



DIGITAL TRANSFORMATION WITH SMART CONTRACTS - DEMYSTIFICATION, LEGAL RECOGNITION, NEXT AND BEYOND



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Genesis of Smart Contract

Many lawyers across countries and continents follow one century old axiom which signifies that “There is everything in law, and there is law in everything”. Business entities, government agencies and even NGOs also follow this axiom for success without frictions and litigations. They always aim at remaining on the right side of law. One of the building blocks in their functional framework is exclusive reliance on legally enforceable contracts, terms of

which are executed with external interventions beyond ICT systems. Compliance with legal and regulatory provisions are generally ensured by incoherent human interventions for performing in compliance with the policies and processes defined and laid down with idiosyncratic judgement and interpretations of statutes and regulations by people at the helm of affairs.

No technology until late 1990s by itself could help ensuring such a unique and all-pervasive responsibility totally and squarely. ERP systems and solutions, offered by likes of SAP, Oracle, Microsoft, etc., to a certain extent facilitated the process by disjointed actions and customisation of applications but not by the software itself in an automated mode. Again, the same is to large extent dependent on human judgement and interventions breaking the chain of automation. The process offered by them are limited to the user entity only and cannot ensure legal and regulatory compliances by all stakeholders involved in transactions on an end-to-end basis.

Blockchain technology recognises and facilitates ensuring implementation of the said axiom in both letter and spirit. Its framework of distributed ledger, with participation of stakeholders and execution principles for establishing one version of truth as the guiding principle. It guarantees execution of mutually agreed transactions without the

Image Source:

<https://softwareengineeringdaily.com/2018/03/29/enterprise-smart-contracts-with-marley-gray/>.

intervention of any trusted party and/or intermediary. One of the guiding principles for designing and writing software for a blockchain platform is to embed in the script itself all legal provisions, rules, regulations, policies, and procedures that are to be followed for executing any transaction. This is one of the major reasons for which the Supreme Court of China announced¹ in September 2018 that, “*Internet courts shall recognize digital data that are submitted as evidence if relevant parties collected and stored these data via blockchain with digital signatures, reliable timestamps and hash value verification or via a digital deposition platform and can prove the authenticity of such technology used.*”

Objective

The first article on smart contracts by the author under this column was published in January 2020 after which there has been many developments in blockchain technology and smart contracts (SC). Objective of this one is to demystify the subject with more dimensional analyses for clarity of understanding about SCs. Efforts would be made to bring out how solution designers can serve multivarious objectives by innovative crafting of solutions and scripting of codes for a blockchain platform with the help of a SC.

The general myth, associated with the word smart would be clarified by analysing how a SC can function as a transaction engine for a blockchain platform and how it can perform more if embedded with rules and SOPs for operational, accounting, reporting, compliance and controlling aspects of participants’ businesses. The author would also examine legal status of SCs. In the last section there would be narratives on the author’s next and beyond ideas about how SCs can be made smarter and versatile for guiding, directing, and monitoring performance of other digital technologies integrated with the concerned blockchain platform

Blockchain Revisited

It would be worthwhile to revisit blockchain technology once more. The simplistic definition of a blockchain is that it is a Chain of Blocks where each block contains transactional data of values without any central supervision. It is also synonymously known as Distributed Ledger Technology for establishing a P2P Network in which each online anonymous ledger protects identity of users. Participants of a blockchain platform follows dual key mechanism, viz. private key for entering the system and public key for performing transactions

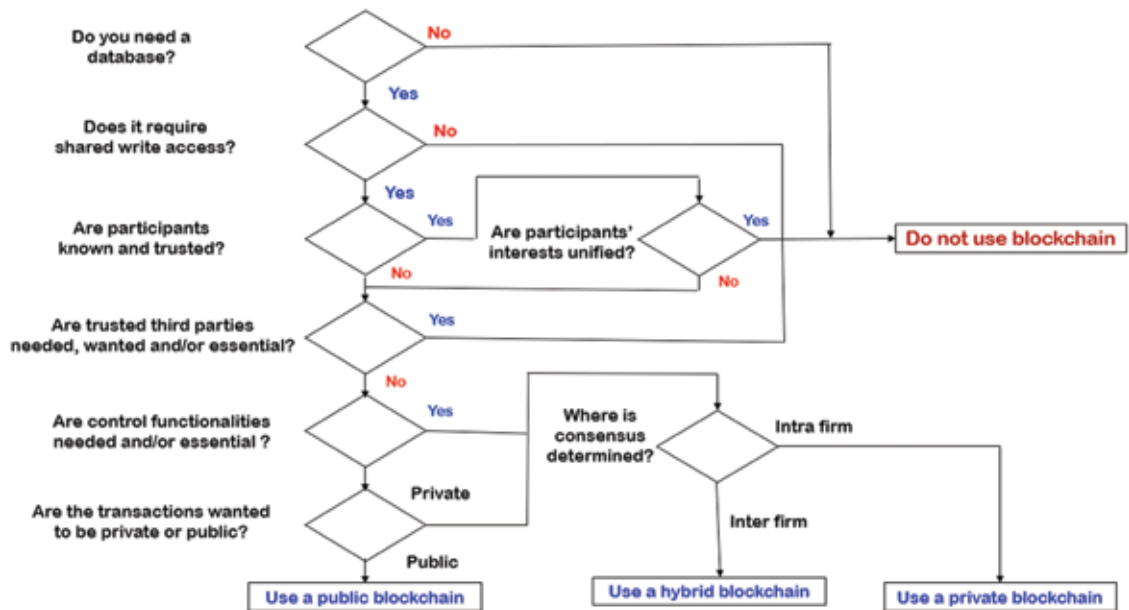
Readers may read the present author’s several published papers³ on blockchain published under this column before and elsewhere. Readers can also learn about blockchain and its various applications for digital transformation by watching the author’s several video-recorded sessions hosted at his personal YouTube channel⁴. For the shake of brevity, and assuming that, readers have read the said

papers and seen the said videos, it would be useful to summarise the salient feature of blockchain technology in the following lines:

1. It is a internet based platform for initiating and completing P2P and B2B transactions by participating individuals, business entities, government, NGOs, etc.,
2. Any blockchain platform is embedded with smart contract(s) and pre-provisioned compliance requirements,
3. It follows the doctrine of decentralised data storage mechanism (DDSM) with decentralised ledger technology (DLT) in which every participant’s computer is called a node,
4. All applications, developed using blockchain, ensures transparency with pseudonymity and are driven by smart contracts,
5. There is no need for any central authority to maintain master and transaction data,
6. Participants of most blockchain platforms are required to pass through the process of ‘Know Your Participant’ in similar line with the KYC done by a bank before onboarding a customer,
7. Every transaction is authenticated by one or more nodes other than the initiator,
8. An authenticated transaction data is pooled into the chain of blocks of transactions and the related documents are stored in its integrated document storage system,
9. Each block is encrypted with a cryptographed hash function which can’t be changed,
10. Applications are programmed with cryptographed computational logic and algorithmic rules which can be dynamic,
11. All transactions and stored documents can easily be retrieved for submission as evidence in eventuality of any litigation or any other requirement,
12. Cryptographed DDSM renders the system almost non-hackable, and
13. Blockchain platforms are of three types, viz., private, public and hybrid.

The common question of business managers to be answered is how one can decide whether blockchain based platform is the best suited solution for digitally transforming their operations, executing transactions and recording all details thereof with due documentation and storage of evidence? Instead of understanding the same from long paragraphs of narratives, readers may follow the route of decision making as have been delineated by the following graphics

Steps for deciding whether blockchain is the right solution to be adopted



Source: Designed by the author

The above graphic reinforces the fact that fundamental reasons for using blockchain technology are creation of databases, shared access of participants into the platform, establish trust within participating unknown and untrusted people/entities, establishing control functionalities in both public and private network of blockchain. It would be useful to corroborate this understanding with comments of one of EY⁵, one of the Big4 consulting firms, in the context of application of a blockchain platform to manage supply chain management. It writes the following:

“If a company’s vendors and customers are also invited to join a private blockchain, it can track and display an entire supply chain, complete with documentation and real-time visibility of all its transactions. It’s even possible that with blockchain’s increasing adoption, new sources of bigger and better data will enable a more frequent application of the comparable uncontrolled price method for establishing arm’s-length prices between MNEs and their subsidiaries and related groups.”

EY has also gone ahead several steps further ahead in the context of application of blockchain for taxation domain. Their view is, *“So far, blockchain technology has received sensible praise and skepticism. We are thrilled by the challenge of understanding its promising implications for the tax world, and we urge our colleagues in the tax function to join in shaping this exciting future.”*

Since blockchain technology-based platforms provide facilities for execution of business and/or non-business transactions by governmental agencies, NGOs, etc., without intermediation of any third party, the entire governance and compliance system of the platform is driven by the Smart Contracts embedded in its duly coded software.

Some people prefer to call it ‘Contractware. The objective is to ensure appropriate controlling and monitoring of transactions in compliance with the pre-articulated policies, systems, and procedures, and in compliance with related legal and regulatory stipulations. All these in turn improves speed, productivity while dealing with many parties that participate in the platform. Such software is suitably written to take care of differentiated requirements of the specific nature of each type of platform, viz., public, private or hybrid as delineated in the above graphic.

Smart Contracts - Genesis, Definitions and Enabling Features

Genesis

It would be useful to understand the attributes of a binding contract to start with which would equally be applicable to smart contracts. A synthesis of Chapter II of the Indian Contract Act 1972 reveals the following essential features of a legally binding contract:

- ⊙ Was there a valid offer with valid consideration?
- ⊙ What was the agreement for and whether its objective is lawful?
- ⊙ Who are the parties and whether they are competent to sign a contract?
- ⊙ Was there valid acceptance of offer without any force, fraud, or duress from any side?
- ⊙ Did equal consideration flow both ways between the offeror(s) and acceptor(s)?
- ⊙ Were there good faith and efforts without any excuses for breach?

- ⊙ Was there partial performance of the contractual obligations?
- ⊙ Is there any breach of any other law and/or regulation?

The genesis of a smart contract lies in the above features of a legally valid contract which is almost the same under similar such statutes legislated by every sovereign nation. A blockchain platform can be designed, digitally crafted, and auto regulated to ensure that every transaction is performed in compliance with the above attributes being ensured on an end-to-end basis, albeit there being no interventions by physical lawyer(s).

Nick Szabo, with his unique combination of talents as a cerebral computer scientist, cryptographer legal scholar and innovator, applied his critical skills to design digital contracts for administering a digital currency. He is considered as the first creator and applicator of a smart contract in 1996 for crypto currency. The SC designed by him had the ability to autonomously execute the terms of a contract, positively influence business associations which can facilitate transparent, trust-less, and distributed application solutions at a faster pace than ever before. Nick Szabo applied his crafted SC through blockchain technology. However, one must keep in mind that these two wonderful phenomena were applied simultaneously.

During the continuing course of evolution of blockchain technology since its first application for cryptocurrency transactions, SCs have also evolved over the years. Many business and compliance requirements, which are not essentially related to contractual terms for performing transactions, are also more and more being embedded into SCs to make it comprehensive as a driver of transactions.

Definition of Smart Contract

A smart contract is therefore, a legally binding contract that is executed and then performed within the digitally crafted platform created by application of blockchain technology. Within the domain of one platform there can be more than one smart contract. When any participant, irrespective of being a person, a legally incorporated entity, a government agency, or an NGO, etc. enters a blockchain platform, the first contract they should execute is the 'Super Smart Contract' with the administrator of the platform to the effect that while conducting transactions with other participants of the platform the related and relevant SCs, as duly embedded in the platform, will be accepted, and resorted to. However, in every subsequent SC, there are required flexibility enabled by provisions to amend the terms of any SC with mutual consent of parties without violating governing laws and regulations as applicable to any given transaction.

This can be explained by an example of the contract to be digitally signed by and between, an importer-buyer,

exporter-seller, and the third-party quality control certification agency in a Blockchain platform for conducting export-import transactions. While the said buyer and seller has bilaterally executed before a separate SC for sell and purchase, this tripartite SC is for the purpose of quality certification which is an essential document as per terms of other SCs, e. g., letter of credit and payment settlement by bank, acceptance of cargo by the captain of ship for carriage insurance company, etc.

Ellis Solaiman, Todd Wike and Ioannis Sfyarakis in their seminal research paper⁶ has defined a smart contract as "... an executable program (written in a programming language ...) that is deployed to monitor interactions between two or more parties. Its main aim is to prevent or at least detect deviations from agreed upon behavior. To achieve this, the smart contract (i) intercepts each initiated operation, (ii) analyses it to determine if it is contract compliant, (iii) produces a verdict (contract compliant or none contract compliant), and (iv) records the outcome in an indelible log that is available for inspection, for example, to sort out disputes". Some digital technology professionals christened digitally embedded smart contracts into the software code of a blockchain platform as 'Contractware' because those help physical instantiation of comprehensible contracts by computers for execution. Thus, execution of contracts in compliance with terms and conditions included in the SCs essentially tantamount to conditional statements which are essential for computing. These qualities of a digital contract make it smart and self-executable.

Enabling Features

Leon Adato of Solar Winds had very aptly said that "*Smart Contracts are where the rubber meets the road for businesses and blockchain*" Essentially any blockchain technology platform starts functioning with constant help and support from the SCs embedded in it. The present author has captured in the following graphic the salient features of a SC in one of his presentations. Readers will be able to appreciate that a SC is not only time efficient but also cost efficient, and safe even without the intervention of lawyer in person at different stages of executing the contract. The terms of smart contracts are embedded while scripting the software code for crafting the platform. Hence none can take a transaction forward without compliance of the terms and conditions of the governing SCs. enable execution of business transactions in compliance with the contractual terms and conditions in an automated mode without the intermediation of a trusted intermediary as a participant in the digitally performed process. Thus, it not only reduces cost, but also reduces lots of risks and time lags. Because of these enabling features the set of smart contracts are also called 'Transaction Engine of Blockchain Platform.'

Smart Contract - The Digital Lawyer of Blockchain Technology

- An embedded digital framework (duly coded lines) to enter into a **legally binding contract** between two or more parties, subject to meeting conditions
- The embedded contract is **precompiled** with concerned Laws and Regulations
- **Flexibilities** can be built in to change terms and conditions
- A **Super Set of several Smart Contracts** covering different types of transactions
- Functional contract(s) serves as **backbone of the Blockchain** binding all parties



Source: Presentation of the author for blockchain technology and smart contract

SCs are drafted, reviewed, tested, and cleared by best of the legal brains before those are adopted for writing software scripts to digitally insert terms and conditions thereof in the code of software. If a blockchain platform for conducting commercial transactions involves parties from more than one sovereign countries, the related SC will ensure compliance of legal and regulatory provisions of the concerned countries as well as international protocols, e. g., ‘Incoterms’ for international trade in case of an Export-Import trading platform.

SCs eliminate the need for reinventing the wheel by avoiding repetitive negotiation of terms of conditions, drafted contracts, documentation and so on. While converting legal contracts into a smart contract for scripting into the software for a blockchain platform there are definitive needs for clearly defining and capturing terms involving rights, obligations, prohibitions, force majeure clauses, penalties against not meeting obligations, etc. Enabling provisions are kept for rendering the SC flexible to the extent that each contracting party can change certain terms and conditions. Scalability of a blockchain platform depends on versatility of the SCs embedded into it.

Taking care of pervasive provisions of many types of business transactions with increased variety of specificities is a challenge by itself. Digital giants like IBM, Microsoft, etc. are engaged in developing ‘Digital Library for Smart Contracts’ which can be adopted by solution developers. Ajay Kumar Shrestha, et.al. in the researched article⁷ concluded that, “*All contract transactions are stored in chronological order for future access along with the complete audit trail of events. If any party tries to change a contract or transaction on the Blockchain, all other parties can detect and prevent it. If any party fails, the system continues to function with no loss of data or integrity.*”

It, therefore, creates a single large secure logically computer system without the risks, costs and trust issues of a centralized model.”

Legal Recognition of Smart Contracts

It would be useful to briefly understand the history of granting legal recognition for electronic documents and signature by giant nations of the world. Forty-seven states of the USA passed the “Uniform Electronic Transactions Act (UETA)” in 1999 followed by the “Electronic Signatures in Global and National Commerce (ESIGN) Act” in 2000. These two Acts facilitated proliferation of digital transformation business operations including internet banking and eCommerce. Section 4, 5, 6, and 7 of the Information Technology Act, 2000 of India granted legal recognition for electronic records, electronic signature, and retention of electronic records. By an amendment of the Act in 2008 the phrase ‘Digital Signature’ was inserted replacing. The General Data Protection Rule of Europe passed in 2016 by the European Union provided comprehensive regulation for this purpose. With proliferations of ICT and internet-based applications almost all nations gradually followed the line for granting such recognitions.

When the world was dealing with internet, electronic data, records, signature etc., came the Blockchain technology and its applications for creating transactional platforms. Law makers could not find any logic to refuse legal recognition for transactional records and supporting documentation created while operating through blockchain platforms. However, the question that started crowding minds of all concerned is, whether existing laws and legal framework are sufficient to help deriving benefits from enormous potentials for value generation by various tailored applications of blockchain technology, besides

enhancing ease of doing business. Such a question is not necessarily related to regulating cryptocurrency because blockchain is not equal to cryptocurrency. It only provides the digital solution and platform for administering and transacting for that.

Dr. Robert Herian⁸ of the University of Exeter in his widely read paper mentioned that *“Blockchains could shape law as much as law shapes them. The balance between the two may change as so called blockchain tourism abates and practical business applications start to appear.”* In a paper published by Ikigai Law in July 2020 details have been provided on how various states of the USA are gradually granting recognition to Blockchain. It states, *“Legal recognition of blockchain and related technologies is imperative on multiple counts – not only does it facilitate enforcement of blockchain based contracts in the courts of law, but it also unlocks innovation by signalling that the regulatory environment of the country looks at blockchain technology favourably – something that India has struggled with off late. Needless to say, this has a cascading effect on all emerging technologies, which can also draw some solace from the government’s innovation friendly outlook”*

As indicated before in September 2018 the Supreme Court of China announced that blockchain based digitally created evidence will be legally binding and accepted as rightful documents by courts of law. Government of India announced the updated version of the ‘National Strategy on Blockchain’ in December 2021. Its objective is to enable creating trusted blockchain framework for development of applications based on this technology. This is a step forward in the direction towards granting recognition of self-executable and self-enforceable computerised contracts which are nothing but SCs. Thus, one can conclude that SCs are nothing but pre-emptive self-help for efficient conduct of business

Next and Beyond

Accounting, Auditing and MIS

Since its advent blockchain technology is advancing and becoming more capable with versatile use cases as days are passing by. The author in his quoted articles³ have cited authentic survey based reports by eminent consulting houses and findings/conclusions of research scholars, Business managers are more and more being convinced that blockchain technology, powered by smart contracts, are more becoming a necessity for gaining competitive advantages than a nice to have digital aid.

In its next level developments, which are gradually migrating from test use cases to production, blockchain technology is helping participants with a wallet created in the node of every participant. Such a wallet can contain all transactional records and have enabling facilities for retrieving underlying documents from the central document storage management system (DSM) of the main platform

as and when required. This is an excellent help for every player because such nodes can be connected using APIs with the ERP system of the participant for generating reports, MIS, auto-posting of accounting entries, etc. The blockchain platform in course of time would also be able to handle payment and settlement transactions as and when central bank digital currencies (CBDC) are issued sovereign nations.

The point to be noted is that the SCs of the main blockchain platform can be articulated and ICT scripts can be coded to ensure that every transaction-related provisions as prescribed by accounting standards, e. g., IFRS, Ind AS, etc., are also complied with while generating structured data/ information from the records of the blockchain. Those are then transferred to the wallet of the participant for further use. Such a process is a huge enabler with cost and time efficiency, because the participant need not have to replicate efforts for generating information for posting in to accounting records, maintain any separate controlling and/or monitoring tracker.

Again, the above facilities will help Auditors to perform online audit on a real-time basis with the application of digitally crafted auditing tools. As a proactive measure, blockchain platform developers can involve statutory and management/internal auditors even at the software development and testing stages to ensure that all their requirements are complied with, including for accounting and auditing standards. Thus, SCs would also be enablers of cost, time and quality efficient auditing systems and processes.

SCs - The integrators of Digital Technology

The author in his previous articles^{9 and 10} on blockchain platforms for agriculture, healthcare service delivery has written about integration of other major technologies with blockchain, e. g., AI and ML, Drone, the cluster of IoTs like IoB, IIoT, IoRT, Robot, RPA, AR, and VR etc. Readers would be able to get ideas on how the SCs of blockchain technology platform would be able to guide and direct performance of other digital technology-based tools/applications as and when integrated with the related blockchain. For example, drones are more and more being applied for:

- ⊙ Surveillance of crops in a large agricultural fields and orchards of farmers,
- ⊙ Sharing pictures of crops with soil scientists to get expert advice before sprinkling of pesticides and insecticides,
- ⊙ Survey of the extent of damages done to crops by natural calamities before insurance claims are processed and paid to the affected farmers and so on.

The author has ideated in his quoted articles that

the edge computing and GPS systems fitted into those drones can be integrated with the concerned blockchain platform for agricultural activities. The SC embedded in the platform would serve as a guide and driver for the drone to perform efficiently, generate information and pass on to blockchain for recording and storing. Similarly, while designing blockchain platforms for healthcare service delivery even the doctor's smart stethoscopes, testing devices of clinicians like Xray, sonographer, CT scanners, etc. can also be integrated with the platform for efficient and quality service delivery. For the sake of brevity and limitation of space the author would like to stop here and look for more opportunities to write in future

Conclusion

Blockchain as a technology, aided by contracts with higher degree of smart capabilities, is extremely potential for value addition. Business entities and national regulators are more and more appreciating its capabilities not only for creating huge financial impacts but also for changing the legacy foundation of economy and society of any nation. The author is convinced more and more research is required for further advancement of this technology. Digital scientists, lawyers, auditors and business professionals from other disciplines must collaborate to explore more in search of excellence for minimisation of value destruction and maximisation of value creation. The objective ultimate objective would be to achieve inclusive happiness and shared values. **MA**

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