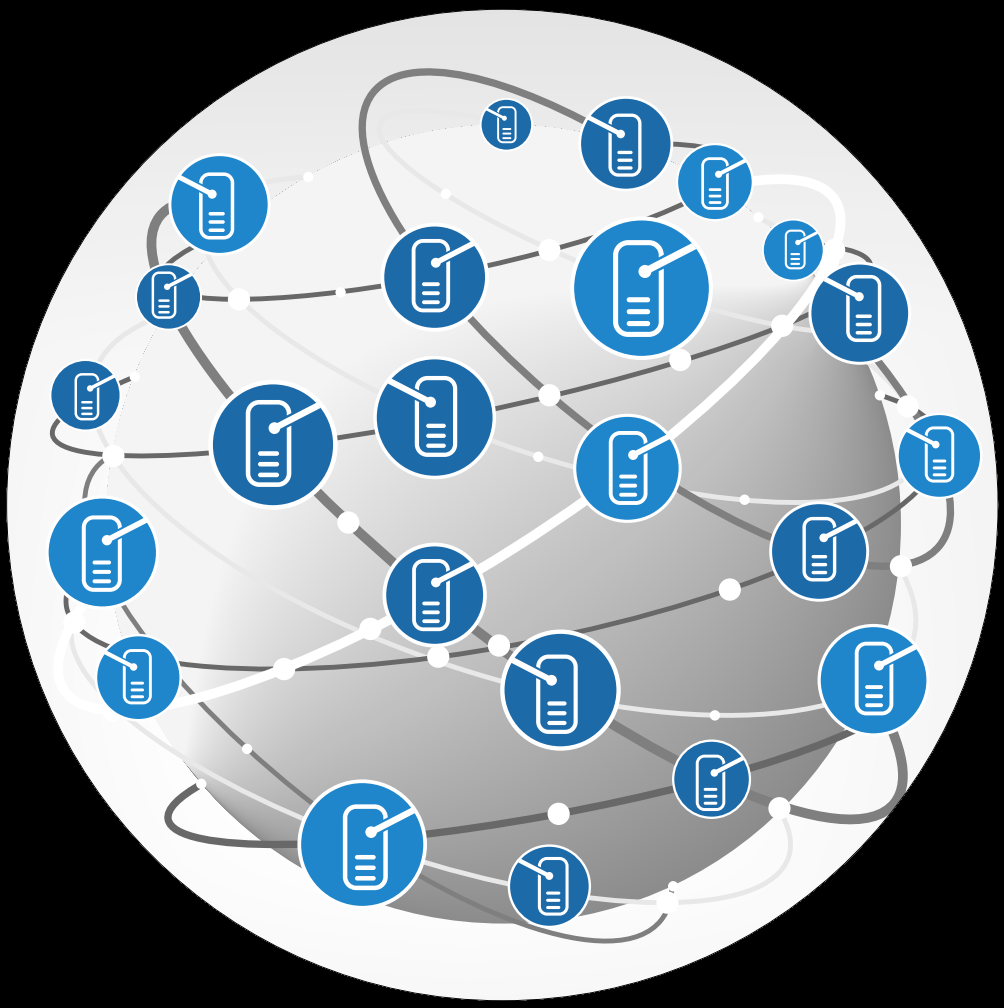

Blockchain in Public Sector

Transforming government services through exponential technologies

January 2018

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Message from FICCI

As the leading and oldest industry chamber in India, FICCI is committed to contribute towards the growth and development of the nation's business and economy.

On the occasion of MTech 2018, FICCI in association with Deloitte is happy to present this White Paper on **"Blockchain in the Public Sector – Transforming Government Services through Exponential Technologies."**

The ICT sector has experienced exceptional growth in the last two decades leading to enhanced connectivity and productivity for the citizens. With Blockchain emerging as the technology to potentially redefine online transactions, a new generation of transactional applications can establish greater accountability and transparency in every business processes. In a nutshell, it has the benefits of internet with enhanced level of security and trust for businesses.

The white paper assesses the current global trends and provide a holistic view on the global and Indian Blockchain Industry – current scenario, pilots, key challenges and recommendations for ushering the next wave of transformational growth. It has a special focus on the Public Sector.

We are grateful to the Government of Maharashtra for the opportunity to work with them during MTECH 2018. I hope all the relevant stakeholders will find this white paper useful and insightful.

Dr. Sanjaya Baru
Secretary General
FICCI

Message from Deloitte

India is at a cusp of technological revolution, taking strides in adoption and implementation of new technologies. The government's thrust on digital transactions, easing business processes and enabling transparency, is opening new doors for innovation and deployment of exponential technologies. As the impact of disruptive digital forces become visible, blockchain as a technology has found traction across the spectrum, within the industries and the government.

Seeing the growth of increase in blockchain adoption globally, Indian policymakers too have taken cognizance of its potential and are exploring this distributed ledger technology in multiple domains such as asset registration, recordkeeping, benefit transfers, and so on. State governments are collaborating with start-ups and technology giants to develop proof of concepts and pilots. The Government of Maharashtra too has been evaluating this technology for applications in e-governance. As this trend continues, the public sector may leapfrog into a new era of digital management.

Deloitte is actively involved in understanding the early trends of blockchain adoption in India, and is undertaking proof of concepts for multiple use cases across industries. We are leveraging the experience from our global member firms to tailor solutions to the Indian context and exploring new avenues for its adoption.

This publication presents the concept of blockchain, a framework for assessing its applicability for use cases in public sector, and discusses the way forward for supporting an enabling ecosystem to accelerate innovations.

We are thankful to the Government of Maharashtra and the Federation of Indian Chambers of Commerce and Industry (FICCI) for giving us the opportunity to be the Knowledge Partners for this prestigious Summit. We are confident that the Summit and this report will help generate more awareness on the subject matter, and express our best wishes for a successful event to the organizing team, delegates, speakers, sponsors, and participants.

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Ushering in a new technological paradigm

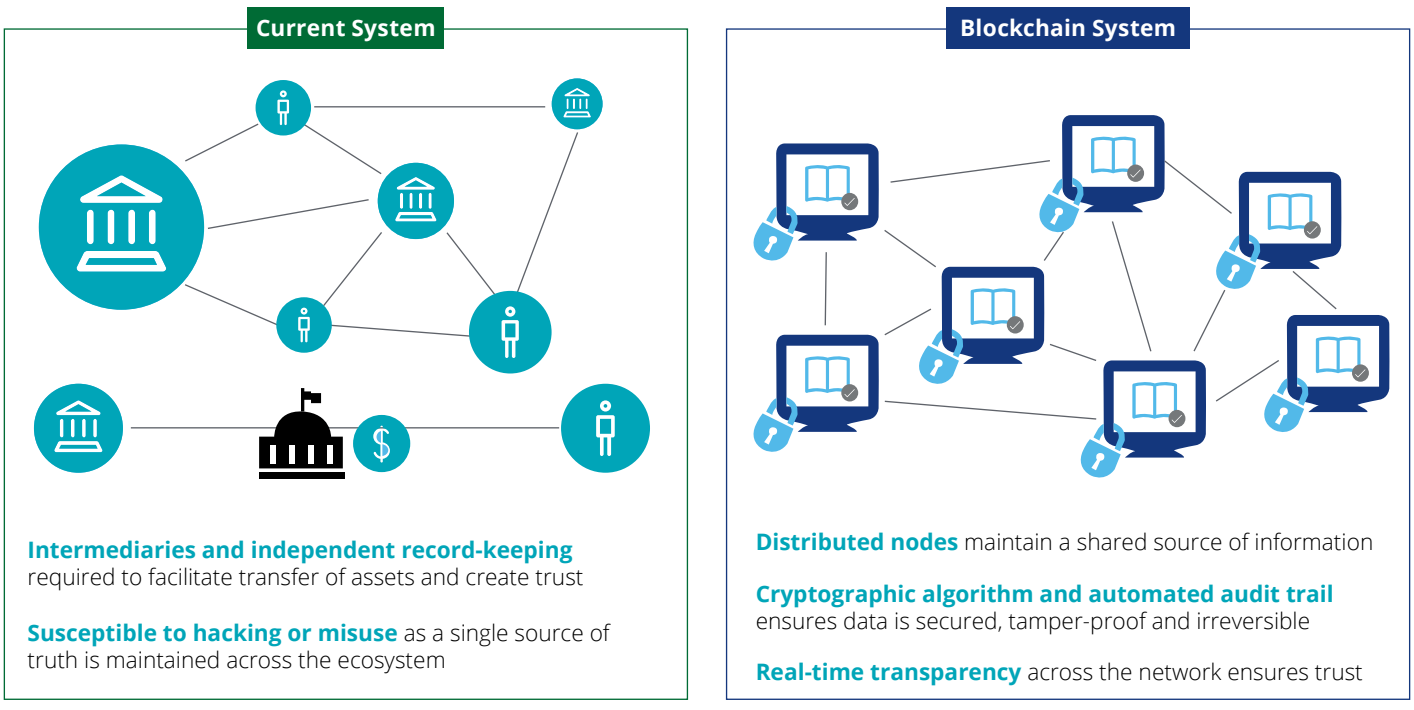
Blockchain today may be compared to what the Internet was in the early 1990s. Commercial enterprises and venture capital (VC) firms have invested more than $1.4 billion[1] in blockchain since 2014, rivalling Internet investments in the early '90s. Funding into blockchain companies is already up, to USD 2.4bn in 2017, with 25% coming from Venture Capitalist investment and 75% from Initial Coin Offerings (ICOs)[2]. While we have witnessed how the 'Internet of Information' has changed our society over the past two decades, we are now entering a phase where blockchain may do the same by ushering in a new paradigm comprising 'Internet of Trust' and 'Internet of Value'. While the financial services industry has been one of the first adopters of this technology, applications abound in other industries as well. Blockchain could well be transformative for the global economy as a whole.

Blockchain: A secure and trusted digital ledger with wide applications

Organizations have traditionally recorded transactions in ledgers, kept under lock and key. Those ledgers are typically isolated to protect their accuracy and sanctity, and when conducting business, each organization maintains its own separate record, to independently verify information. In essence, blockchain is a ledger, but one with built-in trust. A blockchain is a **digital, distributed transaction ledger,** with identical copies maintained on multiple computer systems controlled by different entities. Anyone participating in a blockchain can review the entries in it, but can **update the blockchain only by consensus** of a majority of participants. Once entered into a blockchain, **information can never be erased;** ideally, a blockchain contains an accurate and verifiable record of every transaction.

Instead of relying on a third party, such as a financial institution, to mediate transactions, member nodes in a blockchain network use a consensus protocol to agree on ledger content, and cryptographic hashes and digital signatures to ensure the integrity of transactions. Blockchain, hence, offers several benefits such as reliability, data security, accuracy, and cost savings, etc. (refer Figure 2).

Figure 1: Traditional database vs. blockchain-based distributed ledger



Source: Deloitte Analysis

Blockchain has applicability in a wide variety of areas, including tax filing, voting, land registry, healthcare, and identity management. Though many use cases are getting explored globally, what most enterprises are struggling with is to determine if any use case is a good fitment for blockchain and the corresponding business case. This is where the Deloitte Blockchain Fit Assessment framework can help governments and other institutions to take an informed and logical decision on the way forward.

Figure 2: Benefits of Blockchain

Reliable and available

Since multiple participants share a blockchain, it has no single point of failure and is thus resilient to attacks

Near real time

It provides unbroken and timely record of information

Immutable

It is nearly impossible to make changes to a blockchain without detection, thus reducing chances of fraud

Saves costs

Since there is no third party or intermediary (banks, legal institution, government) involved, blockchain can cut down costs

Irrevocable

It is possible to make records irrevocable, which can increase accuracy and simplify back-end processes

Transparent

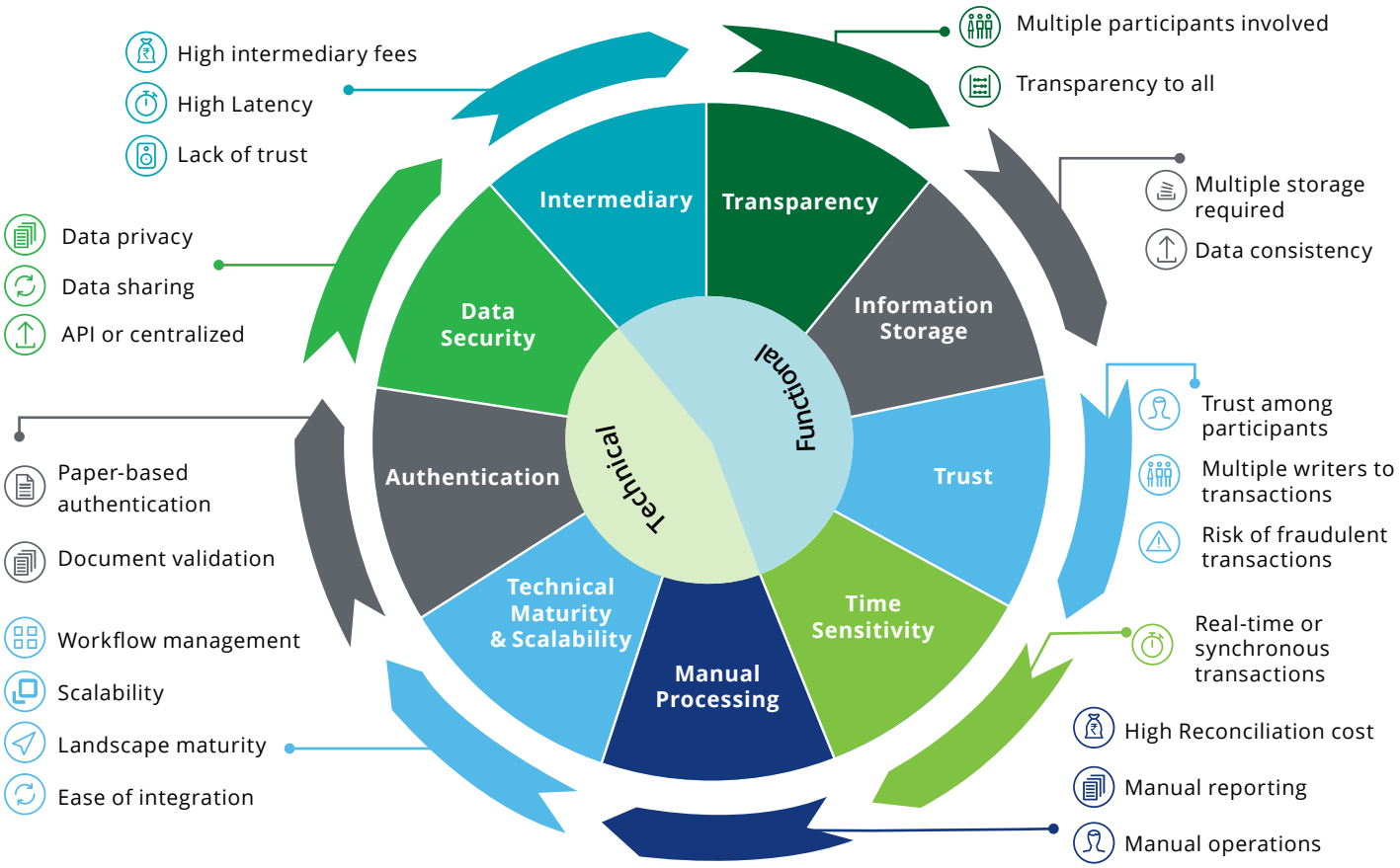
The consensus mechanisms provide the benefits of a consolidated, consistent dataset with reduced errors

Source: Deloitte Analysis

A fit assessment framework for blockchain use cases

Today, governments, healthcare and financial institutions are vigorously experimenting with multiple use cases of blockchain. While experimentation is necessary for a solution to emerge, it is important to select the right use cases for better probability of a viable business case when the solution is scaled to production. A blockchain-based solution will be a good fit for use cases where multiple parties having low levels of trust, transact with each other. The technology will be applicable in areas where same transaction information is getting stored across disparate systems or databases. Blockchain fitment is also dependent on time sensitivity of data, cost of reconciliation, need for data security, and requirement for authentication. However, if only one party exists, a blockchain does not provide additional guarantees vis-à-vis the traditional applications using a database.

Figure 3: Blockchain Fit Assessment framework

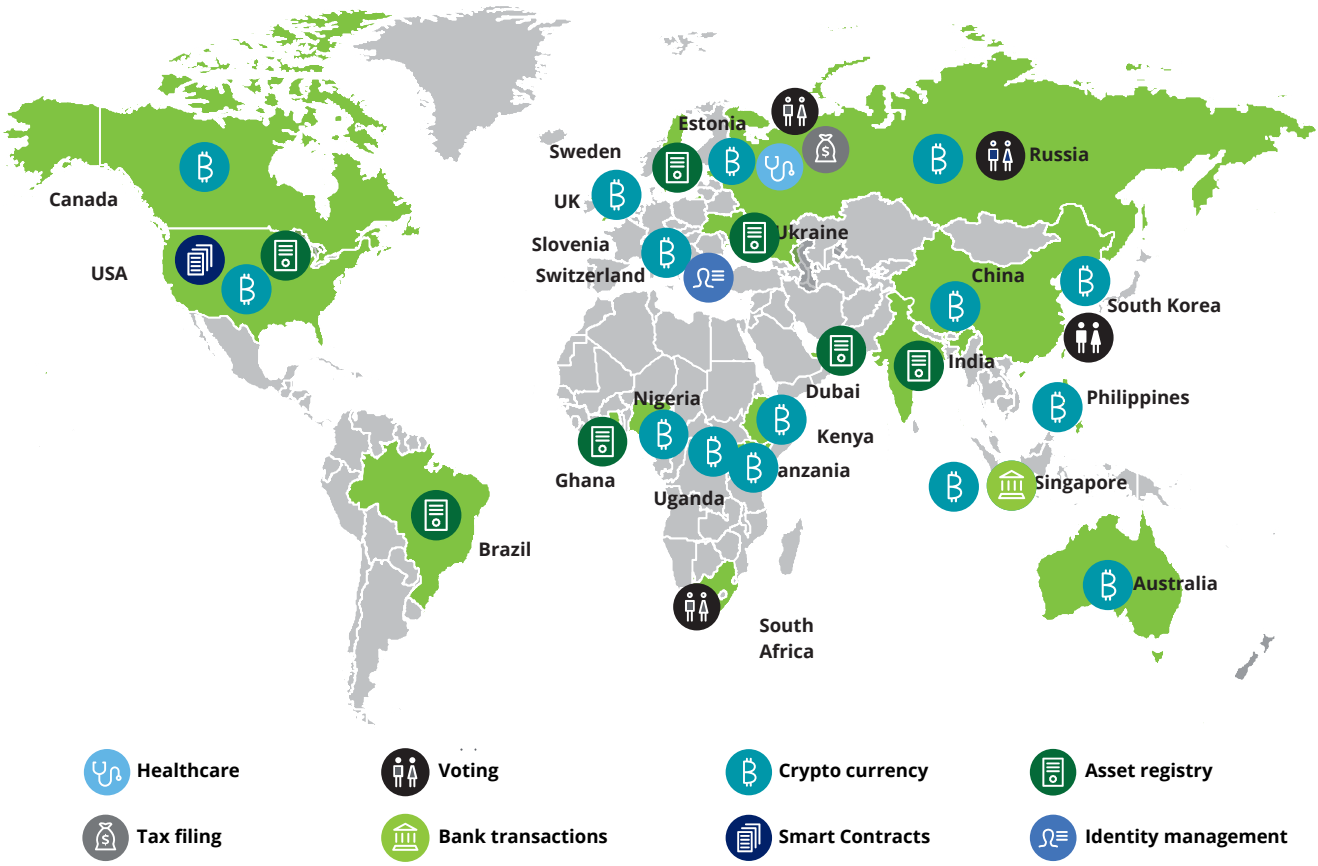


Source: Deloitte analysis

Blockchain experiments in public sector are growing globally

Blockchain experiments in the public sector are accelerating globally. From none three years ago, agencies in more than 20 countries—including Canada, the United Kingdom, Brazil, China, and India — are running pilots, tests, and trials examining both the architecture's broad utility as a basis for government service provision and procurement, and developing individual blockchain-based applications for internal use (refer Figure 4).

Figure 4: Indicative list of blockchain experiments in the public sector, as of 2017



Source: Deloitte analysis; Wirtschafts Universität Wien Global Tax Policy Center

In Estonia, the government is rolling out a technology named **Keyless Signature Infrastructure** (KSI) to safeguard all data. **Electronic health records** of all Estonian citizens are managed using KSI technology. KSI creates hash values which represent larger amount of data as much smaller unique values. KSI allows officials to monitor changes within databases — who changes a record, what changes are implemented, and when are they made, hence, any unauthorized tampering of the records can be detected and prevented[3].

Digital certificates is another use case which is seeing a lot of traction in the government and academics world. DNV GL, a global quality assurance and risk management company, in partnership with Deloitte EMEA Blockchain Lab has implemented the first live blockchain solution in the certification industry and has transferred all its 90,000 certificates to a private blockchain[4].

Another often-used application of the blockchain technology is in maintaining **asset registers,** e.g. property, vehicle, and other documents such as contracts. In the recent times, given the propensity for fraud in property transactions, property or land registration using blockchain has come into prominence. It not only provides a trusted mechanism of storing and transferring data but also provides transparency across the system. Several countries and states such as Sweden, Ghana, and Georgia in USA are exploring blockchain-based solutions for digitizing registration of land and property transactions. Sweden has successfully completed a pilot where land registry copies are shared with all relevant parties to facilitate property purchases with each step of the sale being verified and recorded on the blockchain[5]. Land Commission of Ghana[6] and Dubai Land Department[7] are also adopting blockchain to record all real estate contracts, including lease registrations. State governments like the one in Georgia, USA, are using blockchain to register land titles and validate property-related government transactions[8]. The blockchain-based system boosts land title transparency, reduces the prevalence of fraud, and brings significant time and cost savings in the registration process.

Voting, another critical and legitimacy-granting public function, has been the source of much activity among those working with blockchain. Citizens can cast votes the same way they initiate other secure transactions and validate that their votes were cast—or even verify the election results. Potential solutions are currently working to blend secure digital identity management, anonymous vote-casting, individualized ballot processes (for example, a vote "token"), and ballot casting confirmation verifiable by (and only by) the voter. The Australian government-owned Australia Post has unveiled plans that it will conduct tests through digital voting via the blockchain technology in a bid to reduce costs and improve efficiency of parliamentary election[9].

Academic certificate recording system by The Ministry for Education and Employment of Malta[10], digital diplomas to over 100 graduates by the Massachusetts Institute of Technology (MIT)[11] or the blockchain based mobile app by The University of Melbourne to store and share academic credentials[12], are examples that clearly demonstrate how government institutions are embracing and relying on blockchain for tamper-proof record-keeping of digital certificates. Not only government, but even industry players like Sony are trying to build a suite of educational services on blockchain platform, which would use the technology in part to secure student records and form part of a system for sharing that data between agreed-upon parties[13].

Blockchain also has applicability in **smart contracts** — agreements that can automatically trigger actions under certain conditions, such as when payments are made or missed. For example, making it possible to start a leased car only if the lessee is current on her lease payments. A smart contract could cut legal and administrative costs by being self-enforceable. Other use cases include creating tamper-proof voting records, vehicle registries, fraud-proof government benefits disbursements, and digital identities for individuals, such as refugees, who lack government-issued identity documents.

The ongoing trend leads us to believe that the governments do not need convincing reasons to use this tool/ technology, however, what they need is the skill and understanding of the nuances to utilize the technology to its full potential.

India poised to leapfrog in adoption of blockchain and digital innovation

There is a growing need for large scale adoption of exponential technologies in India. While it may seem challenging at first, it is possible as evidenced by the pace of technology adoption in the country: India's telecom subscriber base crossed the 1.2 billion mark in May 2017[14], of which 1,180 million were wireless subscribers. India will account for 27% of new mobile subscribers globally by 2020[15], while China will account for 21%. With experiments for integrating blockchain and Internet of Things (IoT) gaining momentum across the globe, India is rapidly moving towards the next wave of web — the Internet of Everything (IoE), the intelligent connection of people, processes, data, and things secured through cryptographic protocols and distributed consensus mechanism. The **Digital India** campaign launched by the Government of India in 2015[16] is also focused on digital empowerment of citizens through a combination of building digital infrastructure, providing digital services and implementing e-governance in an accessible manner and using technology as a driver of change.

In India, blockchain saw early adoption in 2016 primarily among the players in the Banking and Financial Services industry. But with the beginning of 2017, India has seen blockchain adoption increasing amongst government bodies, Fast Moving Consumer Goods and Pharmaceutical industry. The **NITI Aayog** is working on building the **country's largest blockchain network — IndiaChain,** in a bid to reduce frauds, speed up enforcement of contracts, and increase transparency of transactions[17]. **Securities and Exchange Board of India** (SEBI) has established an advisory committee for conducting research on the blockchain platform and other emerging technologies[18]. The committee comprises of eminent industry experts in the areas of education services, digital payments, process reengineering, data analytics, e-commerce, etc. The **Reserve Bank of India,** through its research arm Institute for Development and Research in Banking Technology (IDRBT) is also exploring the applicability of blockchain in Indian Banking and Financial Services industry. Many Indian state governments and central government have demonstrated interest in using

blockchain across multiple use cases like asset registry, customs duty payments and property transfer, to prevent tampering of data, remove duplicates and reduce counterfeits. For instance, the **Andhra Pradesh** government[19] is piloting blockchain in two departments – land registry and transport. The land registry pilot will track land ownership, while it will be used to streamline titles of vehicles in the transport department. The state has also set up a repository of use cases for global start-ups to test their solutions. Through this initiative, the state wants to prevent tampering of land records, which have been digitized and placed online. Following suit, **Telangana** has begun a pilot program in parts of Hyderabad to use blockchain technology for land registration[20], while **Maharashtra** and **Gujarat** are also holding discussions with start-ups in the blockchain space and setting up a Fintech Hub to promote blockchain based start-ups.

While required technical skills for exponential technologies may be an issue currently, India's current skilling infrastructure has set a ground for enabling skilling through initiatives such as Skill India, Hi-Tech Training Schemes, and setting up of world-class institutes.

Select India-specific use cases

As we see from examples so far, there are several use cases which are gaining prominence around the world and also in India. For the purpose of this paper we have detailed the following three use cases namely Land registration, Digital certification and Customs duty payment, based on their fitment for implementation using blockchain.

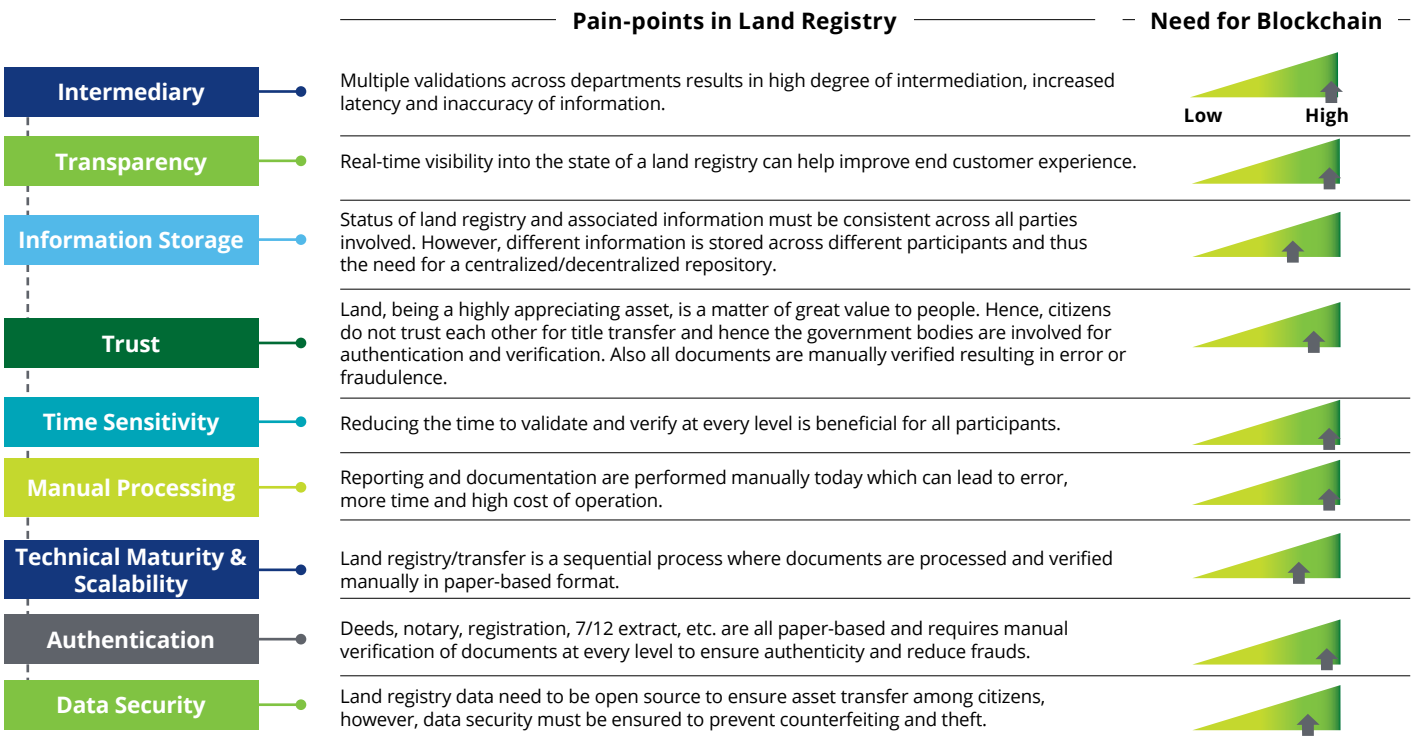
Land registration

Land being the costliest asset in real estate, has often been at the epicenter of land fights, crimes and frauds. Deeds and titling not only provide critical protection for buyers in developed nations, but also serve as a basis for investment and economic growth across many developing nations. By securing a unique and non-corruptible record on a blockchain and validating changes to the status of that record across owners, a reliable land record can be created. Many countries are experimenting with blockchain to digitize their land records.

In the absence of any effective land records maintenance system, one of the biggest challenges that gripped India was about land ownership issues. Over the years, the Government of India has made multiple attempts at digitizing and making land records more secure

Figure 5: Blockchain Fit Assessment Framework for land registration

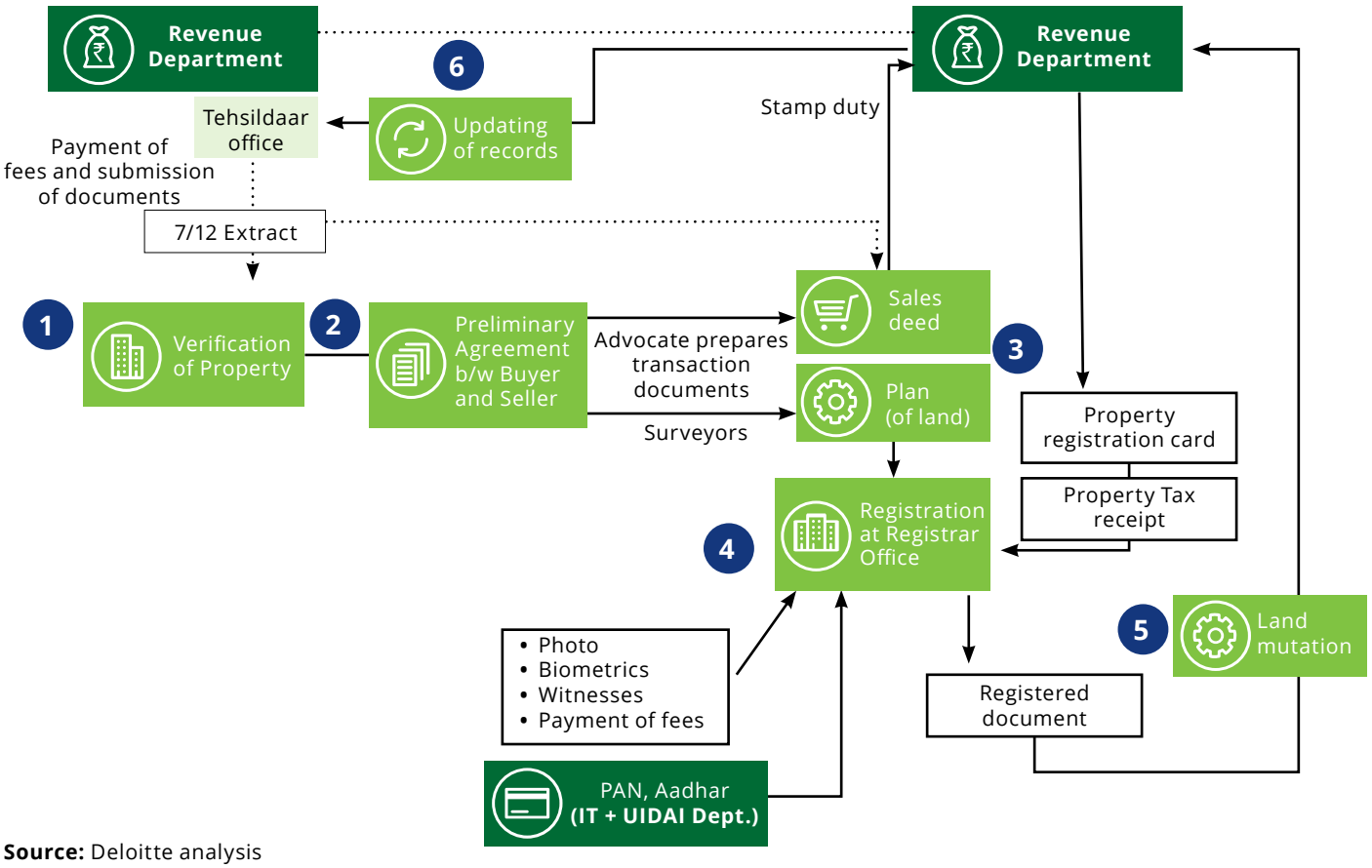
Blockchain Fit Assessment: Land Registry



Source: Deloitte analysis

Current Process

Figure 6: An illustrative process for land registration



Source: Deloitte analysis

and accessible. Of late, blockchain is attracting the attention of many state governments for recording land titles since it can provide a platform to record mutations, digitization of maps and integration of textual and spatial data, and survey/re-survey and update of all survey and settlement records in a secured, immutable and tamper-proof manner. The blockchain fit assessment framework (Figure 5) shows why land registry use case is a good fitment for exploring the use of blockchain.

Land registration process is highly manual and paper-intensive and involves multiple government bodies for verification and authentication[21]. Land title transfer, on the other hand, involves repetition and duplication of processes, thus resulting in high processing time and cost.

Maharashtra has already taken some strides in digitizing some of the processes involved in the land registration process. For example, online facility is provided for registering a lease and license agreement instead of the physical registration in the office of the Sub-Registrar. The Revenue Department of Maharashtra has also initiated a program for online Mutation in 73 talukas of 5 districts to ease the process of Mutation and reduce the need for physical documentation[22]. However, many persistent issues remain. A blockchain based solution could be a good fit to bring

Blockchain Value Proposition:

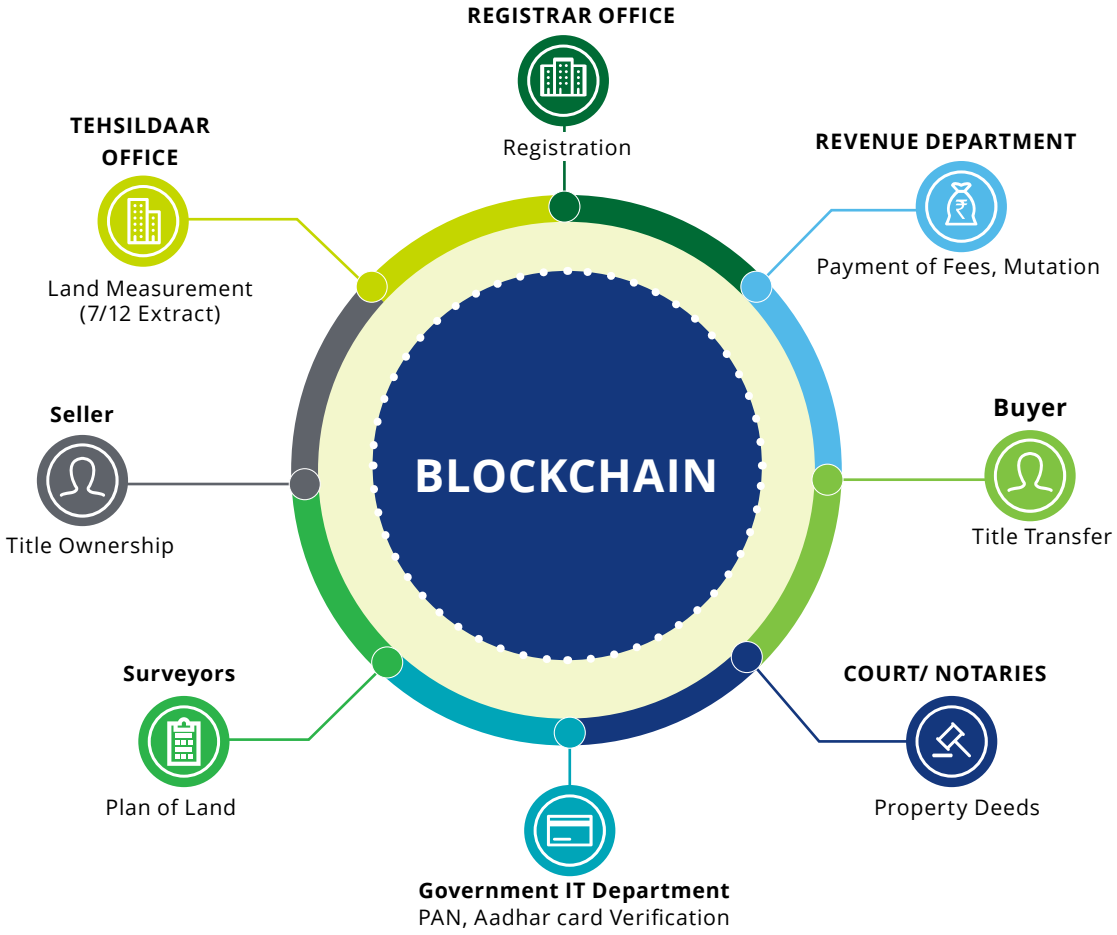
- A decentralized, standardized system for land registration records could reduce the number of intermediaries required, increase trust in identity of transacting parties, increase process efficiencies, and decrease time and cost to process
- Recording property rights via blockchain would enable annual cost savings for title insurers through a tamper-proof ledger
- Blockchain based traceability will bring ease to the judiciary and help settle most of the property related civil cases in Indian courts
- Blockchain technology would reduce lead times and expedite the registration process

robustness and digitization to the entire process, bringing all stakeholders on a single platform as depicted in the process below.

In a blockchain based land registration and title transfer process, all the players are on a single platform with distributed ownership rights. This provides transparency, automated verification and irreversible trail of title transfer; thus blockchain enables faster, secure and cheaper mode of asset registry maintenance.

Blockchain based Future Process

Figure 7: Blockchain based future process



Source: Deloitte analysis

Digital certificates

Everyday citizens use digital certificates, which are electronic cards or digital equivalents of existing identity cards, while interacting with websites, e-commerce portals, banking sites, government agencies, etc. With the advancements in blockchain technology it is now possible to store academic certificates, birth certificates and other important certificates digitally and retrieve them securely and independently anywhere from the globe. Many institutions and organizations have realized the potential of blockchain and are embracing the technology for storing various kinds of certificates.

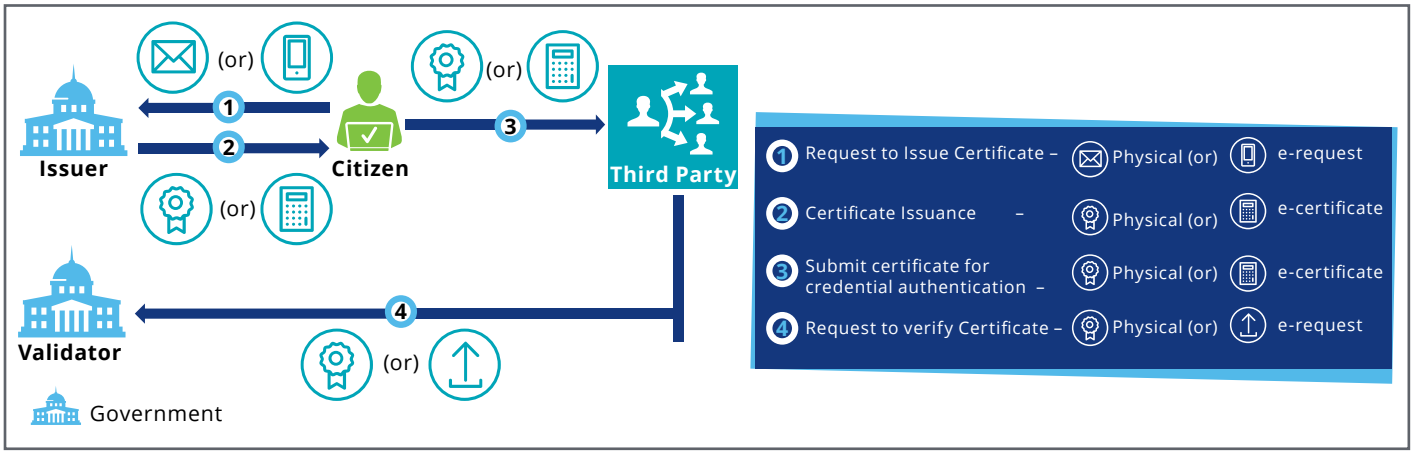
Figure 8: Blockchain Fit Assessment Framework for digital certificates

Blockchain Fit Assessment: Digital certificates

Source: Deloitte analysis

Current Process

Figure 9: An illustrative process for digital certificates issuance and validation



Source: Deloitte analysis

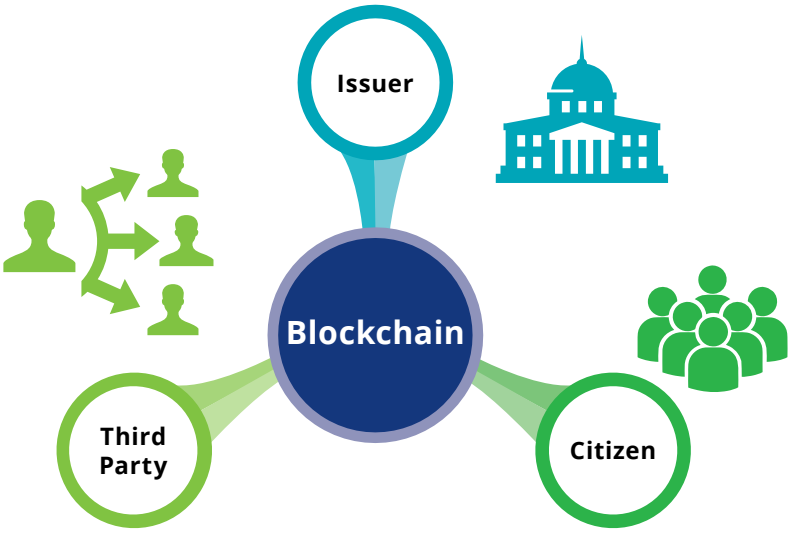
In the present system, digital certificates in India are issued by pre-approved Certifying Authorities. There are broadly two types of certificates – hardware token/device based and Aadhar based. For the first type, processing hardware token based certificate request takes substantial amount of time, followed by which the certificate reaches the citizen after few days, usually by post. These certificates are stored in a USB token and citizens are expected to carry them around, which is a cumbersome process. In the second type, Aadhar based certificates have a validity of 30 minutes before which the citizen has to use them. Every time new Aadhar based certificate is generated, citizen is likely to incur some cost.

In both the cases, any third party using these certificates for providing any service, needs to validate the authenticity of the certificates with the issuing authority. This again requires a lot of to-and-fro movements, thereby causing inconvenience to all parties involved.

The digital certificates network will use a public blockchain, with the government, issuing institution, third parties and the citizens as nodes. The actual certificate will not be stored on the blockchain, instead the hash of the certificate along with details of the citizen will be immutably stored. A certificate issuer will sign a well-structured digital certificate and the hash will be stored within a blockchain transaction. The output of this transaction will be assigned to the corresponding citizen, which will allow him/her to prove ownership of the certificate at any time.

Blockchain based Future Process

Figure 10: Blockchain-based future process



Source: Deloitte analysis

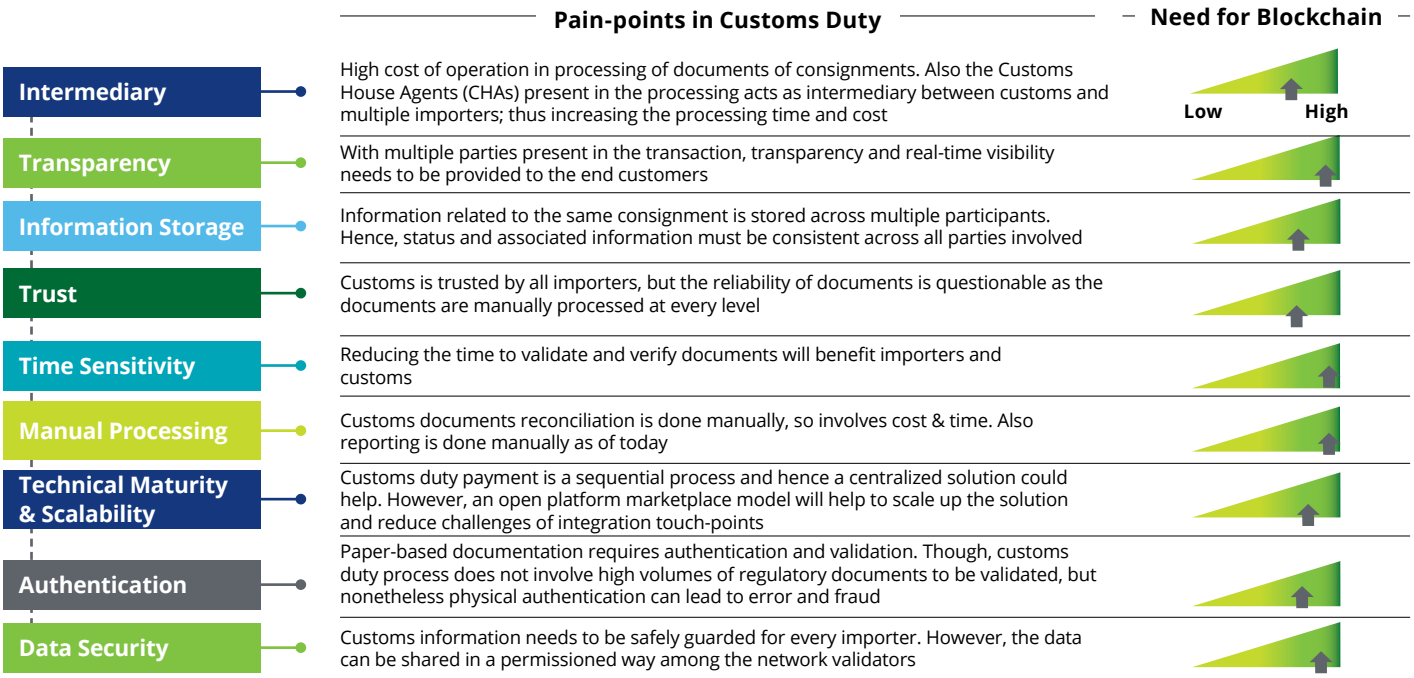
Blockchain Value Proposition:

- The citizens own their individual credentials, independent of the issuing institution
- A certificate once issued on the blockchain is immutable and can be used any number of times in the future
- Reduces the time (almost real-time) and cost required in verification of certificates
- The tamper-proof, immutable nature of blockchain will eliminate credential fraud and misrepresentation of records

Customs duty payment

The Customs Duty payment process involves multiple stakeholders namely the Customs department, importer, exporter, custom house agents and banks. The goods shipped by an exporter comes to the Customs department and on completion of all clearances and payments made by the importer to the Customs, the latter releases the goods to the importer. The process is time-consuming, mainly manual in nature leading to operational delays.

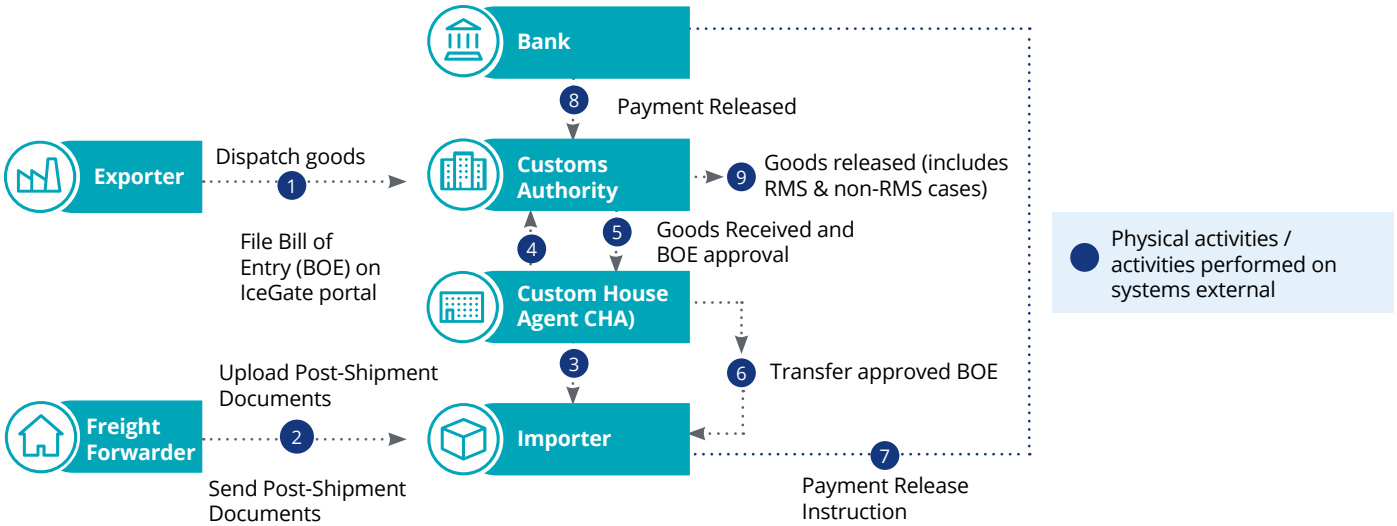
Figure 11: Blockchain Fit Assessment Framework for customs duty payment



Source: Deloitte analysis

Current Process

Figure 12: An illustrative process for Customs Duty Payment

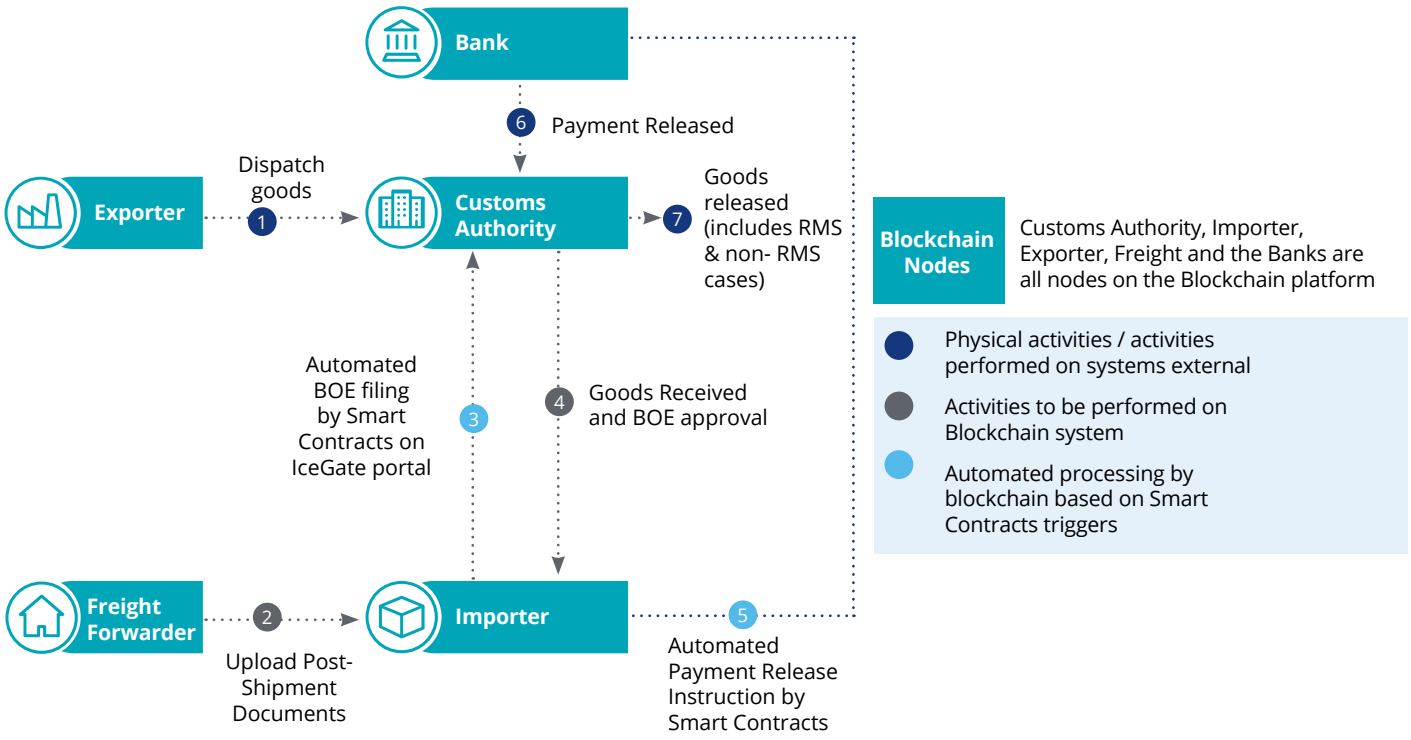


Source: Deloitte analysis

We see in the current process, there is lot of manual processing and paper-based transactions that happen across participants. This leads to lack of transparency, mistrust and results in existence of intermediate players like the custom house agents.

Blockchain based Future Process

Figure 13: Blockchain based future process



Source: Deloitte analysis

A Blockchain based Customs Duty payment processing will enable real-time tracking and transparency of the processing of customs clearance to all the relevant stakeholders viz. Customs department, importer, clearing house agent and bank. The solution will help the Customs department better manage space and cash cycle.

Blockchain Value Proposition:

- **Faster realization of cash:** High level of transparency into the process will reduce the time to completion and thereby quicker realization of receivables
- **Better inventory management:** Real-time tracking of processing of documents by importers will facilitate better management of space, resource and time by Customs department
- **Reduced cost of operation:** Integrated system on the blockchain network provides for higher trust among value chain players and reduced operational challenges for the government bodies

The next steps for the government

As more and more organizations have started experimenting with blockchain, it is not too far into the future that blockchain will become mainstream. To enable the government to create a robust ecosystem and to ensure the successful application of blockchain, there are a number of actions which need to be expedited. Such actions can be broadly classified into two categories:

- Industry enabling initiatives
- Policies or frameworks to guide the boundaries of the blockchain ecosystem

Some of the key actions to be taken under each of these categories are detailed below.

Industry enabling initiatives

- **Building a roadmap:** While the long-term opportunity offered by blockchain is clear, widespread adoption across industries will take between 5 and 10 years from now. Thus the government can look at a roadmap initiative that will define the use cases that can be explored over a period of time. This roadmap will be driven by a number of parameters which would have an influence on the prioritization of a use case, including the readiness of the government departments, the technological maturity of the government, level of public-private partnership required, and the availability, span or reach of the ecosystem.
- **Promoting start-ups through regulatory sandbox:** A regulatory sandbox is a platform which helps the regulator or government in developing guidelines for upcoming technologies, protect consumer interest, and being abreast with latest developments in the sector. At the same time, it helps the fledgling start-ups to shorten their time to market, avoid issues related to identifying applicable legal requirements and other licensing challenges. The sandbox also helps reduce regulatory uncertainty, thereby providing an easier access to funding. This has been used effectively by some regulators/ statutory bodies to test innovations and enable fintech firms to try out new and untested ideas. This helps accelerate public sector experiments as the sandbox allows firms to operate in a live but controlled environment where some regulations have been relaxed. Within the regulatory sandbox, an authorised entity (a start-up or any institution or organisation) can conduct a pilot trial of their initiatives without the need to achieve full compliance with the government's usual supervisory requirements. It also helps the concerned entity assess the impact of regulations on their profitability and overall business model.
- **Creating requisite infrastructure:** While the physical infrastructure to enable large volumes of data storage is one aspect, the government would also need to build the ecosystem of public and private partnerships to accelerate the overall adoption of blockchain in the state. One way to do this could be to enable a collaborative effort by creating incubation centres or conducting hackathons wherein the start-ups or authorised organisations can collaborate with various government departments and build systems on blockchain

platforms. Putting in place the required cyber security infrastructure will also be an important area of consideration for the government.

Further, a robust network infrastructure is important for seamless implementation and operation of the blockchain technology.

- **Re-skilling the workforce:** With the advent of digital disruption and exponential hype, it is of utmost importance to re-skill the workforce for them to cope up with the changing paradigm. In this regard, the ITI training schemes, Teach India initiative, MOOC (Massive Open Online Courses) and similar platforms can be used to develop new skill-sets like blockchain developer, designer, technical architect and strategist.

Policies or frameworks to guide the boundaries of the blockchain ecosystem

- **Providing regulatory support:** A major concern today among the early adopters of blockchain is the lack of clarity on regulatory norms. The government will need to define the legal framework related to the following aspects of blockchain:
  - Nature of transactions on blockchain with no single entity/ central authority being responsible for each distributed ledger
  - Policies for recourse since blockchain transactions are immutable and tamper-proof
  - Validity of assets registered/stored in the blockchain
  - Validity of smart contracts used and reports generated by blockchain

With the various government bodies actively participating in blockchain adoption, the regulations will eventually emerge and it will become easier for businesses to convince their partners and customers and for the government to convince the business houses for blockchain adoption as customer confidence on this new technology increases.

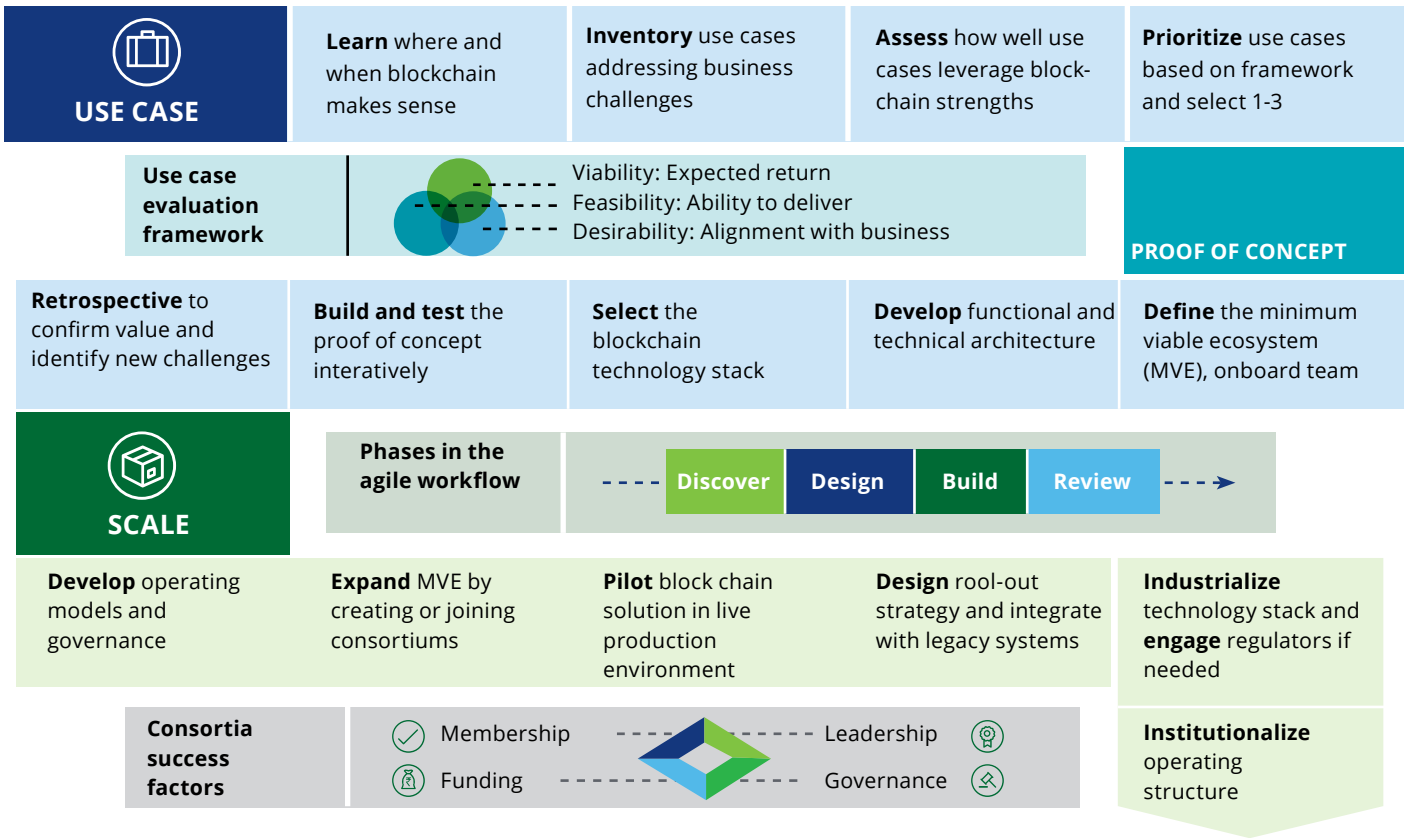
- **Defining standards:** Deloitte conducted a limited survey in early 2017 among the early adopters of blockchain in India. A major concern that was top of the mind for most of the business leaders, implementation partners and start-up houses was around standardization of platforms. Currently most of the experiments are being conducted in silos. Thus, the need to scale up to a single consolidated platform in future is a key aspect for blockchain to become mainstream in future. The government, through its Innovation think-tank, needs to come up with clearly defined standards for technology, legal and tax aspects. Some of the key things to consider for standardisation are as follows:
  - Terminology – a common language for easy interoperability on blockchain
  - Messaging standards and communication protocols
  - Standard API (Application Programming Interface) and messaging routines for building software and applications
  - Authentication – ability to perform traceability of every transactions and security of credentials on the blockchain

- **Security and Privacy:** Ensuring only interested and authorized parties have access to the correct and appropriate data is a common concern for organizations considering using blockchain today. If an attacker is able to gain access to the blockchain network, they are more likely to gain access to the data, hence authentication and authorization controls need to be implemented, as is the case with any other technology.

Roadmap to implementation

With the government providing the platform and the necessary guidelines, the onus will now lie on the industry players including government departments, fledgling start-ups and established businesses to build on the provided blockchain framework and create solutions for the future. In most cases, the blockchain adoption journey starts from the stage of internal awareness generation, through to partner selection and on-boarding and culminates with a proof of concept or pilot implementation for an identified use case.

Figure 14: Stages of blockchain implementation



Source: TechTrends 2018: Deloitte University Press, 2018

Case Study: Government of Estonia

Estonia has been testing blockchain technology since 2008. Since 2012, blockchain has been in production use in Estonia's data registries, such as the national health, judicial, legislative, security and commercial code systems, among others.

All Estonian citizens and e-residents (the government runs an e-residency program wherein foreigners living elsewhere can run their companies in Estonia, and sign documents digitally) are issued a cryptographically secure digital ID card powered by blockchain infrastructure on the backend, allowing access to various public services, financial services, medical and emergency services as well as to drive, pay taxes online, e-vote, provide digital signatures, etc. On a blockchain platform, citizens can verify the integrity of the records held in government databases and also control the access to the documents. The Estonian ID may be thought of as a replacement for multiple cards: driver's license, insurance policy cards, credit and debit cards, etc.

In order to protect the authenticity of records, the government has mandated that no information be stored twice, and any update be performed on the master record. This further allows for auditing of data access and queries of individuals' records.

There exists much potential and opportunity to consider how other governments, through effective partnerships with industries, could adopt certain aspects of the advanced digital identity system in Estonia.

Source: Estonia Government website[23], Thomson Reuter's blog[24] and Enterprise Innovation article[25]

Case Study: Digital Certification by DNV GL

DNV GL is an international accredited registrar and classification society operating in more than 100 countries. They provide business assurance services for several industries including maritime, renewable energy, oil & gas, electrification, food & beverage and healthcare where they certify companies' processes, products, facilities and supply chains to national and international standards. For many years, DNV GL has built trust among its users but in the age of digital transformation, there was an increased need for transparency in a volatile business environment.

In an increased effort to build digital trust, DNV GL in partnership with Deloitte EMEA Blockchain Lab have developed the first live blockchain solution in the certification industry. When a certificate is issued, the data is digitized, sent to the blockchain and a digital identity is assigned to each certificate. All certificates are uniquely tagged and traceable and the original is stored in a network of computers instead of a central repository. In essence, this makes it possible to uncover fraud and by scanning a QR code on the certificate anyone can verify verify whether a company is certified.

DNV GL has transferred all its 90,000 certificates to a private blockchain. The technology blocks counterfeit certificates, allowing companies to communicate their certification in a transparent and secure way.

Source: DNV GL press release[26]

Moving forward: Transforming the public sector

Given blockchain technology's broad applicability and transformative potential, policymakers may find it worthwhile to explore the range of possibilities available within their respective departments. A blockchain-based approach could increase the efficiency of transaction processing and reduce, if not entirely prevent, fraud.

However, to unlock the full potential of this technology, the government will need to work as a facilitator, by providing an enabling environment to interested players. There is also a need to develop uniform standards, assess infrastructure requirements, allay security concerns, raise stakeholder awareness, and build trust within the ecosystem as a whole.

Government departments looking at digital technologies as enablers of competitive advantage and disruption, should not overlook blockchain. Though it may still take some time before we begin to see large-scale commercial applications, it is increasingly likely that many industries, citizen services, and government programs will feel its impact, sooner rather than later.

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FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

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