An Enterprise Transformation Guide for the Inevitable Blockchain Disruption

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Abstract—Blockchain technology presents significant potential for successful digital transformation by eliminating intermediaries in business interactions. While the technology is increasing in popularity, applying blockchains improperly is a risk. Executives need to be able to ask a set of critical questions in order to assess the suitability and net benefits of blockchain based proposals. We present a methodology, the Blockchain Technology Transformation Framework (BTTF), which informs decision-makers on how blockchain fits in their processes, what data will be in the transactions, and who the participants will be. BTTF builds a design map by which process owners can analyze the suitability of blockchain technology. Through BTTF, organizations can redesign their processes or identify opportunities for using smart contracts. BTTF is based on a review of both the capabilities and the challenges of adopting a blockchain-based transformation, therefore allowing users to consider all aspects of a successful blockchain solution.

Index Terms— Blockchain, Transformation Framework, Information Architecture

1 Blockchain disruption and Executives

BLOCKCHAIN technology offers great potential to disrupt and revolutionize businesses. Industry is taking notice of this potential as evidenced by numerous bootcamps, courses and seminars about this technology. However, some executives have been caught in a position where they are informed about the concept but not equipped with a set of critical questions to ask to leverage the potential of blockchains. Technology professionals are knowledgeable about the technology, yet not nearly enough substantial business problems have been solved with blockchains. At times, unorganized effort is spent on getting involved in practice projects on sandbox environments and, yet, there might not be a lot to learn from the cumulative experience of the community of blockchain adopters as what is available is a collection of stories about projects without convincing evidence of their business benefits. This, combined with the concerns about the technology due to privacy, security, performance and capacity issues, makes it imperative to organize the thinking on blockchain-based innovation. We believe a good start to this is the identification of a set of critical questions to decide whether and how a blockchain-based solution could work for a particular organization. Reluctance to adopt disruptive technologies may be a significant competitive disadvantage for an organization whereas proactive planning can be a significant advantage. Understanding where and how blockchain technology will disrupt existing processes is beneficial.

We propose a framework through which enterprises can determine if and how they can transform their business processes to be supported by blockchain technology. We provide key questions in order to provide insight into how blockchain technology might be helpful.

New blockchain-based business models should benefit all involved stakeholders. Increased involvement generally enhances the reliability and resistance of these systems. Marketing of this paradigm to classically trained individuals is a managerial challenge.

Due to the nascancy of the technology, widely accepted industry standards do not yet exist, and organizations are defining their own access rights, data structures and allowable transactions [1]. This lack of standards is another managerial challenge, which BTTF can help alleviate. BTTF provides a guideline for standard defining activities, to help organizations to form a complete set of definitions in their blockchain solution. By following BTTF, executives can also find out whether blockchain is the right solution for their business challenges. A well-designed blockchain solution based on BTTF increases understandability for stakeholders, and demonstrates business benefits to decision makers limiting speculations.

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2 Blockchain Technology as a Disruption Vehicle

2.1 Business Impacts

Without any compelling reason, businesses would not just switch to blockchain technology. To evaluate potential benefits, the following features of blockchain implementations need to be analyzed for their impacts on a particular organization and a specific business scenario as some of these features may be positive for some organizations and negative for others. For example, transparency may concern stakeholders of a certain organization due to its impact on privacy and liabilities whereas another organization may consider it an asset.

Auditability and Traceability: Auditing is essential and very manually intensive. In the absence of trust, auditors spend a lot of time and resources to cross-check the validity of data. Blockchains solve this problem by keeping the complete history of transactions and by providing traceability guaranteed by cryptographic methods. An auditor can easily verify the veracity of transactions based on the events on the blockchain.

Transparency: Having the state and outcome of a business process transparent to the stakeholders increases their trust in the system and improves service experience. It assures all participants of the integrity of the system and the processes. Blockchains can deliver this when the transactions are occurring on a network open to all participants. The value proposition is at its highest when it brings transparency to lengthy processes such as supply-chain management.

Trust: When processes involve applications owned by different parties, disputes arise over what exactly has caused an incident to occur. When parties rely on their own copy of the records, reconciliation becomes a major part of a resolution. Blockchain technology can enable the participants to have the same copy of the records, leading to a quick and cost-effective resolution with higher confidence.

Permanency: Information is power and there may be intentions to not share it or only share what supports a specific cause. In business-to-business communication, omission can be used for the purpose of hiding mistakes or failures. Communication platforms migrated to blockchains have the advantage of maintaining the original truth through this tamper-evident mode of communication. Blockchains enforce availability, integrity and permanency of the complete truth.

Eliminating System Dependencies and Intermediaries: Blockchains can remove the need for a separately maintained book-of record, a central authority or an intermediary through its decentralized architecture, which also removes the risk of a single point of failure. New blockchain-based systems can effectively complete transactions such as cross border money transfer in minutes without any intermediaries.

Event-driven Automation: Smart contracts have made event-driven automation possible. Coupled with the trust provided by blockchain technology, smart contracts can simplify complex business processes by alleviating the need for manual interventions without compromising the integrity or quality of the overall process.

2.2 Blockchain Enabled Features

Below is a list of features that blockchain technology helps to improve. When one considers a benefit such as transparency, they should question whether it would add value, eliminate a weakness, provide an advantage or preclude a threat from competitors. An alternative approach would be investigating whether the corresponding question is a common question in the business process.

Process Tracking – Who does What? Blockchains are very good at recording business events and communicating those to all participants. Such event communication and persistence make blockchains ideal for process tracking.

Sensitive Records – Who can Access What? Sensitive records can be protected with cryptography. Ownership of records can be transferred on digitally signed transactions. Encryption can protect the necessary authorization tokens while access and permissions can be traced and audited.

Identity Management – Who is Who? Trading partners can share identity related information on blockchains, e.g., verifying the information about a customer and placing their public credentials on the blockchain with a flag indicating that this is a verified customer.

Digital Asset Ownership – Who Has What? Cryptocurrencies showed that ownership transfer can securely occur on blockchains without an intermediary.

Voting – Who Approves What? Voting is very similar to digital assets from an ownership perspective. The ownership of the vote, i.e., ability to send or assign the vote, would be given to the user at the beginning of the process. Businesses can model complex processes with smart contracts combined with voting.

Product Traceability – Where is What? Tracing the order, transportation and subsequent delivery of the products in a supply chain can be handled on blockchains. Blockchains would inform partners of the events, and the status would be shared on the ledger. Order, payment, transportation and delivery events can be managed by smart contracts.

Intermediary and Settlement Agencies – Why the Middleman? When there is a distributed ledger and all participants trust the accuracy of the data, a middleman is not needed.

2.3 Challenges Ahead of Mainstream Implementations

Some challenges with widespread implementation of blockchain technology are easier to resolve while others may take considerable amount of time and coordination among industry stakeholders. Some of these roadblocks are of technical nature while others are business related.

1) TECHNOLOGY CHALLENGES: A PROMISING TECHNOLOGY AT ITS INFANCY

Unlike many others that were first developed and matured in academia, blockchain technology has not gone through academic due diligence, which makes it susceptible to a variety of issues.

Software Issues: Each active participant needs the blockchain network specific software for issuing transactions with consensus. Such software is developed in open-

source platforms, and encapsulates the rules of the network that may change with maturity. There can be small changes updating some of the rules slowly [3] or material changes where the network should be upgraded to a new version [4] or even emergency changes [5] to prevent a high-risk issue. In order to publish the updated software and manipulate the behavior of the blockchain network there are two well-known choices: soft and hard forks.

Technical Integration Challenges: Introducing blockchain technology in an established enterprise requires adopters and connectors between legacy systems and the blockchain. The architectural differences may make the integration near impossible [6]. Blockchain adoption could mean a major revamp or a total development from scratch due to incompatibility.

Scalability and Performance: Due to the decentralized architecture and consensus mechanisms, transaction verification takes some time on a blockchain. This can be easily tolerated in many cases such as a supply chain, where it may be a roadblock in others such as stock trading [7].

Cybersecurity: There are several ways blockchains are secured. Cryptographic methods secure the interactions by preventing forgery of blocks or preventing nodes trying to tip the consensus. The system is strong and solid as a whole, but is vulnerable at its nodes. If participants do not have adequate security at their ends, blockchains are open to malicious activity through impersonated clients. If hackers access the private key of a participant, they can issue bogus transactions. The anonymity provided by the blockchain empowers hackers in this case. For example, BitCoin had reputational problems when one of the exchanges got hacked and bitcoins got stolen [8]. This exchange went bankrupt and public trust towards blockchains got a hit.

2) BUSINESS CHALLENGES

The nascent nature of blockchain technology will be more concerning to executives who look at technology merely as a business enabler.

Talent Shortage: Blockchain focused technical skills are not yet taught in standard higher education curricula therefore the industry does not yet have a sizable pool of experts who can implement robust blockchain implementations. As a result, besides cryptocurrencies, blockchain instances are mostly Proof-of-Concept (PoC) implementations with only 5% to 10% moving to production [9].

Cost-Benefit Analysis:

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front cost of blockchain implementation is high. It includes new infrastructure and a capable team so existing revenues can be negatively impacted. A big initial investment and loss of existing revenues are justifiable in the presence of sizable benefits; however, some costs or benefits are not easily measurable hence making the adoption decision difficult. Unlike operational efficiency, it is not easy to assign a dollar value to trust or reputational risks.

Governance: Health and sustainability of business interactions are guaranteed through defined rules and responsibilities. An intermediary system can manage interactions and maintain service level agreements. An authority can define rules and enforce accountability. In a decentralized architecture, however, we lose intermediaries and authorities, and have to opt for decentralized governance in the form of consensus mechanisms or a regulatory body [1], which does not define a single owner for the governing rules and can result in volatility and uncertainty.

Uncertain Regulatory Status: Laws tend to catch up slowly with new technology such as blockchains [1]. Current major players such as banks, insurance companies, government agencies and law firms who are highly regulated are waiting for clear rules for widespread adoption hence there is considerable effort towards legislation. Most concerns are about illegal activities such as money laundering. For governments and revenue agencies, money flow and related tax implications are still a concern.

Cultural Adaption: Business owners are used to solving their problems with systems by sharing minimal information, and concentrating on divided responsibilities. In blockchains, sharing information makes it more secure. This change, which not only distributes power, but also reduces the control of former authorities, would likely threaten some potential participants. Attracting participants is important for the success of the blockchain [1]. Trusting a system with a greater number of participants rather than one with centralized authority is a new concept, which requires a culture change.

Reluctance to Change: Fear of unknown technology and its possible shortcomings can cause concern. 'If not broken, why fix it?' has been the motto of many. Meanwhile, resistance from third parties such as trusted intermediaries who may lose their relevance adds to the overall reluctance.

3 BLOCKCHAIN TECHNOLOGY TRANSFORMATION FRAMEWORK (BTTF)

Many blockchain research initiatives focus on applying blockchain technology to a specific scenario or industry. It is common to see research describe the use-cases for an industry and decide suitability with the end state, i.e the final solution by following a flowchart [10]. These frameworks can be more narrowly focused on the current technologies and problems, instead of transformation of business and discovery of opportunities.

This end state focus also ignores which methodology is followed. For research purposes, focusing on a specific aspect of the problem is natural, but in the industry, lack of a methodology can end with cookie-cutter applications, which might be unsuitable or clones of what already exists such as the creation of hundreds of digital coins after one or two successful ones. Unnatural applications of blockchain cannot provide the desired benefits.

We propose a structured solution (transformation) framework for organizations to redesign their processes or identify opportunities for using smart contracts. The introduction of a new trust model influences the number of collaborators. With the help of our framework processes designed to communicate with a minimum number of external systems or partners can be redesigned to have many more collaboration partners.

TABLE I
LIST OF FRAMEWORK QUESTIONS

Question	Action
Who? Participation	Identify independent collaborators in the process. Decide if anonymous participation is allowed. Decide who can approve or govern this process. Identify how participants can benefit from a trustable distributed ledger and transparency
What? Tokenization	Identify digital assets used in the transactions. Find out how these assets are currently represented and stored by each participant. List the sensitivity of the attributes towards transparency. Find out the book-of-record process dependencies. Find out what information current intermediaries request and provide.
Where? Network & Interaction	Identify how participants interact with each other and how this would change with peer-to-peer networking Identify which interactions utilize which tokens. Identify each participant's role for each token
Why? Trust -injection	Identify current trust issues. Find out quality issues with current service Decide how to provide trust (select from below) • Extended communication • Data sharing, process tracking, • Tamper-resistant transaction history, logs, audit trails, • Fraud prevention, • Transparency, and censor resistance.
When? Events & Automation	Identify events in the system. Identify which events can trigger transactions that can be conducted automatically Identify which interactions have a contractual nature.

BTTF presents five key questions to analyze the participation, tokenization, interaction, trust-injection and events/automation characteristics of the target business process. Detailed analysis of these characteristics reveals whether the business process is suitable for improvement with blockchain technology. Each characteristic is analyzed with further questions. While answering questions in each area, organizations discover the suitability of blockchain technology for their processes.

There are two types of questions in this framework: the first is a question that requires identification of one or more items. For these questions, the number of identified items is an indication of better suitability. For example, answering the question of "Who?" one identifies independent collaborators. Existence of several independent collaborators, the ability to add more, or the expectation of having more, increase the ability of a blockchain solution to improve the business process. On the other hand, if there is only one collaborator, or there is a cluster of collaborators all managed by one entity thus removing any independent decisions, a blockchain solution may not bring much value. The second type of question focuses on decisions which enables the future direction or an existing constraint to become an input to the blockchain based transformation. Having discussions to provide these decisions helps process owners understand the alternatives they have with blockchain technology and the consequences of using blockchains. The ability to have a clear decision shows the strong possibility of improvement while not being able to decide indicates possibility of future issues. For example, whether anonymous participation is allowed or not is necessary to decide the type of blockchain. The ability to decide on these items indicates a clear direction. If there are challenges to make such decisions, this could be an indication of the problem domain being too large for a single solution.

Table 1 shows the five key questions in BTTF. In order to understand the suitability of a potential blockchain solution, analysis in all these five areas is necessary. Below are the descriptions of each question and its analysis process to guide process owners using BTTF. We start with understanding "Who" (participants), continue with "What" (tokenization of assets and information), then "Where?", which reveal the details of the interaction network in order to understand how "Who" and "What?" are interacting. "Why?" is a question to discover the issues to solve and the benefits to gain. "When?" helps to understand events in the system that helps us to use blockchain technology with its smart contracts and automation tools.

Who? – Participants: The re-design process starts with the analysis of existing actors to identify the participants involved in the process. Introducing blockchains will revolutionize the communication, interaction, and collaboration between these participants. Participants in the old process may have new roles in the new process. Depending on the overall business goals, there may also be new participants. Existing participants can remain only if they are independent collaborators in the network. For the participants in the new blockchain led design, the next step is to decide whether every participant in the process can approve and govern. A higher number of participants justifies the use of blockchains.

What? – Tokenization: What goes into an entry in the ledger (a token) is fundamental to the usage and benefit of the blockchain. One of the most common types of tokens are digital assets. Therefore, tokenization should start with identifying digital assets with attributes such as ownership and identifiers. If tokens do not emerge as a result of this analysis, the next step can be to find out whether there are entities in the process that multiple systems are interested in. A token can be created from such an entity. If the process benefits from all transactions related to this entity to be on the distributed ledger, it can be marked as a token. If there are existing book-of-record systems or intermediaries, they can be excluded in favor of similar functionalities over the blockchain. Analyzing the request and response structure may reveal the detail of the peer-to-peer communication over the intermediary and this communication structure can be used to define new tokens.

Where? - Interaction Network: In order to operate on the peer-to-peer distributed network structure, each participant needs to be able to connect with several other participants. An important design target is to eliminate dependencies on a specific group of nodes and removing any single point of failure.

Why? - Trust Injection: The most valuable feature of blockchains is the trust provided to normally untrusting participants. At this point in the process design, all previous

findings should be validated considering trust requirements. Existing trust issues should be listed and prioritized. If a process with the identified participants, tokens and interactions requires trust, the use of blockchains would be justified. Each trust requirement should be matched with a particular blockchain feature.

When? – Automation-Events: This step reveals the events that can be detected in the redesigned process for previously identified participants, tokens, and interactions. For each event, actions would be identified. If an action would automatically trigger a transaction, smart contracts are relevant. Smart contracts would initiate new transactions when predefined events are realized in blockchains. Many legacy processes do not have an event-based approach to automated transaction execution. Therefore, identifying automated transaction sources can be an extended discovery effort. Automation may lead to cost savings. Identification of these savings is important as it helps to justify the new blockchain implementation.

4 Use Case 1: Supply Chain – Global Trade

Most international supply chains are difficult to track. Products and goods change several hands from manufacturers to consumers. Building a foundation of trust is hard considering the variety of trading partners. The current need for such trust is mostly fulfilled by intermediaries and legal contracts. The additional costs of acquiring trust and process traceability are very significant. For example, documentation and follow-up costs for a container shipment are more than double the cost of real physical shipment [11].

In supply chain industry, there are existing blockchain solutions for the food supply chain [12], mining [13], and diamond tracking [14] among others. We present a generic solution to a simplified use case of an international supply chain process to demonstrate the concept, steps and value of BTTF in this context.

The analysis in Table II shows that the target supply chain use case is a good candidate for improvement with blockchain technology. There are plenty of independent collaborators. Participants have motives and benefits from the implementation. There are several well-defined tokens present in the process. There are a lot of ways that the collaborators will benefit from the new token model and the new interaction model. The current trust and quality issues are well listed. Almost all possible ways of injecting blockchain related trust into the new process model are confirmed. Several smart contract opportunities including a partial payment automation are identified. Our framework has been followed well in the above example and the process is a good candidate for improvement through blockchain technology.

5 Use Case 2: Real Estate Sale Process

Multi party agreements such as a real estate sale process require information to be shared between the seller, the buyer, their lawyers, their banks, their spouses, insurance companies, the power utility, the gas company, city utilities, land registry and government revenue taxation agencies, which are traditionally done by sharing information between two parties at a time. Smart contracts can execute the sale, transfer responsibilities, change the ownership, and transfer the money. Such a system under close monitoring of so many stakeholders would be more trustable than one where each stakeholder keeps their own records with partial information.

The analysis in Table III shows that the target real estate use case is a good candidate for improvement with blockchain technology as well. There are plenty of independent collaborators. Participants benefit from the implementation. Most have clear duties and responsibilities tied to the success of the collaborated process. There are several well-defined tokens present. Ownership related information is a good token. With the old and new interactions, there are many ways that collaborators will benefit from the new token model and the new interaction model. Currently. there is established trust in the system, which is based on the parties' past experience. Execution seems orderly, but transparency is limited, and operational redundancy is very high. Almost all possible blockchain related trust injection is confirmed to inject trust and efficiency into the new process model. It is identified that the majority of transactions can be automated with smart contracts. Our framework has been followed well, and the process is a very good candidate to be improved by blockchain technology.

TABLE II
FRAMEWORK RESPONSES - SUPPLY CHAIN – GLOBAL TRADE

Who?	What?	Where?	Why?	When?
Independent collaborators Factories, Land transportation providers, Freight forwarders, Customs brokers, Governments, Ports, Ocean Carriers, Insurance, Retail businesses.	**Digital assets used in the transactions** Shipment, Export certificates, Container.	**How participants interact with each other** Participants currently interact with several media of communication including online, e-mail, fax and paper. There are several business-to-business custom integrations.	**Current trust issues** Participants can hide the issues and defer responsibilities due to insufficient, imprecise, corruptible, forgettable and not provable information.	**Events in the system** Several handover events where a participant delivers the item, and another receives it. Government approval Customs clearance Loss and Damage
Are anonymous participants allowed? No. This process requires participants to have identities and permissions.	**How is this information currently represented and stored by each participant?** Product details, Shipment status (OK, lost, damaged), Ownership of the shipment, Documentation, Approvals.	**How do the interactions change with peer-to-peer networking?** There would be great transparency if every stakeholder can access others and receive information from all. They can create more successful plans with more information.	**What are the quality issues with current service?** It is not clear where the shipment is, why it is late, whose mistake delayed the arrival.	**Which events can trigger transactions that can be handled automatically?** Several payment and acknowledgement transactions can be automated with the delivery events, e.g., custom duties to be paid when the item is in the port.
Can any participant approve or govern the steps of this process? Each participant has a major role in the governance of this process.	**What are the book-of-record process dependencies?** Factory is the book of record on the content Land transportation providers and ocean carriers are book of record on location and destination Ports are book of record for departure, arrival.	**Which interactions need which tokens?** Factories, land transportation providers, customs brokers, governments, and retail businesses need product information token. Customs brokers, ports, ocean carriers, and retail business need container token.	**How is trust provided?** Extended communication, Data sharing, Process tracking, Tamper-resistant transaction history, Audit trails, Fraud prevention, Transparency.	**Which of these interactions are contractual in nature?** From factory to the retail store, many mini transactions and payments can be coded in smart contracts and executed by sensor events, e.g. 30% of the payment to be paid to factory at the time the shipment leaves the factory. 20% to be paid when shipment is in the ocean carrier.
What are the DLT benefits? Each party can have a clear view of the process details and see incoming shipments and provide their process details downstream.	**What is the information current intermediaries request and provide?** Freight forwarders coordinate the movement of goods to their destination and handle the necessary paperwork. They would request product and destination information and provide estimate of arrival.	**What are each participant's roles?** Since there are several equal contributors, the roles can be distributed uniformly. Participants can all form nodes to create new blocks. Due to the business volume, they all have stake in the health of this blockchain. Privacy concerns between competing businesses should be handled at the token level to hide details that should not be shared.		

TABLE III
FRAMEWORK RESPONSES - REAL ESTATE SALE PROCESS

Who?	What?	Where?	Why?	When?
Independent collaborators The seller, the buyer, their lawyers, their banks, their spouses, insurance companies, the power utility, the gas company, city utilities, land registry and government revenue taxation agencies.	**Digital assets used in the transactions** Real estate ownership, insurance, power and gas contracts, city utility services, mortgage application, mortgage.	**How participants interact with each other** Currently there is one to one interaction between participants. There is process based centralization around lawyers. Buyer interacts with her lawyer and her lawyer interact with most other process stakeholders.	**Current trust issues** Buyer does not see the process state. Her relation is solely based on her trust in the lawyer and her perception of the reliability of the process Seller does not know when the funds would be deposited Buyer is not sure if ownership is transferred Buyer is not sure if utility contract is in effect Bank is not sure if insurance is valid and not cancelled.	**Events in the system** Sale agreement Closing Mortgage funding
Are anonymous participants allowed? No. This process requires participants to have identities and permissions. Another alternative is to have the incorporated entities as identified while individuals anonymous. Trusted such as lawyers can introduce the anonymous entities to the system in order to enable their anonymity while validating, they are real.	**How is this information currently represented and stored by each participant?** Buyer and seller has paper documents. Lawyers has paper and scanned documents. Bank has mortgage agreement Insurance company has insurance contract details Power and gas company has service contract details Land registry has the title information.	**How do the interactions change with peer-to-peer networking?** There would be great transparency if every stakeholder can access others and receive information from all. As the needed information is already shared, the number of interactions between the participants would decrease significantly.	**What are the quality issues with the current service?** Why there is gap in information held by different public agencies and the banks? Why do buyers need to provide the same information again and again?	**Which events can trigger transactions that can be handled automatically?** Closing event can trigger several transactions: land transfer, utility, gas, power bills activation. Insurance starts. Money transfers, etc.
Can any participant approve or govern the steps of this process? There are some major roles in the process. Banks, government and lawyers. Governance can be done by all the major stakeholders. Distributed governance. Roles like buyer and seller are not suitable for governance.	**What are the book-of-record process dependencies?** Land registry is book of record for title.	**Which interactions need which tokens?** Lawyer-Land Registry-Real estate ownership Lawyer-Insurance-Title Insurance contract Buyer-Insurance-Home insurance contract Buyer-Power and gas companies-Power and Gas contract Lawyer-city utility services-City utility services contract Buyer-Bank – Mortgage Bank-Lawyer-Mortgage	**How is trust provided?** **Extended communication** – Buyer and seller can receive the extended communication events and know about the status. Income tax authorities are notified from the sale immediately. Tamper-resistant transaction history – All steps would be on the blockchain so there is no dispute. For example, there is no dispute that city utilities bill starts from the closing day. There is no dispute that power bill starts from the closing day. Tamper-Evident Logs, Audit trails. In case of a dispute, the events that happened are all in the blockchain. Fraud prevention. Every detail is shared on the blockchain about the sale. For instance, a lawyer trying to commit fraud would be obvious as all steps are on the blockchain.	**Which of these interactions are contractual in nature?** Closing, land transfer, utility, power, gas. several of these interactions are contracts. Smart contracts can execute the sale, transfer responsibilities, change the ownership, and transfer the money.
What are the DLT benefits? Seller and buyer can benefit with the ability to access to a repository to observe the state of the process. Lawyers can communicate the details, manage the signatures and close the deal transparently.	**What information do current intermediaries request and provide?** There are not many intermediaries in this process. The main process issue is the number of interactions between entities and risks associated with it. In order to understand the entities in the process, we need to look at every one-to one process.	**What are each participant's roles?** Mortgage – Buyer signs, bank provide funds, lawyer attach the fund to closing agreement.		

6 CONCLUSION

Applying blockchain technology without a multi-dimensional assessment of the business process may result in an unnatural application of blockchain that does not provide the desired benefits. In order to prevent this problem from happening, we introduced a prescriptive approach for transforming business processes. The Blockchain Technology Transformation Framework (BTTF) is a structured way of assessing whether business processes can be improved with blockchain technology.

BTTF applies to any existing or new business process. Beside our use case examples in supply chain and real estate, other industries such as finance, government, insurance, and energy are well-known application areas that can benefit from applying BTTF. Applying BTTF to more sensitive business processes such as those in healthcare would reveal the critical compatibility issues between the process and blockchain technology.

A limitation of the BTTF is the manual nature of the analysis. Our research will continue on this topic, and we will develop a tool in order to automate the planning and execution of BTTF based analysis. This tool will help in understanding the details of the analysis questions, evaluating the answers, informing on the impact of the choices, identifying possible conflicts, generating ideas on the opportunities as well as comparing the analysis of different processes. The comparison ability can also improve our framework with the possibility of an empirical assessment of the framework.

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