Business, Management and Economics Engineering
ISSN: 2669-2481 / eISSN: 2669-249X
2022 Volume 20 Issue 2
DOI: 10.5281/zenodo.7485986

A STUDY OF IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN LAND REGISTRATION- SWOT ANALYSIS

Ankita Goyal
Research Scholar, Department of Commerce & Finance, SRM University, Delhi-NCR, Sonipat, Haryana, Email ID- ankitagoyal.1994@gmail.com

Dr. Upendra Singh
Associate Professor, Department of Commerce & Finance, SRM University, Delhi-NCR, Sonipat, Haryana, Email ID- upendrasingh@srmuniversity.ac.in

ABSTRACT
Blockchain technology has been receiving great attention in different domains due to its various features and possible use cases. This paper attempts to review the work that has been done in the field of blockchain technology. It gives an insight into the terminology and applications of blockchain technology for beginners in the field. The paper looks into various research papers, books, and article which suggest various implementations of blockchain technology. The paper sheds light on various use cases of blockchain in different domains like finance, healthcare and land registration among others. The prime focus of the paper being application of blockchain in land registration, it looks into real-life examples of such implementation across the world. The main aim of the paper is to conduct a SWOT analysis to help assess the current situation and readiness of the technology for implementation in domain of land registration. A detailed analysis of the Strengths, Weaknesses, Opportunities, and Threats of the application of blockchain technology in the process of land registration has been done in the paper.
KEYWORDS: Blockchain technology; Land registry; SWOT Analysis;

1- INTRODUCTION
Blockchain technology is often considered a driver of change because it is transparent, immutable, and gives new meaning to trust thus enabling transactions that are trustworthy, secure, and fast.(Underwood, 2016) A Blockchain is created by nodes that link various blocks cryptographically in the form of a chain. Every block contains details like a header, data of transactions, and security metadata like the signature of the creator, details of the previous block, etc.(Minoli & Occhiogrosso, 2018)
Here we try to define the commonly used terms in the context of blockchain technology to give a brief introduction to the readers.
Transaction- A record of an agreement of exchange between two parties is called a transaction. These transactions once verified are added to the ledger. Several transactions grouped is called a block. (Hewa et al., 2021)
Block- A block can be understood as that part of a blockchain that stores information about a set of transactions that occur at any given time. A collection of these blocks connected to the

previous block is called a blockchain. Herein every new block has information about the previous block. (Reyna et al., 2018)

Nodes-Every member in the network system is an anonymous entity and is called a node. All nodes maintain a copy of the ledger on their systems. A node performs various functions in the blockchain system including proposing & creating transactions, validation of transactions, and undertaking mining to support consensus so that integrity of the data is established.(Minoli & Occhiogrosso, 2018)

Smart contracts- They are self-executing computer programs that execute on the meeting of certain conditions. The obligations, benefits, and penalties of the parties involved under different circumstances are included in the contract. (Ganne, 2018) Smart contracts along with blockchain technology have the potential to make a great difference in the way things work.

Consensus- It is the mechanism by which participants of a network agree on the source of truth. The longest blockchain in the network is considered the source of truth. Its identification is possible due to the existence of computational power and proof of work. (Mus, 2018)

Cryptography- This is the technology used to protect the integrity of data and to allow digital signatures. SHA 256 is the cryptography technique used to generate hashes in the bitcoin blockchain. Every block has its unique hash and also stores the hash of the previous block in the chain to ensure continuity. (Mus, 2018)

Time stamping-It is the act of assigning digital time stamps to electronic events to ensure that they are sequenced chronologically. A timestamp here would mean data that represents the time and date of happening of an event. Every block in a blockchain has a unique timestamp that is material in determining the sequence of transactions in a network. (Ganne, 2018)

Blockchain technology stands out in today's scenario due to its distinctive features. These features make the technology so desirable and worth implementing. These distinct features can be understood as follows: -

Immutability- The records of the transactions saved on the blockchain ledger are permanent. They are tamper-proof and unalterable providing a greater sense of security to the users. (Hewa et al., 2021) It preserves the integrity of data which is often compromised in the centralized database system.

Decentralized- Decentralization in blockchain technology refers to the delegation of authority amongst the participants in such a way that eliminates the need for a trusted third party to carry out the transactions. It improves the trust in the system itself and reduces the risk of failure.(Hewa et al., 2021) It allows the control to be distributed among individuals through its consensus mechanism. (Zhang et al., 2018)

Distributed ledger- It is one of the most prominent features of Blockchain technology. This implies the presence of a digital ledger of transactions which is created by and shared by all the user computers of this distributed network. The ledger of transactions is usually not owned or controlled by a single authority and the transactions can be viewed by all the participating users on the network. (Underwood, 2016)

Trust less- The system of blockchain is a trust less system. It does not require any external source for trust. The trust is built in the software itself. That means the system does not require any assistance from a third party to secure transactions. (Ølnes, 2016)

Transparency- The smart contract and ledger are visible to all the parties in a blockchain which is not the case in centralized systems. (Hewa et al., 2021)Blockchain technology allows its participating nodes access to all the blocks to enable them to observe any data tampering that occurs. (Yermack, 2017)

With this introduction of the basics of blockchain technology, we are ready to indulge in different applications of this technology. The paper includes in Section 2 we will be exploring the different use cases of blockchain technology in the modern world, Section 3 specifies the research methodology, in Section 4 specific attention will be paid to blockchain technology application in the process of land registration in different countries and states, in Section 5 a SWOT analysis is conducted to study the implementation in land registration. Section 6 specifies the limitations and future work, concluding the study in Section 7.

1.1 Research Questions

- Explaining the concept of blockchain for beginners in the field.
- What use cases are available for blockchain technology & smart contracts in the real world?
- What are the strengths, weaknesses, opportunities, and threats to the application of blockchain technology for land registries?

2- LITERATURE REVIEW

Blockchain technology was first introduced in 2008 by Satoshi Nakamoto as the technology behind the crypto currency Bitcoin. Since its introduction, it has found various uses and applications in different fields like Finance, Healthcare, Registration, Supply chain management, etc. Researchers and organizations all over the world are working to find various use cases that can benefit from the various features of this technology.

2.1 USE CASES OF BLOCKCHAIN IN VARIOUS DOMAINS- In this section, we discuss various use cases and proposed implementations of blockchain technology in different domains. A study of research papers and

A. **Finance**- The first known use case of blockchain technology was proposed by Satoshi Nakamoto in his 2008 paper on Bitcoin. It gave a solution to avoid the double-spending problem and eliminate the need for a trusted third party in electronic cash transfer systems. (Nakamoto, 2008) Many crypto currencies like Bitcoin, Litecoin, Dogecoin, Ethereum, etc. are gaining popularity among the masses due to the various benefits they offer.

B. **Insurance**- Gatteschi et al.(2018) show how blockchain technology can be used in the Insurance sector. It throws light on how the technology can be used for reducing the operating costs, identity verification, risk assessment, premium calculation, and micro-insurance, etc. The technology has great potential which is being explored by various companies and researchers among others.

C. **Healthcare sector**-Zhang et al. (2018)provides a detailed insight into how blockchain technology can be used in the healthcare industry to improve the well-being of individual and community. It can be done by improved care coordination and quality through the use of technical resources for the exchange of data. It will help various health care providers and related parties to securely exchange data like electronic health records of individuals, communicate and use the exchanged data across organizations and app vendors.

D. **Logistics& Supply chain management**-Perboli(2018)throws light on how the immutability of data and public accessibility of data streams in the blockchain can be of great help in supply chain management. It can increase the transparency, efficiency, and reliability of the overall supply chain and optimize the processes. A model designed keeping in mind the needs of all the different actors of the process is capable of generating returns in terms of money as well as customer satisfaction.

E. **Education**- Many educational institutes are exploring the application of blockchain technology in the field of education. It has great potential in keeping records of students' academic achievements, skills, research experience, interests of individuals, etc. The technology can also aid in the management of students' certificates and academic degrees. It can contribute significantly in the way of reducing fraud of academic degrees.(Chen et al., 2018)

F. **Smart Cities & Internet of Things**- A combination of IoT and Blockchain can prove to be of great use in the vision of making smart cities. Alketbi, Nasir, & Talib(2018) show how the Dubai government is working on this technology for the creation of a peer-to-peer communication network that can lead to effective management in fields like transportation, smart building, healthcare, power and utility services, etc. Blockchain here will record the location and status of goods and services with the help of IoT devices without any form of manual intervention thus eliminating the need for a trusted third party.

G. **Registration of land**- Many countries deal with weak governance and a flawed system of record keeping. This often leads to unclear land titles, frauds relating to land titles, and the problem of the double registry. Records are altered and manipulated by some individuals with access for their gains. (Chavez-Dreyfuss, 2015; Williams, 2015) Blockchain with its immutable, time-stamped record keeping can provide a reliable solution for these problems.

H. **DAO**-Blockchain enables new business models like Decentralised autonomous organizations. (Risius & Spohrer, 2017) DAOs are complex multi-function entities that can be formed by weaving together simple building block contracts. (Scott, 2016) DAOs can be defined as organizations that are based on smart contracts and which exist solely on a blockchain. In these organizations, business logic encoded in the software directs how governance rules are automated, formalized, and enforced. (Nærland et al., 2018)

I. **Voting system**-Alketbi, Nasir& Talib(2018) highlights how governments can make effective use of blockchain technology for the conduct of the voting process. The paper gives the example of the Danish Political Party which first used blockchain technology for voting as it provides transparency in the process of voting while also maintaining an immutable record of the votes.

Reviewing the current literature, we can see that blockchain technology has wider applications apart from its initial use case of crypto currency. The decentralized ledger, transparency, immutability, and inbuilt trust features of this technology make it a probable solution for many modern-day problems. In the following sections, we will look deeper into the applications of blockchain technology in the field of land registries.

3- RESEARCH METHODOLOGY

The research is conducted as a detailed review of existing literature to conceptualize blockchain and to study the possibility of its application in the land registry process. The technology is in general popular mainly in the crypto currency market, so this study tries to focus on a different aspect of its application i.e., in the land registry. Google Scholar, Scopus, and other popular research databases were used to collect relevant literature on the topic. Literature was searched using keywords including blockchain technology, blockchain technology applications, land registry using blockchain, the use case of blockchain in land registrations, and innovations using blockchain technology. The search results received from these keywords were sorted by reading their abstracts and relevant conference papers and journal articles were studied from the full version for detailed review. Newspaper articles and government department reports on the relevant topic were also studied to assess the current status of implementation of blockchain in land registry more accurately.

4 - DISCUSSION

USE CASES OF BLOCKCHAIN IN LAND REGISTRATION- In this section, a study of research papers, reports, and newspaper articles is undertaken to identify the implemented use cases of blockchain technology in the process of land registry. Examples of several countries and states have been taken up from around the world which are in different phases of exploring the use of blockchain technology in the land registry. Strengths, weaknesses, opportunities, and threats associated with these projects are discussed below-

A. **Republic of Georgia**- The government of Georgia initiated a project for the implementation of Blockchain technology in Land titling as an association between NAPR (National Agency of the Public Registry) and Bitfury. The implementation strengthens the system by incorporating trust in the system. It also helps in the prevention of fraud by verifiability of data. (Shang & Price, 2018) The existence of supportive data protection laws in the country is an opportunity for the technology. (Lazuashvili et al., 2019)The weakness of the system can be defined as insufficient public awareness of the technology. The implementation brings along an opportunity to attract foreign investors due to the increased ease of doing business. (Rodima-Taylor, 2021) For this project to succeed an important factor is the education of the public about the technology, which can pose a threat to the same if it is not taken care of.

B. **Sweden**- The possibility of application of blockchain technology for real estate in Sweden was initially explored by Kairos Future (The strategy consultant of Lantmäteriet), Telia (the telecom company), and ChromaWay (a blockchain start-up) in 2016. (Chavez-Dreyfuss, 2016) The project was driven by the incompetency of the existing system of land registration including time-consuming processes, delays in transfer, manual processes of verification, and vulnerability to error among others. (McMurren et al., 2018) The implementation of blockchain technology will strengthen the system by making it secure, efficient, trusted, less vulnerable to error & fraud, transparent and fast. The validity of digital signatures is still uncertain for real estate contracts which depict a weakness of the model. Since the project was successful in the trial phases, there lies a vast opportunity to scale it up to process real land transfers. With the increased scale of operations, the need for infrastructures like servers, storage, and nodes for blockchain verification will increase thus posing a threat to the system. Another challenge for

the system will be the inclusion of various parties to the system like realtors, buyers, sellers, etc. which are still not there in the system.

C. **Dubai**- Dubai land department implemented blockchain technology for registration of property, buying, selling and mortgages, etc as a part of the Smart Dubai Office initiative. (Bishr, 2019)The strengths of this project are the key features of blockchain technology including Immutability of records, faster processes, cost savings, and security and verifiability of transactions. Since it is a relatively new technology, lack of awareness among the public and limited availability of the skilled human resource can be termed as its weakness. The implementation of this technology has significantly improved Dubai's ranking in the Ease of Doing Business Index thus making it a more attractive destination for investments which can be termed as a great opportunity. Apart from this, the implementation provides the government an upper hand in its aims of becoming the world leader in blockchain intellectual capital and skill development. (Dubai Land Department, 2019)The absence of regulatory frameworks and data protection laws poses threats to this project. (Papadaki & Karamitsos, 2021)

D. **Honduras**- The government of Honduras in collaboration with two companies namely Factom and Epigraph agreed to build a permanent and secure land title record system. The need for this project arose out of widespread corruption,time-consuming registration process, and land title frauds happening in Honduras. The main strengths of the project include increased transparency in a transaction, precise, verifiable transactions, and immutable register resulting in a lower number of disputes in the future. These strengths result in creating opportunities like opening economic growth opportunities by lowering the cost of borrowing. Also, a lesser number of property disputes in the future will provide respite to the judicial system. The system also has some weaknesses like high costs of development, implementation, and setup of hardware. The threats associated with the project include long term investments and lack of laws available to deal with. (Chavez-Dreyfuss, 2015; Collindres et al., 2016)

E. **Ghana**- In association with Bitland (A US-based platform), Blockchain technology was introduced in the land registry system in Ghana.(Kshetri & Voas, 2018)The trust, immutability, and verifiability properties of blockchain technology are the major strengths of the project. (Mintah et al., 2020)The introduction of blockchain technology will provide various opportunities like enabling the use of land capital and allowing mortgages to support development processes. ("Bitland Partners with CCEDK to Improve Blockchain Land Registry in West Africa," 2016) The implementation of blockchain technology in land title registration is not in coherence with the existing laws and regulations of the country, which is a weakness of the system. This needs to be addressed before the complete implementation of the system. The digital records are placed on the ledgers having control outside the jurisdiction of the Government of Ghana which can pose a threat to the immutability and privacy of records. (Mintah et al., 2020)

F. **Andhra Pradesh**- In 2017 the government of Andhra Pradesh started a project to enable land registries on a blockchain platform for the city of Amravati in association with a Sweden-based start-up, ChromaWay.(Kshetri & Voas, 2018) Zebi data is a local firm that is doing most of the implementation work in this project. As can be seen from the example of Amravati, the strengths of the system are security, automated document writing, transparency, and no duplicity. This provides an opportunity for the system to prevent fraud relating to property in the future. The use of private blockchain denies the property owners accessibility

to monitor changes to records which proves to be a weakness of the system. The corruption of officials is posing a threat to technology. (Bhattacharya & qz.com, 2018)

G. **Telangana**- The government of Telangana signed MoU's with Tech Mahindra and IIIT-Hyderabad to explore various potentials of blockchain technology including that in land registration. (Kshetri, 2018)Dharani Portal is one such initiative by the government which aims to integrate the registration and revenue department of the state and put it on a blockchain ledger. The project is still in the early stages of the implementation phase. The strengths of the project are its transparency and ease of working. It has led to the elimination of corruption. (Planning Department Government of Telangana, 2021) The implementation of this project makes an instant transfer of land a possibility shortly which is an opportunity that can be grabbed. Lack of proper training of officers dealing with the new technology is a weakness of the system. The unclear existing records of land transfers and incoherent revenue law are becoming threats to the new system. (MK, 2019)

H. **Maharashtra**- In 2018 Government of Maharashtra started exploring the possibility of implementing blockchain technology for data security in the land and revenues department. The pilot project will be initially rolled out in Pune and Konkan divisions. The main strengths of this project are transparency and tamper-proof data. The opportunities that come along include increased ease of doing business and less vulnerability of hacking of systems.(makaaniq, 2018; Nambiar, 2018)The threat lies in gaining the scale of operations required for state-wide implementation due to the unavailability of large-scale proof of concept which is a weakness of the system. (Mandavia & ET Bureau, 2018)

This section has thrown light on the stages of implementation of blockchain technology in land registration in various states across the globe. The technology is being used not just to record transactions involving the land title but also to integrate various other aspects of the land. Integration of revenue and title records department, provision of a platform for buying, selling, rent, and mortgage of property, and combining of various utility departments are some major uses of the technology in this domain. The pilot projects and implementation have resulted in highlighting some strength, weaknesses, opportunities, and threats associated with the projects which will be collectively analysed in the next section.

5- ANALYSIS

A broad insight would have been generated about the application of blockchain technology in land registration from the above discussion. Table 1 below summarises the positives and negatives associated with this technology implementation in the domain of land registry. A list of advantages and disadvantages has been generated from the existing prototypes and proposed models. This section deals with an analysis of the key aspects of the projects of blockchain application in the land registry. The advantages of this technology are numerous but it is not free from its own set of problems. Let's take a look at the prominent features of the technology as derived from the use cases in the previous section.

Table: 1 SWOT ANALYSIS

STRENGTHS	**WEAKNESS**
● Trust incorporated in the system ● Fraud prevention by data verifiability ● Security & Efficiency ● Lesser vulnerability to error ● Transparency ● Time-Saving ● Cost-saving in long run ● Immutability (Tamperproof) ● Automated document writing ● No duplicity ● Ease of working	● Uncertain validity of digital signatures for real estate transactions ● Limited availability of skilled human resources for technology implementation ● High costs of initial development and implementation ● Accessibility to monitor changes is only available to the government department ● Lack of proper training of officers ● Unavailability of large-scale proof of concept
OPPORTUNITIES	**THREATS**
● Existing supportive data protection laws in some countries ● Attract foreign investments by increased ease of doing business ● Becoming a world leader in blockchain intellectual capital and skill development ● Economic growth opportunities due to lower cost of borrowing ● Respite to the judicial system due to lesser number of property disputes(frauds) ● Enabling the use of land capital and allowing mortgages will assist in the development ● Instant transfer of land ● Lesser vulnerability to hacking ● Elimination of corruption through increased transparency	● Lack of Public education about technology ● Need for Infrastructures like servers, storage, and nodes for verification ● Inclusion of various parties like realtors, buyers, sellers, etc. ● Absence/ Incoherence of regulatory frameworks & data protection laws in many countries ● Long term investments ● Control of records outside government's jurisdiction ● Unclear existing records of land transfers ● Gaining scale of operations required for state-wide implementation

The strengths of the projects come from the distinct features of the technology. Trust is incorporated in the system. Verifiability of transactions leads to the prevention of fraud and the immutability feature of the blockchain makes it taper proof. Some states have existing laws which support the implementation of the technology in the land registry. It has the potential to eliminate corruption, save time, save costs and ease the processes.

The weaknesses of this technology are drawn from its novelty. Since the technology is still in its exploration phase there is a lack of education and awareness about it in the masses. In many states, the existing laws and regulatory framework are not supportive of the technology. The skilled human resources required for large-scale implementations are limited. The costs of the

development of resources are high. Large-scale proof of concepts is scarce due to limited real-life implementations. By providing appropriate training and education to the involved parties and revising the laws to accommodate new changes most of the weaknesses can be dealt with.

Once implemented the technology has the potential to harvest a vast set of opportunities. It will ease the process of registration thus opening avenues for foreign investments, easing mortgages, and reducing the cost of borrowings. It will promote economic growth and developmental activities in the state. Property-related frauds and disputes will be reduced due to clear title availability resulting in a reduced burden on the judicial system. Due to its decentralized nature, the system will be almost impossible to hack thus making it less vulnerable.

Lack of awareness and know-how poses a threat to the large-scale implementation of the technology which can be dealt with by the provision of appropriate training to the concerned parties of transactions. New laws need to be formulated and old laws need to be amended to make provisions for implementing the new technology so that its full potential can be realized. Software and hardware need to be developed for large-scale implementation which can be purchased on the model of software as a service thus reducing costs. (Rathore et al., 2021) The threat of corruption hovering over the system can be mitigated by ensuring that multiple permissions are required to tweak the data. This way no one individual can manipulate the data for his/her gain.

Strengths:

- Trust- Distrust in institutions of government is a major problem in many countries(Collindres et al., 2016). Blockchain promises to deal effectively with this problem by incorporating trust in the system itself. The shared ledger of blockchain and time stamped transactions makes this technology trustworthy (Sahai & Pandey, 2020).
- Data verifiability- Verification of documents to complete a land registration transaction can be done through blockchain in a quick manner. Also all the transactions being added into a blockchain network can be verified by checking the hash function of the previous block (Suganthe et al., 2021). Cryptography plays an important role in the verifiability of data on blockchain (Sheetal & Shanmuga Rathinam, 2020).
- Security and Efficiency- Security is guaranteed by the framework of blockchain in the form of contractual security and privacy of transactions. Authenticity, Confidentiality and Fairness in terms of finance amongst the parties is what combines to form contractual security (Alketbi et al., 2018). Efficiency here refers to computational efficiency, efficiency of storage and efficiency in data management (Rizal Batubara et al., 2019).
- Lesser vulnerability to error- Paper transactions being mandated by legislations and legacy processes hinder the accuracy of the overall process of land registration and make it more vulnerable to error. With the automated systems of blockchain the vulnerability of error in the system can be reduced significantly. Implementation of blockchain in the system will bring transparency to the system. When parties will have digital records of all transactions in

shared digital ledgers, the vulnerability to error and frauds will be reduced (McMurren et al., 2018).

- Transparency- Implementing blockchain to land registry implies existence of a digitally distributed database that enhances the transparency in the system and helps in garnering trust in the public department (Sahai & Pandey, 2020). In blockchain a verifiable and clear record of transactions can boost transparency. Transparency in terms of this system would mean the disclosure of relevant data publicly while still maintaining the privacy of individuals (Rizal Batubara et al., 2019).
- Time-saving- In most countries the process of land registry is time consuming. By digitalizing the process and using digital signatures in the different stages of land registry, the process can be automated thus speeding up the process and significantly impacting the time consumed (Sahai & Pandey, 2020).
- Cost-Saving in long run- Dubai, Sweden and Ghana among other early adopters of blockchain in land registry have reported huge savings in costs resulting from blockchain implementation. These saving arise from reduced costs of document processing and also savings from real estate title insurance market (Themistocleous, 2018).
- Immutability- Using blockchain records can be saved in a tamper proof way. The cryptography mechanism being used in blockchain provides layers of security that stops any attacks on the system and prevents fraud arising out of manipulation of data (Sahai & Pandey, 2020). Immutability simply means the files cannot be edited or deleted (Lazuashvili et al., 2019).
- Automated Document Writing- In the case of India's first large scale blockchain implementation in Andhra Pradesh's Amravati's land registration, facility of automated document generation has been provided. Here the government provides at zero extra cost, system generated QR-code marked documents that can be directly used for registration (Bhattacharya & qz.com, 2018).
- No duplicity- Blockchain by its very nature eliminates the problem of double spending. In the case of land transfers, using blockchain will help avoid frauds occurring due to duplicate documents. It will restrict the selling, mortgaging of same property multiple times by the means of duplicate documents.
- Ease of working- Property is a prime asset in any business venture and it also involves significantly large amount of money. Uncertainty regarding the title of land and complex process of land registration discourages new investments and makes working difficult. With the implementation of blockchain technology in land registration, several countries have seen significant improvement in their ease of working rankings. Thus, indicating improved levels of ease of working.

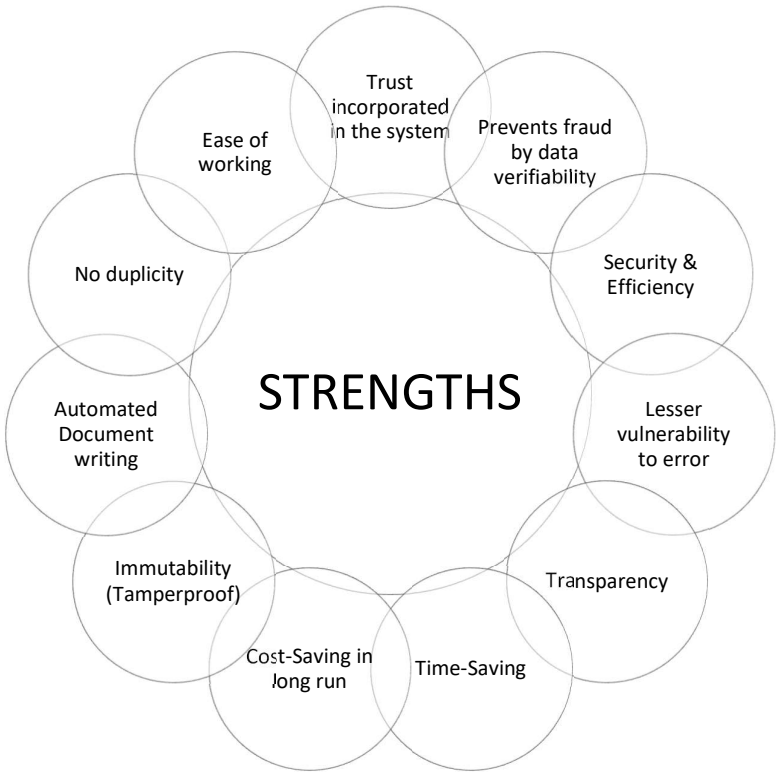

Figure 1- Pictorial Representation of Strengths of Blockchain Implementation

Weakness:

- Uncertain validity of digital signatures for real estate transactions- Digital signatures are being widely used for various financial purposes across the world but its validity for real estate transactions is still uncertain. Legal regulations regarding the use of digital signatures need to be revisited to check for the possibility of its use in these transactions.
- Limited availability of skilled human resources- Since the technology is still in its incubation stage, not many people have the skill to handle and develop the software and mechanisms to run it.
- High costs of initial development and implementation- To develop and implement it initially the technology requires huge investments in form of setup of hardware, servers etc. This can be effectively managed by using the SaaS(Software as a Service) approach which can divide the cost over the useful life of software helping pay as per use.
- Accessibility to monitor changes is only available to the government department- The biggest advantage of blockchain were its immutability and traceability. But as can be seen from the various examples of real-life implementation of blockchain in land registration, the public has no or limited access to track the changes made to a property title. This contradicts the very nature of blockchain
- Lack of proper training of officers- The officers who have to work with blockchain are often facing problems due to lack of proper training. At many instances they are not fully aware

of the technology they have to use. This can be addressed with the provision of comprehensive training with hands on experience.

- Unavailability of large-scale proof of concept- The proof of concept available from implementation of blockchain is still limited to smaller regions. Large scale proof of concept of application in blockchain technology is still not available.

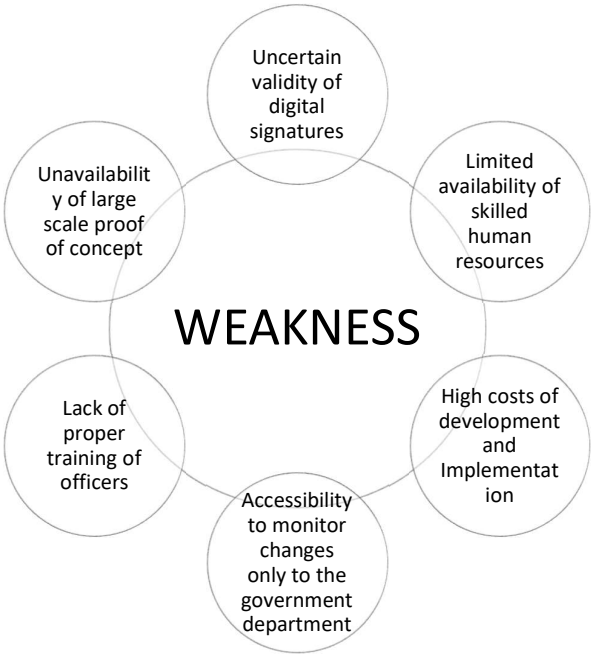

Figure 2- Pictorial Representation of Weaknesses of Blockchain Implementation

Opportunities:

- Supportive data protection laws- In a few countries like Georgia the existing data laws support the implementation of blockchain in land registry. For those countries, their data protection laws are a source of strength in the process of implementation of blockchain. Their laws do not hinder the saving of citizen's data on blockchain (Lazuashvili et al., 2019).
- Attract foreign investments by easing the registration process- With the introduction of blockchain technology in the process of land registration the registration process will have a complete overhaul. This eased registration process and clear land titles will pave the way for increased foreign investments in the country. Property is a major asset for any business. Easy acquiring and safe title of this asset makes it easier to do business. Therefore, implementation of blockchain in land registration will provide the opportunity for a better position of ease of doing business.
- Becoming a world leader in blockchain intellectual capital and skill development- Countries like Dubai have the vision to take the first mover advantage and become the blockchain hub of the world. They desire of becoming a world leader in skill development and provision of intellectual capital for the booming blockchain industry.
- Economic growth opportunities due to lower cost of borrowing- Clarity in land titles opens newer opportunities for growth. One such opportunity occurs out of lowered costs of

borrowing resulting from clear land title leading to increased opportunities of economic growth.

- Respite to the judicial system due to lesser number of property disputes and frauds- Since the land titles are becoming clearer due to application of blockchain technology, the disputes related to property will be resolved more easily. Also, the number of disputes arising will be lesser in number thus providing a respite to the system of judiciary. In most countries the maximum disputes in courts are those related to property. The availability of clear titles of land and records of all modifications in the system will help prevent frauds related to property. This will also result in giving respite to the country's judicial system.
- Elimination of Corruption through increased transparency- The presence of widespread corruption in public departments is a problem common to various countries. The corruption in land registration department ranges from bribes of small scale to the government power abuse at various levels including local, national and state(Kshetri & Voas, 2018). The use of blockchain in land registration has the potential to eliminate corruption to a great extent, thus making it even more appropriate to be implemented as a solution.
- Instant transfer of land- With the implementation of blockchain the process of land registry will be shortened thus removing the time lag before the actual registration. Time taken in completion of a transaction of property is significantly reduced by the use of blockchain. It helps in making the transfers instantly thus resulting in increased efficiency.

Figure 3- Pictorial Representation of Opportunities of Blockchain Implementation

- Enabling the use of land capital and allowing mortgages will assist in the development- Land capital is the biggest asset for most people. Uncertain titles of land make mortgages

difficult. With the implementation of blockchain technology in land registration the titles to land will become clear, thus making the use of land capital through mortgage a possibility. These measures will ultimately be helpful in the development of the country or region.

- Lesser vulnerability to hacking- Since the blockchain have a shared ledger across multiple nodes and all transaction data is secured through cryptography, these security mechanisms make the use of technology more attractive. It becomes less vulnerable to hacking. The software boasts of a distributed ledger technology and time stamping which makes it almost impossible to hack. Thus making the database less vulnerable.

Threats:

- Lack of Public education about technology- The public is still not educated about the technology and its potential use cases. Day by day people are learning to trade in and deal with cryptocurrency but not about the technology that supports thosetransactions. Use cases of blockchain in other domains are still not known to most people.
- Need for Infrastructures like servers, storage, and nodes for verification- The requisite infrastructure needs to be developed for the implementation. The absence of the infrastructure in most countries is a source of threat for the technology implementation.
- Inclusion of various parties like realtors, buyers, sellers, etc- Implementation of blockchain on large scale will mean involving various parties in the network. Parties like banks, financial institutions, buyers, sellers, service providers, realtors etc will have to be included in the blockchain network. While it is an important step for completely using blockchain technology's benefits but it also poses the threat of involvement of multiple parties.
- Absence/ Incoherence of regulatory frameworks & data protection laws in many countries- The existing regulations of most countries regarding data protection are not in coherence with the functioning and mannerisms of blockchain technology. This poses a threat to the implementation of the technology on large scale in the public domain.
- Long term investments- The implementation of blockchain involves initial investments of long-term nature to create the required infrastructure. The structure including servers, computing equipment, storage devices etc needs to be invested in beforehand to begin the implementation.
- Control of records outside government's jurisdiction- The records stored on blockchain technology though visible to various parties are saved outside the reach of government. Private players across national borders are generally involved in such record keeping which makes the records vulnerable to manipulation. The data stored on such servers can also raise concerns of national security and misuse of the private data of individuals.
- Unclear existing records of land transfers- Existing land records will form the basis of the initial entries in the blockchain system. Existence of problematic records will not resolve the problem of unclear land records.
- Gaining scale of operations required for state-wide implementation- The large-scale implementations require preparations for large scale of operations. The pilot projects have been implemented on smaller scales.

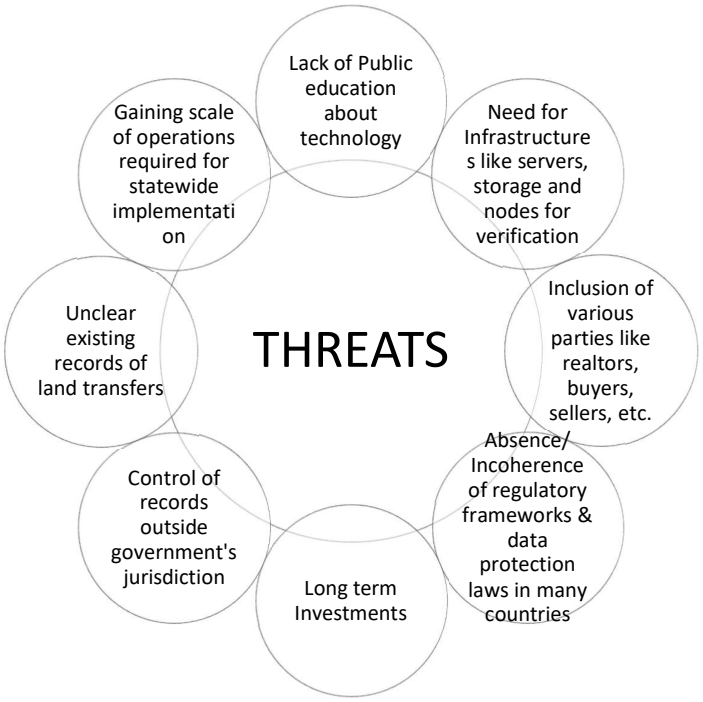

Figure 4- Pictorial Representation of Threats of Blockchain Implementation

6- LIMITATION&FUTURE WORK

This study focussed on the overview of various projects of the land registry using blockchain technology. Detailed analysis of the projects could not be undertaken in this research paper. In the future, more studies can be conducted focusing on In-depth study of implementation in a particular region. This way greater insights can be drawn about the implementation. Further studies can be more interactive by taking into consideration the viewpoints of various stakeholders.

7- CONCLUSION

Even though property is an essential part of the modern economy but still most systems of property registration are flawed. Improving the systems is essential for the growth and development of the region and for better opportunities for the public and businesses. The system of property registration provides details about ownership and land parcel. The existing systems work in isolation from other related government departments and are also prone to malpractices like the adulteration of records. The new system of blockchain technology in land registry promises to remove ambiguity in records by recording all transactions in an unalterable ledger with the permission of multiple nodes. The new system also promotes security and efficiency in the process. By implementing this technology newer avenues for development will be opened by the way of easy credit, better mortgages, attracting foreign investments, and reducing corruption. The technology is not free from its problems like unawareness and lack of accommodating regulatory framework. But these problems can be fixed in various ways to benefit from the larger good. The advantages of the technology outweigh its shortcomings paving a way for its successful implementation in society at large.

8- Bibliography

Alketbi, A., Nasir, Q., & Talib, M. A. (2018). Blockchain for government services-Use cases, security benefits and challenges. *2018 15th Learning and Technology Conference, L and T 2018*, 112–119. https://doi.org/10.1109/LT.2018.8368494

Bhattacharya, A., & qz.com. (2018). *Blockchain is helping build andhra pradesh's new capital- but can it cut through the red tape?* Scroll.In. https://scroll.in/article/887045/blockchain-is-helping-build-andhra-pradeshs-new-capital-but-can-it-cut-through-the-red-tape

Bishr, A. Bin. (2019). Dubai: A City Powered by Blockchain. *Innovations: Technology, Governance, Globalization*, *12*(3–4), 4–8. https://doi.org/10.1162/inov_a_00271

Bitland partners with CCEDK to improve blockchain land registry in West Africa. (2016). *EconoTimes*. http://www.econotimes.com/Bitland-partners-with-CCEDK-to-improve-blockchain-land-registry-in-West-Africa-271517

Chavez-Dreyfuss, G. (2015). *Honduras to build land title registry using bitcoin technology*. Reuters. http://in.reuters.com/article/usa-honduras-technology-idINKBN0O01V720150515

Chavez-Dreyfuss, G. (2016). *Sweden tests blockchain smart contracts for land registry*. Reuters. http://www.reuters.com/article/us-sweden-blockchain/sweden-tests-blockchain-technology-for-land-registry-idUSKCN0Z22KV[11/10/2017 09:25:38]

Chen, G., Xu, B., Lu, M., & Chen, N.-S. (2018). Exploring blockchain technology and its potential applications for education. *Smart Learning Environments*. https://doi.org/10.1186/s40561-017-0050-x

Collindres, J., Regan, M., & Panting, G. (2016). Using blockchain to secure honduran land titles. *Fundacion Eleutra, Honduras*, 15. https://s3.amazonaws.com/ipri2016/casestudy_collindres.pdf

Dubai Land Department. (2019). *Annual Report Real estate sector performance 2019*. https://dubailand.gov.ae/media/qq0nxuoi/annual-report-real-estate-sector-performance-2019.pdf

Ganne, E. (2018). Can Blockchain Revolutionize International Trade? In *World Trade Organization*. World Trade Organization. https://doi.org/10.30875/7c7e7202-en

Gatteschi, V., Lamberti, F., Demartini, C., Pranteda, C., & Santamaria, V. (2018). Blockchain and Smart Contracts for Insurance: Is the Technology Mature Enough? *Future Internet*, 16.

Hewa, T., Ylianttila, M., & Liyanage, M. (2021). Survey on blockchain based smart contracts: Applications, opportunities and challenges. *Journal of Network and Computer Applications*, *177*, 59. https://doi.org/10.1016/j.jnca.2020.102857

Kshetri, N. (2018). The Indian Blockchain Landscape : Regulations and Policy Measures. *Asian Research Policy*, *9*(2), 56–71.

Kshetri, N., & Voas, J. (2018). Blockchain in Developing Countries. *IEEE IT Professional*, *20*(2), 11–14.

Lazuashvili, N., Norta, A., & Draheim, D. (2019). Integration of Blockchain Technology into a Land Registration System for Immutable Traceability : A Casestudy of Georgia. *Business Process Management Blockchain and Central and Eastern Forum*, 16.

makaaniq. (2018). *Maharashtra Eyes Making Use Of Blockchain Technology To Secure Data*. https://www.makaan.com/iq/latest-real-estate-news/maharashtra-eyes-making-use-of-

blockchain-technology-to-secure-data

Mandavia, M., & ET Bureau. (2018, February 13). Maharashtra plans a pilot to try out blockchain technology. *The Economic Times*. https://economictimes.indiatimes.com/tech/internet/maharashtra-plans-a-pilot-to-try-out-blockchain-technology/articleshow/62896305.cms?from=mdr

McMurren, J., Young, A., Verhulst, S., Juliet McMurren, Young, A., & Verhulst, S. (2018). Addressing transaction costs through blockchain and identity in swedish land transfers. *Blockchain Technologies for Social Change; GovLab: New York, NY, USA*, *1*(October), 1–13. https://blockchan.ge/blockchange-land-registry.pdf

Minoli, D., & Occhiogrosso, B. (2018). Blockchain mechanisms for IoT security. *Internet of Things*, *1–2*, 1–13. https://doi.org/10.1016/j.iot.2018.05.002

Mintah, K., Baako, K. T., Kavaarpuo, G., & Otchere, G. K. (2020). Skin lands in Ghana and application of blockchain technology for acquisition and title registration. *Journal of Property, Planning and Environmental Law*, *12*(2), 147–169. https://doi.org/10.1108/JPPEL-12-2019-0062

MK, M. (2019). *Why Telangana farmers are facing the brunt of the new digitised land record system*. The News Minute. https://www.thenewsminute.com/article/why-telangana-farmers-are-facing-brunt-new-digitised-land-record-system-114462

Mus, F. (2018). *Blockchain implementation into supply chain management*.

Nærland, K., Beck, R., Müller-Bloch, C., & Palmund, S. (2018). Blockchain to Rule the Waves - Nascent Design Principles for Reducing Risk and Uncertainty in Decentralized Environments. *ICIS 2017: Transforming Society with Digital Innovation*, *September*.

Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. https://doi.org/10.1162/ARTL_a_00247

Nambiar, N. (2018, March). Maharashtra to roll out blockchain technology for land deals. *The Times of India*. https://timesofindia.indiatimes.com/city/pune/state-to-roll-out-blockchain-technology-for-land-deals/articleshow/63250707.cms

Ølnes, S. (2016). Beyond Bitcoin Enabling Smart Government Using Blockchain Technology. *5th International Conference on Electronic Government and the Information Systems Perspective (EGOV)*, 253–264.

Papadaki, M., & Karamitsos, I. (2021). Blockchain technology in the Middle East and North Africa region. *Information Technology for Development*, *27*(3), 617–634. https://doi.org/10.1080/02681102.2021.1882368

Perboli, G., Musso, S., & Rosano, M. (2018). Blockchain in Logistics and Supply Chain: A Lean Approach for Designing Real-World Use Cases. *IEEE Access*, *6*, 62018–62028. https://doi.org/10.1109/ACCESS.2018.2875782

Planning Department Government of Telangana. (2021). *Socio Economic Outlook 2021*. http://www.indiaenvironmentportal.org.in/files/file/Telangana Socio Economic Outlook 2021.pdf

Rathore, V. S., Kumawat, V., & Umamaheswari, B. (2021). The rising of blockchain technology and its adoption in India. In *Advances in Intelligent Systems and Computing* (Vol. 1187, pp. 351–357). Springer. https://doi.org/10.1007/978-981-15-6014-9_20

Reyna, A., Martín, C., Chen, J., Soler, E., & Díaz, M. (2018). On blockchain and its integration

with IoT. Challenges and opportunities. *Future Generation Computer Systems*, *88*(2018), 173–190. https://doi.org/10.1016/j.future.2018.05.046

Risius, M., & Spohrer, K. (2017). A Blockchain Research Framework: What We (don't) Know, Where We Go from Here, and How We Will Get There. *Business and Information Systems Engineering*, *59*(6), 385–409. https://doi.org/10.1007/s12599-017-0506-0

Rizal Batubara, F., Ubacht, J., & Janssen, M. (2019). Unraveling transparency and accountability in blockchain. *ACM International Conference Proceeding Series*, 204–213. https://doi.org/10.1145/3325112.3325262

Rodima-Taylor, D. (2021). Digitalizing land administration: The geographies and temporalities of infrastructural promise. *Geoforum*, *122*(August 2020), 140–151. https://doi.org/10.1016/j.geoforum.2021.04.003

Sahai, A., & Pandey, R. (2020). Smart contract definition for land registry in blockchain. *Proceedings - 2020 IEEE 9th International Conference on Communication Systems and Network Technologies, CSNT 2020*, 230–235. https://doi.org/10.1109/CSNT48778.2020.9115752

Scott, B. (2016). *How can cryptocurrency and blockchain technology play a role in building social and solidarity finance?* (No. 2016–1). http://hdl.handle.net/10419/148750

Shang, Q., & Price, A. (2018). A BLOCKCHAIN- BASED LAND TITLING PROJECT IN THE REPUBLIC OF GEORGIA. *Innovations*, *12*(3/4). http://direct.mit.edu/itgg/article-pdf/12/3-4/72/705280/inov_a_00276.pdf

Sheetal, & Shanmuga Rathinam, G. (2020). Analysis of various applications of blockchain technology: a survey. *Data Science and Security*, *132*, 305–311. https://doi.org/10.1007/978-981-15-5309-7_33

Suganthe, R. C., Shanthi, N., Latha, R. S., Gowtham, K., Deepakkumar, S., & Elango, R. (2021). Blockchain enabled Digitization of Land Registration. *2021 International Conference on Computer Communication and Informatics, ICCCI 2021*, 1–5. https://doi.org/10.1109/ICCCI50826.2021.9402469

Themistocleous, M. (2018). Blockchain technology and land registry. *Cyprus Review*, *30*(2), 195–202. http://cyprusreview.org/index.php/cr/article/view/579

Underwood, S. (2016). Blockchain beyond bitcoin. *Communications of the ACM*, *59*(11), 15–17. https://doi.org/10.1145/2994581

Williams, S. E. (2015). *Are Notaries an Endangered Species ?* https://williamsassociates-ltd.com/articles/Are_Notaries_an_Endangered_Species_by_Steven_E_Williams.pdf

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, *21*(1), 7–31. https://doi.org/10.1093/rof/rfw074

Zhang, P., Schmidt, D. C., White, J., & Lenz, G. (2018). Blockchain Technology Use Cases in Healthcare. In *Advances in Computers* (1st ed., Vol. 111). Elsevier Inc. https://doi.org/10.1016/bs.adcom.2018.03.006