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Business Model Transformation with Technology-Enabled Social Capital in Agriculture Domain

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Full research paper

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Abstract

Recent digital technological advances have not yet reached the smallholder farming communities in developing economies. Prevailing business models support farmers to trade mainly at informal markets where farmers receive significantly low prices. Research claims that building trustworthy buyer-seller relationships can promote farmers' participation in emerging markets that provide rich opportunities for them. Thus, we propose a mechanism to enhance trust between farmers and buyers, demonstrating the transition from a spot market to sophisticated markets when facilitated in a blockchain platform. We present how micro-level trust can evolve into macro-level trust and then onto social capital and digital social identity, leading to novel business models. We validate how micro-level trust can be established with a selection of a permissioned blockchain platform, Hyperledger Fabric, with an implementation of a spot market. The proposed business model is applicable to other industries where the seller-buyer relationship is the focal point.

Keywords agriculture, business models, trust, blockchain, farmers.

1 Introduction

Recent advances in digital technologies have engendered dramatic changes in society, the economy and organisations via disruptive and dynamic business models. These advancements have not yet reached the agriculture domain in developing economies to enhance the business models for smallholder farmers. With existing business models, the majority of smallholder farmers sell their harvest at informal markets (Di Giovanni et al. 2012; Fafchamps and Hill 2005; Somashekhar et al. 2014; Yundra and Sumarlan 2021), where they receive only a third to half of the retail price of fruits and vegetables (Hamangoda and Pushpakumari 2020; Mitra et al. 2018; Somashekhar et al. 2014). Lu et al. (2008) claim that building trustworthy buyer-seller relationships can promote farmers' participation in emerging markets that provide rich opportunities for farmers to get an increased income for a high-quality harvest.

A smooth buyer-seller relationship depends on both contractual trust and competence trust. While contractual trust is expecting the promises to be kept, competence trust is self-reliance on the trading partner's capability to carry out the tasks in the transaction (Sako 1992). In today's digital world, most transactions happen in an electronic commerce environment. Tan and Thoen (2002) declare that transaction trust in electronic commerce depends on the trust placed in the counterparty (party trust) who engages in the transaction, trust in the control mechanism (control trust), potential gain, and the risks associated with the transaction. The control mechanism defines the procedures and protocols that monitor and control the successful performance of a transaction. Blockchain technology, a peer-to-peer distributed ledger technology that enables immutable, transparent, cheaper, faster, trustworthy, and secure transactions (Underwood 2016), is an exemplary mechanism to implement the control mechanism due to its potential to establish control trust with impeccable characteristics such as non-repudiation, authentication and integrity. It also facilitates party trust via untamperable history of transactions.

Based on the properties of blockchains, in our earlier research, we have conceptualised three possible market models: a spot market where harvest and money are exchanged on the spot, smart contracts market that allows establishing smart contracts between farmers and buyers in advance, and smart futures contracts market that allows establishing smart futures contracts between farmers and buyers (Kumarathunga et al. 2022). An essential requirement for this conceptual model to work is having a practical way to create the necessary level of trust.

This paper presents the blockchain-based framework we developed to create micro-level trust between farmers and buyers that can lead to macro-level trust and, thereon, to social capital, which refers to a network of community relationships that facilitate trust and motivate purposeful actions (Bourdieu 2018). Empirical evidence shows how social capital enhances an individual's social identity and vice-versa (Kramer 2006). Thus, through a stepwise implementation of markets, it is possible to gradually establish social capital and digital social identity for farmers, buyers, and the farming community (Kumarathunga et al. 2022).

We further demonstrate how each market contributes to building trust when deployed in a correctly chosen blockchain platform. We implement the spot market in a blockchain platform to evaluate the transition of micro-level trust to social capital, enabling control trust and party trust, before implementing it on a commercial level.

The remainder of the paper is organised as follows. In section 2, we provide the literature review on existing agribusiness models from the farmers' perspective, leading to the research approach in section 3. We present the novel business model, implementation including the selection of a blockchain platform, and evaluation of the spot market in section 4 and then the discussion in section 5. The conclusions are presented in section 6.

2 Literature Review

2.1 Agribusiness Models – From a Farmer's Viewpoint

There are distinct types of business models associated with agriculture. The simplest is the spot market, which is characterised by fewer barriers to entry, high transaction costs, and low returns. Another business model is where the farmers produce relatively undifferentiated crops for contracts to a known buyer. The model has potential barriers to entry, moderate risk of financial loss, and low transaction costs. The contract production to a known buyer for quality differentiated crops business model has higher barriers to entry, higher potential of financial returns, and higher risks (Boughton et al. 2007). In all these scenarios, money and material flows directly happen between the buyer and farmer. There is evidence that they receive only a third to half of the retail price of fruits and vegetables (Hamangoda and Pushpakumari 2020; Mitra et al. 2018; Somashekhar et al. 2014).

A case study from Sri Lanka reveals that while some farmers engage in spot marketing in the local market, where the selling price changes vigorously, 90% of farmers depend on a middleman or a shopkeeper to sell their harvest (Di Giovanni et al. 2012). Similarly, in India, fruit and vegetable farmers heavily depend on intermediaries to sell their harvest (Somashekhar et al. 2014). Mitra et al. (2018) claim that middlemen collect between 50% and 71% of the price difference between farm-gate and resale prices. Coffee from Ugandan farmers is bought by either an itinerant trader or a middleman. Middlemen also purchase coffee from itinerant traders who bought coffee from farmers, mill and sort them to be exported to a coffeehouse in Europe or elsewhere (Fafchamps and Hill 2005). According to Yundra and Sumarlan (2021), lowland rice in Jogoroto District in Indonesia is distributed in three trading patterns: from farmers to middlemen traders to rice mills to collectors to retailers to consumers, from farmers to middlemen to rice mills to retailers to consumers, and from farmers to rice mills to collectors to retailers to consumers. In addition, farmers sell their rice to a barn where rice is processed, packaged, labelled, and distributed to retailers.

The diagram in Figure 1 illustrates a comprehensive accumulation of all the business models included in this section.

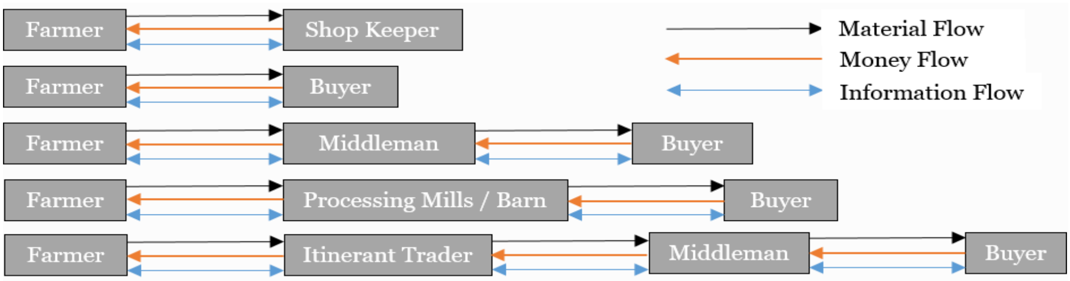

Figure 1: Existing Agribusiness Models (Farmer's Perspective)

When the transaction happens directly between the farmer and buyer, it can be either spot market or contract farming. Often researchers claim that contract farming generates greater benefits for farmers with timely payments and fixed rates (Ray et al. 2021). Singh (2002) discloses that contract vegetable production in Punjab state in India is associated with a series of problems: imbalanced power between farmers and buyers, violation of the agreements, social differentiation, and environmental sustainability. When the prices provided by the buyers are too low and unfair, farmers tend to do side marketing, breaching the contracts (Dzingirai 2003). The literature reports farmers in Pakistan are willing to join maize contract farming when they are confident that the buyer is reliable (Khan et al. 2019). However, the majority of marginal farmers are excluded from contract farming due to the small land size that can produce small quantities of harvest (Ray et al. 2021). These happenings indicate the requirement for disruptive business models that can generate richer opportunities for these underprivileged farmers.

3 Research Approach

This research follows the Design Science Research (DSR) methodology, a method of addressing important unsolved problems in unique or innovative ways or solved problems in more effective or efficient ways. DSR consists of 3 cycles: Relevance Cycle (RC), Rigour Cycle (RgC), and Design Cycle (DC) (Hevner and Chatterjee 2010).

The relevance cycle provides the requirements for the research and defines the acceptance criteria for the ultimate evaluation of the research results. The rigour cycle provides past knowledge to ensure innovation with the selection and application of appropriate theories for constructing and evaluating the artefact. The design cycle focuses on generating design alternatives and evaluating the alternatives against requirements until a satisfactory design is generated (Hevner and Chatterjee 2010).

We had several iterations of the three cycles that led us to conceptualise three possible market models: a spot market, a smart contracts market, and a smart futures contracts market. We focused on enhancing financial inclusion among smallholder farmers by exploring ways to solve the issues related to the lack of trusted buyers and microfinance (Kumarathunga et al. 2022). Solving for lack of trusted buyers led us to develop the blockchain-based framework. This framework incorporated four major features to enhance farmers' margins.

- Enabling farmers to sell their expected harvest as smart futures contracts to mitigate future price uncertainties, using social capital as collateral.
- Empowering farmers to establish trustworthy relationships with reputable buyers who offer higher prices, reducing transaction-related risks.
- Establishing Many-one-Many (MoM) market linkages that support community-wise aggregated marketing, providing high bargaining power to farmers, enabling them to access bigger markets, leading to better prices.
- Facilitating farmers to receive some cash in advance, enabling them to purchase high-quality Agri inputs to produce a high-quality harvest that attracts higher rates, mitigating financial risks.

The crucial requirement for this conceptual model to work is having a practical way to create the necessary level of trust for each of the market models. The blockchain-based framework enables micro-level trust among farmers and buyers that can lead to macro-level trust. This trust establishment generates a network of trust relationships over time, leading to social capital and social identity. We implement the spot market in the blockchain platform to evaluate the transition of micro-level trust to social capital, enabling control trust and party trust as specified by Tan and Thoen (2002).

4 Novel Business Model

Our novel business model consists of three markets implemented in the blockchain platform as represented in Figure 2. The numbers 1,2,3 is used to represent the timing and order of the flows.

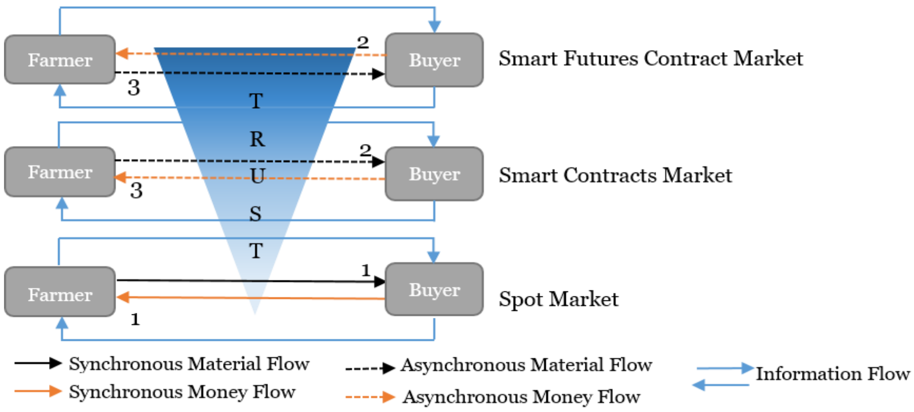

Figure 2: Novel Business Model with 3 Markets

- Spot Market: In the spot market, a buyer agrees to buy from a group of farmers and this agreement is recorded in the blockchain. On the agreed date, they meet and exchange the harvest and the money concurrently. The numbers 1 and 1 in the two arrows in Figure 2 represent these synchronous flows. These transactions are recorded in the blockchain as fulfilled agreements. This information is used to enhance the level of trust in the buyers and farmers, enabling party trust.
- Smart Contracts Market: When there is a sufficient level of trust in a buyer, farmers will be willing to deliver the harvest first and receive the money later. The order of these asynchronous flows is represented by numbers 2 and 3 in Figure 2. This is the prevailing model at present in which farmers are selling to trusted buyers or brokers where history indicates that they will get paid on a future date. The issue is there are only a small number of buyers with this level of trust (Kumarathunga et al. 2021). Thus, farmers have less bargaining power to get a high price. With the new online business model, farmers can connect with more buyers over time to establish contracts in advance with enhanced bargaining power.
- Smart Futures Contracts Market: When farmers build a sufficient level of trust with the emergence of competence trust and contractual trust, the buyers will be willing to enter into a contract with farmers and pay some money upfront to ensure the supply. The numbers 2 and 3 in Figure 2 denote this asynchronous order. With the possibility of a cash advance, the need for a farmer to get a microfinance loan to cover the cost of cultivation can be eliminated. The literature reports getting a microfinance loan has often resulted in undesirable

side effects, especially if the farmer cannot obtain the expected harvest due to unforeseen circumstances (Kumarathunga et al. 2022).

Implementation of the spot market in a proper blockchain platform establishes control trust, leading to micro-level trust. This micro-level trust enables farmers and buyers to establish contracts in advance for the expected harvest. The establishment of contracts in the form of smart contracts and tamper-proof records in the blockchain establish contractual trust and competence trust, leading to party trust at the macro level. When macro-level trust is established between the farmers and buyers, the potential of developing a network of trust relationships is enhanced. That is indicated as social capital. Figure 3 demonstrates this process of establishing trust between farmers and buyers from micro-level trust to macro-level trust and, thereon, to social capital.

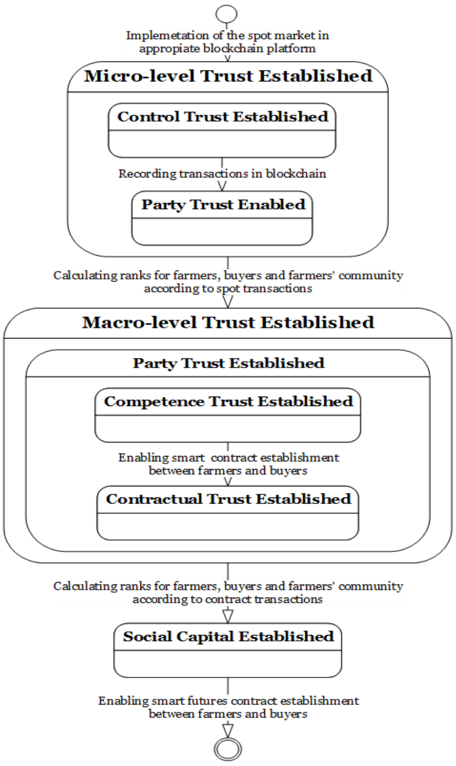

Figure 3: Evolution of Trust Represented as a State Machine Diagram

4.1 Implementation of the Spot Market on a Blockchain Platform

4.1.1 Blockchain Technology

Blockchain is a peer-to-peer network of computers that holds a replicated and synchronized open ledger. The ledger has a replicated copy of a set of records called blocks. Each block in a blockchain consists of multiple transactions. A cryptographic hash pointer links each block to the previous block. The blocks are timestamped to record the exact time of creation (Verma and Garg 2017). These timestamped and linked blocks create a chain of blocks, engendering the blockchain (Christidis and Devetsikiotis 2016). Blockchain technology provides many desirable properties to build trust for an application and among the users of that application (Bashir 2020).

- Decentralization: There is no need for a trusted intermediary to validate transactions. Instead, a consensus is achieved among participating nodes to validate transactions.
- Transparency and Trust: Blockchains are transparent among the participating nodes since all the nodes consist of a copy of the same ledger, leading to trust establishment.
- Immutability: The data recorded in the blockchain is immutable due to the infeasibility of altering data in all subsequent blocks of the replicated ledgers on all participating nodes in the network.
- High availability: Since a blockchain network is a peer-to-peer network with multiple nodes that consist of replicated and updated ledgers, the network becomes highly available. Inaccessibility or unavailability of some nodes does not affect the availability of the network.

- Highly secure: Any transaction broadcasted to a blockchain network is verified based on a predetermined set of rules. The valid transactions are hashed and included in a block with a timestamp. Thus, the blockchain network provides integrity with cryptographically secured data by its design.
- Non-repudiation: Participants of a transaction cannot deny the transaction and behaviour in the transaction in the blockchain due to non-repudiation property. The non-repudiation service collects, maintains, provides, and verifies the undeniable evidence about transactions/messages from the sender to the receiver. Thus, a sender cannot deny sending a transaction, while the receiver cannot deny receiving that transaction.
- Authentication: When a transaction is initiated, the verifying nodes authenticate the digital signature using the sender's public key to ensure that the signature is created only by the sender, who possesses the corresponding secret private key.
- Simplification of current paradigms: Blockchain facilitates maintaining a shared ledger among interested stakeholders, simplifying the complexity of managing separate systems with centralized databases.
- Faster Dealing Settlements: Since blockchain does not require a lengthy process of verification, reconciliation, and clearance due to the availability of a single version of agreed-upon data on a shared ledger, blockchain can enable quick settlements of trades.
- Cost-saving: Since no fees are paid to a third party or a clearing house, overhead costs are eliminated significantly.
- Platform for smart contracts: Blockchain technology provides a platform for deploying smart contracts that are automated, autonomous programs with encapsulated business logic, and code to execute a required function when certain conditions are met.
- Cryptographic Tokens: Blockchain technology provides an underline infrastructure for programmable assets or access rights that represent anything from a store of value to a set of permissions in the physical, digital, and legal world as cryptographic tokens. Blockchain enables tokenomics, circumventing the double-spending problem.

4.1.2 Selection of a Blockchain Platform

Of the above-mentioned 12 aspects of the blockchain, 11 aspects are applicable to the proposed business model except the one mentioned as simplification of current paradigms. However, the most critical features are immutability, smart contracts and cryptographic tokens since the farmer converts some or all of his expected harvest to token contracts in the form of smart futures contracts in the third version of the proposed market. When a buyer purchases a token contract, a new smart contract is deployed into the blockchain with pre-defined conditions to transfer ownership of the digital asset once the conditions are met. Thus, a blockchain platform that allows deploying smart contracts can be chosen for the proposed implementation.

However, like in many other technologies, research is in progress to improve the robustness, accessibility, and usefulness of the blockchain, mitigating sensitive problems. The most sensitive problems related to blockchain are as follows (Bashir 2020).

- Scalability: When compared with current financial networks, blockchain stands far behind. However, researchers have proposed many impeccable solutions for this.
- Adoption: Although blockchain is considered a nascent technology, there is still a lack of mass adoption.
- Regulation: In blockchain networks, there is no regulatory authority or central control. This becomes a barrier to adoption since consumers are unable to build up confidence by holding someone accountable when there are disputes.
- Relatively immature technology: Since blockchain is still an emerging technology, it requires a lot of research to achieve maturity when compared with traditional IT systems.
- Privacy and confidentiality: Transparent feature in the blockchain is not desirable in industries such as financial, law and medical sectors where privacy and confidentiality hold higher values.

Thus, we analyse the existing blockchain platforms based on the properties and the sensitive problems that blockchain technology brings to an application. There are two basic types of blockchain platforms according to the scheme of ledger sharing and who is allowed to participate (Bashir 2020).

- Permissionless: Open and distributed blockchains such as Bitcoin and Ethereum allow any peer to join or leave the platform as a reader or writer, even illegitimate ones. The nodes, called miners, perform a sophisticated mining process to validate blocks before adding them to the blockchain. While some (Eg: Ethereum) facilitate deploying smart contracts, some (Eg: Bitcoin) are not.
- Permissioned: A consortium, a group of entities, manages the membership of the individual peers in the network. While policies defined by the consortium decide the reading/writing rights, pre-defined nodes engage in block validation without a mining process. Hyperledger Fabric (HyperLedger Fabric 2022) is an instance of a permissioned blockchain.

Implementation of the novel business model into a system requires an appropriate blockchain platform that maximizes the positive impacts while mitigating the negatives. The main actors of the proposed system are farmers, buyers, and organizations that maintain the blockchain platform. Many farmers and some buyers may not be tech-savvy enough to maintain a full node or be minor in a blockchain platform. They may also not have sufficient computational power for the mining process and maintaining a full node. Thus, a blockchain where the mining process is used to validate blocks (Bashir 2020) is not suitable for the proposed implementation.

Furthermore, the required blockchain network should not be open to everybody. Only authorized farmers, authorized buyers, and relevant organizations are allowed to participate in the blockchain platform. Thus, a permissionless blockchain, where anyone can participate as a node in the decision-making process (Bashir 2020), is not a good choice. In addition, the full transparency provided by such blockchains is not acceptable for this use case since the platform should enable farmers to sell their harvest as token contracts at competitive prices to different buyers without disclosing the farmer or farm details. Thus, the full transparency feature of permissionless blockchains (Bashir 2020) does not match the requirement of maintaining some private data.

Moreover, the proposed business model targets smallholder farmers although large-scale farmers are also allowed. Most of these marginal farmers would not prefer to pay a transaction fee for each transaction they do for the expensive mining process in the permissionless blockchains (Bashir 2020). Therefore, a permissionless blockchain can deter many farmers from the proposed system.

Therefore, permissioned blockchains are better suited for the requirements of the implementation of the proposed business model. First, the permissioned blockchains support consensus protocols that validate transactions and blocks without the need for a native cryptocurrency to offer mining incentives. Second, they only allow groups or individuals who agreed to share the ledger among themselves. Third, permissioned blockchains allow to store both public and private data (Bashir 2020). Moreover, the contemplation of sensitive problems of the blockchains mentioned above, a permissionless blockchain cannot compete with permissioned blockchains in the scope of scalability, privacy and confidentiality issues. In addition, a permissioned blockchain consists of a group of entities to decide the policies in the network. Thus, the availability of a regulatory authority leads to participants' confidence improvement, building trust in the platform (HyperLedger Fabric 2022). Trust is the fundamental building block of this business model. Thus, we can conclude that permissioned blockchains are the best choice for this implementation.

Although there are many permissioned blockchains, the fact that most of them are still nascent led us to choose the Hyperledger Fabric blockchain for this implementation since it is one of the most mature ones. Also, it is open source. The fact that it is hosted by the Linux Foundation made us more confident in choosing it due to the widespread community support. More importantly, it supports developing smart contracts with three general-purpose programming languages: Nodejs, Javascript, and Go, soothing the development process. Besides, it has a modular architecture that enables plug-in identity or key management protocols, supporting the management and safeguarding of digital keys and minimizing the possibility of losing keys due to human error (HyperLedger Fabric 2022).

4.1.3 Implementation of the Blockchain Network in Hyperledger Fabric

Hyperledger Fabric (HF) network consists of nodes called Peers and Orderers. Peer nodes host the ledgers and smart contracts. Applications are connected to the peer nodes to access ledgers by invoking a chaincode (smart contract) deployed in peers. Orderer nodes order the transactions received from all peers to generate a new block that will be broadcasted to all the peers in the network. All the peer nodes and orderer nodes connect with each other in a channel (HyperLedger Fabric 2022).

Thus, for the proposed business model, an HF network is designed with 4 peer nodes (2 peer nodes per organization) and 3 orderer nodes for a consortium of 2 organizations in a local Ubuntu virtual machine as depicted in Figure 4. Thus, 4 CouchDB databases are hosted for the 4 ledgers. Four peer nodes and 3 orderer nodes are running in separate Docker containers. A chaincode is deployed in all 4 peers to access the ledger for read/write functions. A serverside Javascript app is developed to connect with peers. All peers are accessible to users registered in both organizations. Once the ledgers are initialised, the CouchDB databases are accessible through an assigned port in the localhost.

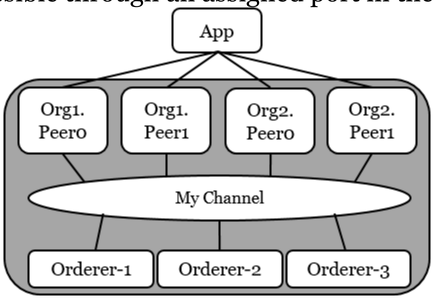

Figure 4: HF Network Structure

We developed two web sites: one for farmers and one for buyers, enabling them to access the HF blockchain network.

4.2 Evaluation of the Spot Market in HF

According to the DSR methodology, the design artefacts should be evaluated against the requirements gathered during the RC (Hevner 2007). One requirement of the spot market is generating the initial building block for trust building via the tamper-proof history of records and smart contracts in the chosen blockchain platform: HF. Since the last two markets will be built on the base of progressively developed online trust, leading to social capital that can be used as collateral in future financial exchanges, establishing the bottom line foundation with a thorough evaluation is vital. Thus, evaluating whether the spot market in HF assists in establishing micro-level trust is crucial for the quality utility of the artefact as well as the research outcome.

For evaluation, we chose the Framework for Evaluation In Design Science (FEDS) proposed by Venable et al. (2016). According to the FEDS framework, when the major design risk is technically oriented, researchers may choose the technical risk & efficacy evaluation strategy and begin with the formative end, in which evaluations must provide a basis for successful action. The evaluation can consist of several episodes to continue towards the summative end, in which evaluations must create a consistent interpretation across shared meanings. Since micro-level trust can be gradually transformed into macro-level trust, the first and second episodes of evaluation are targeted toward the rigour and technical risk of the spot market and the establishment of control trust and micro-level trust. Thus, the evaluation episodes are as follows.

Episode 1: Technical risk & efficacy strategy at the formative end

- Goals: Technical Risk and Suitability of the Chosen Blockchain Platform, Establishment of Control Trust and Micro-Level Trust
- In this episode, we have analysed the records in the ledgers in all the peer nodes, retrieve them, try to alter them, add new contracts to confirm the applicatory of Hyperledger Fabric.
- At the end a report is prepared on the suitability of Hyperledger Fabric, control trust, and micro-level trust

Episode 2: Technical risk & efficacy strategy at the formative end

- Goals: Rigour and Technical Risk, Establishment of Control Trust and Micro-Level Trust
- In this episode, we hired some users to act as farmers and buyers, asked them to use the platform, perform successful/unsuccessful transactions with imaginary money and harvest, establish contracts while using the evolving ranks as trust indicators

- At the end they will be given a questionnaire to answer open ended question regarding expected outcomes: control trust, micro-level trust and technical aspect

While Episode 2 is in progress, Episode 1 is carried out for the spot market deployed in a local virtual machine environment as described in section 4.1.3. The evaluation disclosed that an authorized user could read/write transactions to the ledger and update the values in the existing transactions (Eg: price, the quantity of the contract). Therefore, in real-life development, a proper membership management mechanism in the HF network should be maintained and audited. Since the ledgers are running in 4 CouchDB databases in local Docker containers, they are accessible for altering data. However, altering data in one database did not change the world state of the blockchain. Altering the same record in all 4 databases did change the world state of the blockchain. When the HF network is hosted in the real environment, these databases can only be accessed by the administrators of the participating organizations, and thus, are not available for normal users. Moreover, organization administrators can access their ledger only. Hence, altering data in all ledgers is infeasible. Thus, the evaluation reveals that with a proper membership management mechanism, HF is a match for the proposed business model implementation. Since it fulfilled the requirements of the design, episode 1 confirmed that the spot market in HF has the potential of establishing micro-level trust by establishing control trust and enabling party trust.

5 Discussion

Inherent properties of blockchain technology have the potential to generate social capital via the establishment of party trust, competence trust, and contractual trust, as illustrated in Figure 5.

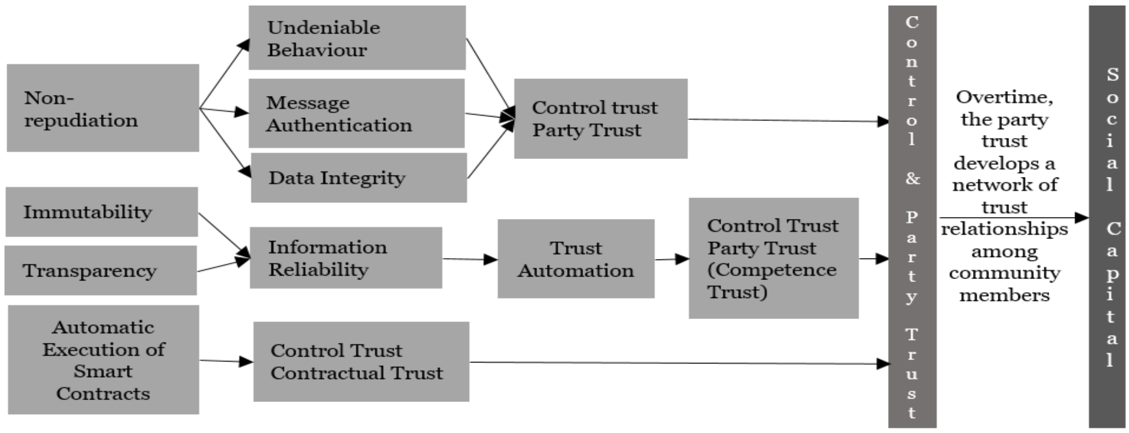

Figure 5: How Blockchain Enables Social Capital

Due to the non-repudiation feature, the participants cannot deny their behaviour in the digital environment. In blockchains, this feature is supported through digital signature schemes that facilitate message authentication and data integrity (Bashir 2020). While the message authentication feature confirms the sender who created the message, leading to party trust, the data integrity feature ensures that message is not altered during the transit, leading to control trust. Thus, the non-repudiation feature contributes to building both control trust and party trust.

Information reliability that influences trust automation (Kraus et al. 2019) can be achieved with immutability and transparency features. When the control mechanism provides reliable information about transactions and users, control trust and party trust are built up among the participants. In addition, the automatic execution of smart contracts contributes to establishing control trust and contractual trust.

Gradual enrichment of party trust, competence trust, and contractual trust can lead to the development of a network of trusted relationships among community members over time that refers to as the social capital for individuals in this digital environment. This social capital enables the novel business model that facilitates the three types of markets. While the spot market enables trading when the harvest is ready, both other two markets support trading the expected harvest in advance while the crops are still growing, reducing future price risks. In addition, the smart futures contracts market facilitates trading smart futures contracts on behalf of the expected harvest, enabling farmers to receive some money beforehand using social capital as collateral, mitigating the microfinance burden. Implementation of this business model in a real environment stands out from similar blockchain markets due to the MoM market linkages (Kumarathunga et al. 2020) that support aggregated marketing.

With the tamper-proof history of transactions, farmers, buyers, and the farmers' community receive a calculated rank. This rank represents a digital identity for the farmers' community, generating a community brand, leading to a brand reputation. This reputation empowers smallholder farmers to trade their harvest under a reputed brand name, which is challenging for an individual farmer to develop. In addition, obtaining certificates for their products or growing methods becomes straightforward with the community's reputation.

According to the requirements of the proposed business model, HF is one of the best choices for blockchain network development due to the governance by a consortium, leading to control trust. The evaluation of Episode 1 reveals that with proper membership management protocol, control trust can be further enhanced while establishing party trust. The untamperable records and smart contracts engender competence trust and contractual trust in order. Thus, the proposed business model satisfies the requirements for transaction trust proposed by *Tan and Thoen (2002)* and the requirements for a smooth trading relationship by *Sako (1992)*.

6 Conclusion

Recent digital technological advances engender dramatic changes in society, the economy, and organisations via new business models. Trust plays a vital role in enabling such business models. In this paper, we have demonstrated an approach to establishing trust using blockchain technology. Using this ability to establish trust, we have developed a set of novel business models to enhance the margins generated by impoverished smallholder farmers. These business models range from a blockchain-based spot market to a smart contracts market and, thereon, to a smart futures contracts market.

We demonstrated how to establish micro-level trust between farmers and buyers by selecting a permissioned blockchain platform to implement the spot market. Implementation of the smart contracts market could upgrade this micro-level trust into macro-level trust and, thereon, to social capital, enabling the smart futures contracts market. The proposed business model can be applied to other industries where the seller-buyer relationship is the focal point of the business. We expect implementing these business models among underprivileged farming communities will upgrade their living standards, leading to poverty alleviation.

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