

An Adaptive Model with Blockchain Technology for Mortgage Industry in Myanmar

Kyaw Soe Lin
Technology Division
Yoma Bank
Yangon, Myanmar
kyawsoelin@yomabank.com

Prof. Mie Mie Su Thwin
Head of Cyber Security Research Lab
University of Computer Studies
Yangon, Myanmar
drmiemiesuthwin@ucsy.edu.mm

Htoo Aung Maw
Risk Division
Yoma Bank
Yangon, Myanmar
htooaungmaw@yomabank.com

Abstract— Attaining a mortgage can be very painful, costly and lengthy process especially when the policy and infrastructure is not easy to implement it. In Myanmar, the process of the origination for mortgage can be minimum 30 days to up to 90 days based on the bank that the customer chooses to apply. In addition, the documents that required to do all the process will take time to prepare and also there is no single truth of source that the bank can rely and validate it. The origination process involves more than 100 steps and do manual assessment and reconciliation among a variety of parties, including appraiser, borrower, lender, insurer and the list can go on. In Myanmar mortgage industry, there is no way to verify and validate the documents that are related to the apartment or real estate. On the other hand, it is not just origination process, the bank needs to consider the servicing, prediction of the financial loss based on customers' behavior that include both financial and non-financial information. Therefore, the whole process needs to be seamlessly going through from the very beginning for both customers (buyer and seller) and the bank. In addition, the bank needs to measure and validate every single information that collected from customers and external sources to predict how the customers' behaviors will look like in upcoming years. The proposed model is a solution to ensure high security while eliminating fraud, lowering operational risks and reducing administrative cost as well as a competitive advantage in the mortgage industry.

Keywords—Mortgage Financing, Blockchain, Banking Industry, Land Registry, Smart Contracts, Formalization, Adaptive, Myanmar.

I. INTRODUCTION

Blockchain has gained tremendous interest in financial services both banking and financial inclusion over the past several years. Adoption of Blockchain is slow but people are realizing that there is a great value that the Blockchain technology can add on to both the unbanked and the bank. The advantages of the using blockchain can have multiple benefits that include efficient, secure, faster decision and to provide decentralized services. Lielacher (2017) mentioned that blockchain technology can provide the potential solution that will greatly improve the transaction processes for both banked and unbanked customers. Mortgage sector in the bank is catching up the blockchain technology after the technology is added value to market by enabling people to easily access real state or mortgage loan. Hjønnneväg (2018) stated that blockchain technology has already begun to cause disruptions in the financial industry. In the earliest days, mortgage or real estate financing was meant for only well-defined group (rich crowd), as it seems like they always have an easy access to it. The people who needs mortgage financing do not get the tenure that they want and people who get those tenure, do not need a loan for longer term frame. There is always been a necessity to provide to fill these requirements. Daley (2019) described that blockchain-based smart contracts ensure that

both buyer and seller agree to fair and feasible terms regarding things like proof-of-funds and payment planning. Blockchain technology may not be accommodate all the requirements to solve the various problems but it may address the problems that can be solved one by one.

On the other hand, Artificial Intelligent (AI) in getting popular for various reasons in banking such as improve process for Anti-Money Laundering (AML), Know-Your-Customer (KYC) regulatory checks as well as that can lead to monitoring and prediction of the financial projection, customer behavior prediction by using multiple AI models. Most of the top banks in the world such as Capital One, Citi, HSBC, JPMorgan Chase, Personetics, Quantexa and U.S. Bank are using AI technology to reduce cost on front office (conversational banking), middle office (anti-fraud) and back office (underwriting), Digalaki (2019). Therefore, using AI in general adds tangible value in many ways.

The combination of both Blockchain and AI will be a very suit for the bank but it is not just for the mortgage industry instead it can apply to across all the area. Schmelzer (2019) stated that Blockchain is a decentralized, distributed ledger of transactions that has elements of transparency, trust, verifiability and something called smart contracts. In our case, an ownership, location, legal contract and the documents and financial information that related to real state or apartment can be defined as a smart contract. If the smart contract is available to all the bank in Myanmar industry, the mortgage financing process can be easily done by accessing the required data throughout the whole network that can be locally and national level. In addition, AI technology will use this smart contract information and both non-financial and financial information from the bank to make a prediction of customer behavior and its impact on financial. Therefore, use of both blockchain and AI technologies in the financial sector will bring a great benefit to both bank and customers, in other word people.

The main objective of this paper is to address “how blockchain technology can add value to local people (land registry, seller, buyer, accessor, viewer and insurance agency) for easy accessible to all the documents that related to apartment or real estate and the banking industry to validate required information for the mortgage assessment in Myanmar”. This paper also states that how the proposed adaptive model with blockchain technology can provide better services based on our financial needs and also define as one of the benchmark models for mortgage industry in emerging market like Myanmar.

II. BLOCKCHAIN CHALLENGES: ISSUES WITH ADOPTION

Using a blockchain technology to open up Myanmar mortgage market and new liquidity source is a challenging concept for our society to adapt new technology and develop effectively and efficiently in the banking industry.

A. Conceptual Challenges

In Myanmar, centralized process and operations can be seen everywhere in the banking industry and adopting a decentralized

approach will be conceptual challenged due to no central authority and involvement of multiple layers and components such as distributed ledgers, mining, zero-knowledge proof, proof of work and stake and decentralized storage and etc.,. There will be a big conceptual challenge in current practice and technology to transform into block chain and decentralized practice that will take time to understand, learn and safely to develop in practice. This problem is not new. There were challenges in early internet days with society to understand how URL works and how digital payments make it easier to adapt and change the environments.

B. Trust Issues

There is a similarity between conceptual and trust since trust and adoption of new technology in Myanmar is another major challenge to consider. In blockchain technology, instill development of trust with its unbiased and decentralize network will reduce expenses in the banking industry and greatly reduce the loan processing time. Additionally, security tokens and cryptography in blockchain technology will need to ensure that accuracy of transaction records and prevent from fraud especially in each entry point due to involvement of multiple stakeholders. Therefore, sufficient check and balance must be taken place from the beginning until the whole chain process. As with above, time as well as improved application with sound proven mechanism are required to alleviate these hardens.

C. Regulatory Challenges

There is another challenge that international banks in other markets and Bank in Myanmar faced dealing with complex regulatory challenges. *"In our jurisdictions, the tokenization of an asset is synonymous with the securitization of an asset, meaning the process by which an illiquid asset is turned into security"* [1]. The whole process must need to be approved by the regulator, met their criteria and the new technology, laws, regulations and policies must be enforced by the regulator, Central Bank of Myanmar in our case.

D. Complexities and Dependencies

Based on mortgage industry and regulatory necessities in Myanmar, changing the way of transactions that managed, handled and recorded is not a simple way to adapt blockchain technology quickly and effectively. The entire process must be digitalized to provide transparency and immutable. Additionally, significant coordination with local institution, authority and banks is another important dependency that need to be addressed carefully. To create a tangible asset, we will need to create a digital record of detailed information such as ownership history, property taxes, properties information and its historical records. There should be a link between that digital block chain record or land registry or local authority for official recognition that endorsed by legitimate parties. There might be a case when users create a parallel record of properties that duplicate those maintain in the land registry. It means that there will be confusion and additional overhead due to duplicate records and will be hard to maintain consistency among records.

E. Volatility and Market Risk

Market volatility is another challenge to consider and address it. Based on cryptocurrencies stock market, we can clearly see that how investors can sometimes overreact to market downtime. Different between cryptocurrencies and real estate market is that one is pure liquid and another one is currently illiquid since real estate market heat up and cool down time are taking over months and years. Don et al. (2019) mentioned that "people who own a house, while disappointed in any drop in value, are likely to be able to absorb a downturn because they have no immediate intention to sell their house". There will be a high demand and will be increased in the number of active real estate investors, when the property ownership is tokenized and traded in minutes.

F. Uniform Data Standards for Servicing

In Myanmar, there is a lack of data standard and data field validation that are constantly vary from one service to another

service. Even in the banking industry when Myanmar Credit Bureau is initiated, there are lots of data remediation program to clean up the existing data. Therefore, uniform data standards for servicing will be big challenges if we are considering from the very beginning. The proposed model should have a standard data structure, data field and valid format that can be easily accessible and enter by all the customers. If there is no uniform data standard, there is no data inconsistencies and ambiguities that can deny and delay in the mortgage process. Data lost or misinterpreted during the application process can cause harm to consumer and potential fines from regulatory when it is occurred.

When there is a new technology that is developed and implement it for better living and society, there are always challenges and issues to adapt and consider it before the technology is taking place. On the other side, there are opportunities that are waiting ahead to us to ease our living and improve our lifestyle. Next session will cover how block chain technology can bring and improve our way of living and lifestyle in Myanmar.

III. BLOCKCHAIN OPPORTUNITIES

A. Digital Identity

Digital identity is well known and truly established as one of the significant technologies in the world. In Myanmar, the technology can be easily adapted with current National Registration Card (NRC). Currently Myanmar Immigration is collecting biometric data such as fingerprints for international travels. Combination of a unique NRC number and biometric information of each one can be used as digital identity as well as can be used as public keys in digital signatures process to provide enhance security in the blockchain process. Unless the use's credential and biometric information are share with public, there will be no lack of secrecy in the process.

B. Land Registry

Myanmar is an emerging market and there is no digitalized land registry process. To successfully develop the digitalized land registry, all partners must be involved and adopted the blockchain technology. This will be an independent from legal and technical solution as having trust in a third dimension. The parties such as sellers, buyers, banks, insurance agency, accessors, local authority, registered public agent or agency, local public must be endorsed in each process to complete the mortgage transactions and processes. A blockchain based land registry must be initiated identification of right owners and holders and creating or enhancement of new actual land titles. Once it is known the actual owner of this land, the title transfer can be done easily by using digital solutions. Blockchain acts as a single source of truth and can be only edited and modified by rightful owners.

Therefore, digital identification that stated in previous section is a main factor to provide security properties such as confidentiality, integrity, availability, authorization, authentication, freshness, secure localization, forward and backward secrecy in the blockchain process. The solution can be easily integrated with photo and document submission by using Optical Character Recognition (OCR) and Natural Language Processing (NLP) technology to analyze entry data for accuracy and less time consuming.

C. Smart Contracts

Szabo [11] introduced the concept of smart concept that defined as a computerized transaction protocol that acts as the term of a contract. A smart contract is a set of rules and run as a program that is self-verification, self-execution and tamper resistant on the blockchain. The combination of blockchain technology and smart contract can provide flexibility to address problems in the mortgage industry by less cost and time without involvements of other traditional based systems. The main advantage of smart contract is

trackable and irreversible as well as it allows peer to peer transaction and related data can be maintained publicly in the trustee environment by using a secured way. Bhabendu [12] mentioned that some characteristic of a smart contract can be listed as follows:

- Smart contract is machine readable code that run on block chain platform
- Smart contract is event-based program
- Smart contract is automatically log once it is created in blockchain
- Smart contract is stored in a distributed manner

The smart contract is getting popular in the world and promising program but applying in Myanmar society will bring up to the next level up to our society.

D. Relationship (among parties)

On the other hands, blockchain technology will increase the level of trust among the multiple parties in distributed private network environment. As each action and transactions are recorded and logged automatically in distributed manner that used secured channels with digital signature will transform the mortgage industry in Myanmar due to enforce interoperability across multiple processes in the banking industry. Additionally, validation of entries, protection of entries and maintain historical records in blockchain will increase the level on trust among all the parties such as sellers, buyers, banks, insurance agency, accessors, local authority, registered public agent or agency, local public in Myanmar.

The combination of the above opportunities can addresses a lack of transparency and efficiency, and can transform core mortgage lending processing such as purchasing, sale, financing, leasing and title management in Myanmar and significant contribution to society where there is a lack of trust and transparency in the Myanmar Market.

IV. A CONCEPTUAL FRAMEWORK AN ADAPTIVE MODEL WITH BLOCK CHAIN

There are many research such as [1],[2],[3],[4],[5],[6],[7] that has been done already in the market that related to how to develop and implement the blockchain technology in mortgage industry. The proposed model is based on their finding and address carefully based on requirement of Myanmar Mortgage industry. The In this session, we will more focus on the followings that hardly address in Myanmar market for mortgage processes and how it can change the mortgage industry and improve operational efficiency and less time consuming.

A. Digital Ledger Transaction

Digital Ledger Transaction (DLT) is the fundamental requirement of the blockchain, and its offering. “*DLT offers a consensus validation mechanism through a network of computers that facilitates peer-to-peer transactions without the need for a centralized authority to update and maintain the information generated by the transactions*” Rennock et al. (2018) [13]. Every transaction will be validated with multiple parties that are verified and validated within the network and will add a new “block” to the previous existing chain. There is no way that anyone can alter and remove the chain once a transaction has been added to the chain.

DLT is known as a ledger and is recorded digitally by using distributed database. Using cryptographic method in blockchain will significantly improve security properties and will provide more transparency within the multiple parties. The shared ledger provides better transparency and reduce a single point of failure due to separate ledgers and centralized approach. In Myanmar, this can be one of the solutions to move forward for building trustee environment.

B. Interoperability

Interoperability is another area that need to be addressed carefully. In emerging market like Myanmar, there is a big issue in interoperability due to multiple systems, different infrastructure, and technology. Currently, there is no way that the system can talk each other in Myanmar Market even for the credit scoring and validation of Know Your Customer (KYC) information within financial institutions. In information technology, interoperability refers to the basic feature and functionality of computerized system to link and communicate with other system even if they used different infrastructure and technology. Lack of interoperability can create problems such as lost trust between multiple parties, additional cost and time and security breaches. Using the blockchain technology can meet interoperability between multiple parties that use the same transaction type and distributed ledger which all parties can connect without compatibility problem and can solve the problem of uniform data standard.

C. The Blockchain

In the blockchain, the block is not only financial information and transactions that are recorded but also other information such as transaction data set, digital events and its related information, transaction validation and agreement or consensus that verify by multiple parties electronically. All the recorded information can be either a block or multiple blocks that follow by right sequence and automated references and logs. Each block of data is entered correctly into DTL system and will link with the existing blocks to create a chain and to retrieve information of all the existing blocks. When multiple blocks are in the chain, it will be easy to retrieve data and will be able to receive complete information from the very beginning. Using blockchain technology will make all the financial institutions and people in Myanmar to easily check the historical recorded data at any time and can provide transparency.

D. Digital Identity

A digital identity is known as a set of validated digital attributes and credentials for the digital world and there is a similarity to each person’s identity for the real world, NRC that is acted as a unique identification number in the Union of Myanmar. It can include unique number such as NRC, Social Security Board Number (SSB), Tax Identification Number, name, place, date of birth, citizenship, biometrics and others that defined by national law or regulation. These sets of digital attributed can used and signed electronically to retrieve information from the blockchain. Additionally, when the user requests an access to the blockchain for data retrieval, changing title, update information or does any kind of read and write action, they must be digitally signed and kept it in the system automatically as a log.

E. Public and Private Keys

In this paper, the public key refers to the main key that will use by customers to retrieve the complete information and data for land registry information and its related information to get a holistically view of that land, and building, condominium and apartments. The private key refers to a key data entry that validate and verify by an authorized party for enhancement and modification. In this framework, both public and private key will be used to enhance security properties such as authentication, authorization and integrity.

Therefore, the public key will be used for data retrieval for the customers and private key is considered to use for critical records for approval and authentication purpose. For public key AES will be used in this model to design a scalable and flexible system in the block chain whether the secret key of a user and ciphertext are dependent upon their attributes and credentials. NRC and biometric

information can be one of their attributes to consider when the public key is created due to unique ID and can linked to digital identity in the future when the centralized ID is developed by government of Union of Myanmar.

F. Digital Signature

For decades, digital signatures have been widely used in system to provide integrity, non-repudiation and authentication to control given access to a set of data or information that shared electronically across networks. Whenever each transaction is entered into DLT, every transaction must authenticate and validate by using a digital signature. This is another opportunity that we need to introduce in Myanmar to promote digital literacy and features.

G. Consensus Model

The development of consensus model can be challenging and need to implement it carefully based on external market situation especially Banking industry in Myanmar. Consensus is literally agreement and it is very important to standardize and agree on process. Consensus model is an algorithm that help in distributed networks to unanimously take a decision when it is necessary during the data exchange processes. Main features such as decentralized governance structure and fault tolerance and performance will be included in the model. Additionally, the concept of proof of work (PoW), proof of state (PoS), proof of elapsed time (PoET), proof of existence (PoE), delegate proof of stake (DPOs) and proof of storage should be included in the consensus.

Stellar consensus protocol [25] is one of the consensus models that is currently used in the market to create applications using blockchain architecture. SCP protocol consists of nomination and ballot protocol itself. The nomination protocol is run initially to propose agreement based on new values to vote by receiving parties. Once nomination is completed, the ballot protocol is activated to confirm either commit or abort the values that raised by nomination protocol. Based on the SCP protocol, our proposed model will be similar that will contain both nomination and ballot to control the decentralized governance structure.

V. MODEL FORMATION

In this session, the formal and standardized process of the lending process for the mortgage industry in Myanmar. There are two areas that considered to address in this paper: one is for how to register in land registry, update and change title when someone purchase a land, condominium and apartment and another one is to show that how block chain and AI technology can effectively use in mortgage lending process to save time and cost and create a tangible records for future investment. The following steps are used for land tile registration for the proposed land registry system.

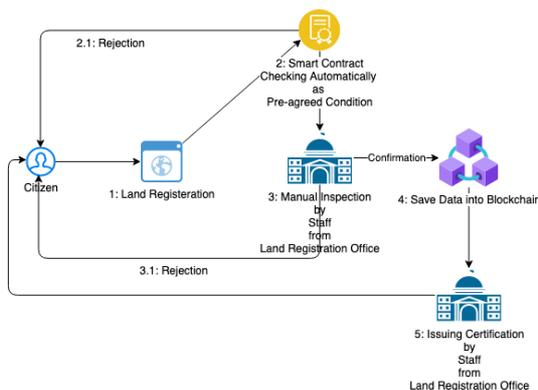


Figure 1: An overall diagram of proposed land registry system

1. Real estate owner will request a registration request with digital identity such as NRC, SSB number and etc.,
2. Land register will verify and validate their records and create a smart contract (registration and detailed info) with signed with private key based on requester's credential
3. Land register will check based on electronic records that is submitted by owner for inspection purpose. If it is not enough due to several constraints like location, the manual inspection will occur to the remote area.
4. Land registry office will update and share a smart contract in public and hybrid blockchain
5. Land registry will provide and share a smart contract that can be decrypted by using requester's credential. If the owner wants to update the other detailed information, he or she can use his private key to add additional information that is not updated by land register. Once it is updated, the transaction is trackable and irreversible as well as create another block.
6. Public viewer can check the legitimacy and detailed information of related real estate in public and hybrid blockchain by requesting an access.

Once the registration of land is successfully completed, the proposed adaptive model with blockchain technology for mortgage industry in Myanmar is used to speed up and effectively make a decision in the lending process.

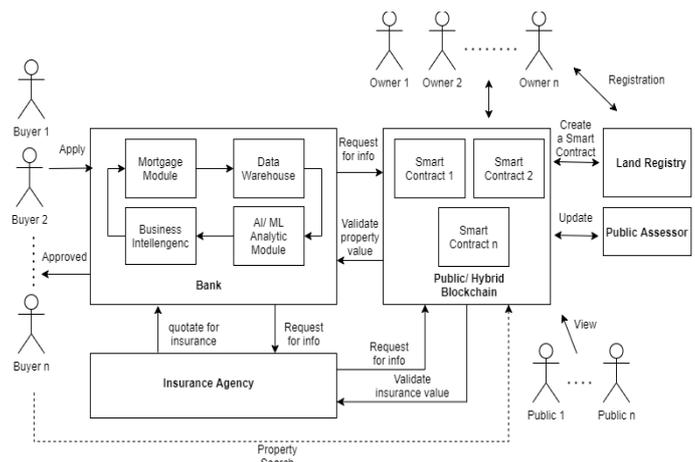


Figure 2. An overall diagram of proposed model for mortgage

Based on the Figure 2, the process can be standardized and formalized as follow:

1. Buyer can search and view properties which are already on public and hybrid blockchain
2. Buyer will contact to bank for mortgage process and fill the applications for preliminary assessment. Only the buyer fulfils the assessment, bank will proceed further for credit assessment
3. Bank will request an owner to view a smart contract to check and verify all the information and history for assessment
4. Bank will do credit risk assessment based on application data, behavior information and Myanmar Credit Bureau data
5. Bank will request an insurance agency to insure this property
6. Insurance agency will check and verify all the information and history of this property and set the policy
7. Insurance agency will do assessment and share insurance policy and its package with Bank

8. Bank will do final assessment based on insurance policy and either approve or reject the loan.

The proposed model used a simple business logic to develop the simple application to evaluate the results especially for land registration purpose. Developing and using new technology to improve a mortgage lending system is easy to implement it but the process has to be consistence and syndicate among other banks to work properly. Therefore, the enforcement of regulators and Central Bank of Myanmar will play an important role to successfully develop the proposed model in emerging market like Myanmar. In this paper, artificial intelligence module and credit assessment based on application data, Myanmar Credit Bureau and behavior data will not be covered and focused due to focus on land registrations and formalization of models based on new technology/

VI. DEVELOPMENT AND IMPLEMENTATION TOOL

Choosing the right architecture, infrastructure and tool is another important factor to successfully develop and implement the proposed model. After carefully considerations on development tool, the following technology and tools will be used.

Architecture	Tools
Front-End Application	Node.js
Back-End Application	Spring Boot
Blockchain Source Code	Hyper Ledger (Java)
Chain Code Application	Vagrant, containers and microservices
Encryption	AES256

Table 1: Development platforms and its implementation tool

Based on the above table, Node.js [20] is used for front-end application development. It is an open-source, cross-platform development that included backend application support. Node.js is based on JavaScript runtime environment. Additionally, Spring Boot [21] will used alongside with Node.js for development of backend and microservices.

Hyperledger Fabric is designed as a fundamental module to develop blockchain based application and solutions that support a modular architecture. Hyperledger Fabric supports other components such as consensus and memberships services, to be plug-and-play and satisfies a broader area of different segments and industry scenarios. It offers a unique approach to consensus that enables performance at scale while preserving privacy [22]. On the other hand, Hyperledger fabric supports a simple API for distributed ledger or query to submit transactions as the contents with a minimum coding requirement.

Vagrant is used to develop and manage virtual blocks in virtual environments in a single workflow and its automation processes [23]. A container is used to run application quickly and reliability from one computing environment to another. A microservices architecture is used to develop fine-grained functionalities within the whole application process. Encryption is one of the fundamental requirements to provide securities properties such as confidentiality, integrity, authenticity, secrecy and etc., within the applications and the network environments. An encryption system such as Advanced Encryption Standard (AES) [24] is used to encrypt sensitive information to protect and prevent it from security breaches. AES encryption algorithm is widely used as trusted system with widespread adoption. AES becomes one of the industry standards for encryption and used in both private, public, commercial and non-commercial applications development and its implementation.

The next session will explain how we evaluate the proposed model and how a simple application is implemented for land registration purpose.

VII. EVALUATION

The evaluation session is divided into four sessions to address based on the research methodology.

A. Preliminary Considerations

Sonnenberg (2012) [19] stated that “a researcher could present intermediate products of a design science process to the research community in order to build consensus on the relevance, novelty, and importance of a chosen problem domain, to discuss design objectives and feature, or to disseminate an initial blueprint of an IT artifact”. Therefore, the previous session that described the theoretical explorations and model formalization is addressed this purpose. Additionally, this session follows design-evaluate-construct-evaluate pattern that will validate the design of an artifact. Table 2 shows how the proposed model is evaluate based on above evaluation pattern.

Activity	Input Criteria	Research Outcomes	Evaluation Criteria	Evaluation Method
Evaluation of Research Proposal	Problem Statement, Research need, Research methodology, Existing industry practice	Validate problem statement, Identify research gap, Justified research objectives	Novelty, Feasibility	literature review of current industry and existing solution in Myanmar market
Evaluation of Design and Implementation	Design specification, Design and implementation tool	Validate design specification, Justification of right design and tools	Operationality, Accessibility, Understandability, Simplicity, Consistency	Simulation and a simple application for benchmarking

Table 2: Evaluation activities and evaluation criteria

B. Practical and Theoretical Relevance and Novelty

This paper identifies and addresses the research gap for mortgage industry in Myanmar; there is any published research papers that addressed lending in the mortgage sector as well as digitalized land registration process with blockchain and artificial intelligence technology. This means that our proposed model will fulfil the industry needs and can be reflected in Myanmar Banking Industry. It can also be one of the benchmark models for mortgage industry in Myanmar. As stated in Session V and VI, the preliminary model that incorporates with current technologies such as distributed ledger technology, smart contracts (blockchain) and artificial intelligences could be a very first innovative approach on how mortgage lending process can be improved in two aspects; economically and social relevant sector.

C. Feasibility's of Model Instantiation

The information flows that presented in section V relies on two main features: digitization of land registration and blockchain based mortgage lending process. Digitalization has been already successful in global market but there is hardly any work done in Myanmar market. The proposed lending process has been improved based on new technology and assessment of the existing mortgage process. There are certain legal restrictions and regulations that are important to consider and may need to improve and enforce it at the same time. The feasibility of instantiating the model that is presented in section V depends on a capability of smart contracts to develop it in the mortgage lending life cycle. Our preliminary evaluation is that our business logic is simple enough to be successfully coded and follow the proposed workflow. The simple application is created for land registration and distributed ledger for mortgage processes. The user interface of the simple application for land registration can be seen as follow:

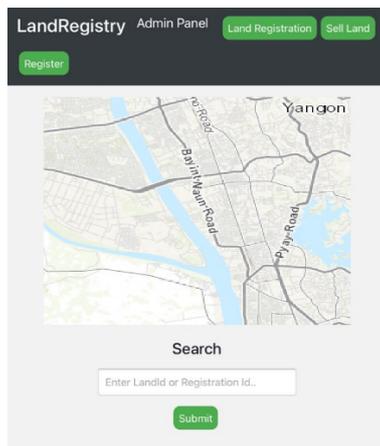


Figure 3: A user interface for land registration process

D. Addressing Mortgage Financing Problems and Issues

The advantage of using blockchain for mortgage industry in Myanmar can dramatically improve the society and benefit to financial institutions.

- Buyer and bank can check the whole history to a particular land, condominium and apartment
- External accessor can value the property based on their expertise and update in timely manner based on external market
- Owner title and credentials can be easily change and update
- The update information can be seen in timely manner and no delay
- Verification and validation will be easier due to blockchain
- Establishment of an objective and standardized data-driven decision-making culture
- Efficiency in land registration and mortgage origination
- Accessibility of mortgage financing for underserved population segments.
- Customer satisfaction improvements

Based on the above discussion, the proposed model will increase access to finance for underserved segments by improving mortgage financing processes in Myanmar market.

VIII. CONCLUSION AND FUTURE RESEARCH

Based on our studies in blockchain technology, land registration process both register and update in Myanmar, the principal of good governance and administration processes can be met and improved. Additionally, the transparency and efficiency can be provided by recording all the transactions that include historical information that stored as a smart contract. Transaction rules can be easily developed and implemented as well as validation can be done via distributed manner by the multiple stakeholders due to accessibility and availability. Additionally, the data privacy can be provided by using AES encryption in the whole processes.

This paper has developed and formalize a business model for land registration and mortgage financing in Myanmar market based on blockchain technology to improve efficiency and to drive a data driven credit scoring assessment. The proposed model is a preliminary phase of the research project that will conclude with the whole infrastructure and architecture with its application and introduction to the emerging market and evaluation based on actual mortgage scenario in Myanmar. This study has several limitations since the research is in its preliminary phase and there are more works to be done such as applying artificial intelligence technology in credit scoring assessment and combination of all the proposed model. The proposed model is developed separately as a module and

we will need to combine as one model to validate end to end journey with real time mortgage scenario in Myanmar for future usage.

REFERENCES

- [1] B. Don, D. Rajah, S. Ott and K. Fromm, "Real Estate Use Cases for Blockchain Technology", Enterprise Ethereum Alliance – Real Estate Special Interest Group, 2019.
- [2] K. Kaul, L. Goodman, A. McCargo and T. Hill, "The case for Uniform Mortgage Servicing Data Standards", Urban Institute, 2018.
- [3] "How Blockchain Would Improve the Mortgage Process", <https://www.synechron.com/> [Accessed: 1st of December, 2020].
- [4] A. I. Ali and D. T. Smith, "Blockchain and mortgage lending process: A study of people, process, and technology involved" Online Journal of Applied Knowledge Management, 2019, pp. 53-66.
- [5] J. M. Graglia and C. Mellon, "Blockchain and Property in 2018: At the End of the Beginning" Innovations: Technology, Governance, Globalization. 2018.
- [6] "Blockchain in Commercial Real Estate: The future us here!" Deloitte Center for Financial Services. <https://www2.deloitte.com/mm/en.html> [Accessed: 14th of November, 2020]
- [7] J. Vos, "Blockchain-based Land Registry: Panacea, Illusion or Something in Between?", 2017.
- [8] R. Henriquez, I. Cohen, N. Bitan and K. Tulbassiyev, "Blockchain and Business Model Innovation: Designing a P2P Mortgage Lending System", 2019.
- [9] E. Shalev and D. Micley, "elphi: A Business Plan to Streamline the Mortgage Lifecycle Through Blockchain", Thesis, 2019.
- [10] "The Land Registry in the Blockchain", 2016. http://ica-it.org/pdf/Blockchain_Landregistry_Report.pdf [Accessed: 1st of November, 2020].
- [11] N. Szabo, "SMART Contracts: Building Blocks for Digital Market", 1996.
- [12] M. K. Bhabendu, S. S. Panda and D. Jena, "An Overview of Smart Contract and Use Cases in Blockchain Technology", 2018.
- [13] M. J.W. Rennock, A. Cohn and J. Butcher, "Blockchain technology and regulatory investigations". The Journal of Litigation, 2018, pp. 35-44.
- [14] Forbes, AI and Blockchain: Double the Hype or Double the Value? <https://www.forbes.com/sites/cognitiveworld/2019/10/24/ai-and-blockchain-double-the-hype-or-double-the-value/#4681145b5eb4> [Accessed: 5th of January, 2020]
- [15] Hachernoon, "How Blockchain Can Reshape the Mortgage Industry", 2018. <https://hackernoon.com/how-blockchain-can-reshape-the-mortgage-industry-4b5cdc3edc0f> [Accessed: 7th of January, 2020]
- [16] Business Insider, The impact of artificial intelligence in the banking sector and how AI is being used in 2020 <https://www.businessinsider.com/ai-in-banking-report> [Accessed: 9th of January, 2020]
- [17] Nasdaq, How Blockchains Can disrupt the Mortgage Market (21-September-2017) <https://www.nasdaq.com/articles/how-blockchains-can-disrupt-mortgage-market-2017-09-21> [Accessed: 9th of January, 2020]
- [18] ACCENTURE, Mortgage and Blockchain: Ready for Disruption? <https://www.mba.org > Documents > Accenture - Mortgage and Blockchain> [Accessed: 15th of January, 2020]
- [19] C. Sonnenberg and J. V. Brocke, "Evaluations in the Science of the Artificial – Reconsidering the Build-Evaluate Pattern in Design Science Research" Design Science Research in Information Systems. Advances in Theory and Practice. DESRIST 2012.
- [20] Node.js, <https://nodejs.org/en/>, [Accessed: 6th of June, 2020]
- [21] Spring Boot, <https://spring.io/projects/spring-boot>, [Accessed: 6th of June, 2020]
- [22] Hyperledger Fabric, <https://www.hyperledger.org/use/fabric>, [Accessed: 6th of June, 2020]
- [23] Vagrant, <https://www.vagrantup.com/>, [Accessed: 6th of June, 2020]
- [24] AES, https://en.wikipedia.org/wiki/Advanced_Encryption_Standard, [Accessed: 6th of June, 2020]
- [25] Stellar Consensus Protocol" <https://www.stellar.org/developers-blog/intuitive-stellar-consensus-protocol?locale=en> [Accessed: 1st of December, 2020].