Overcoming Barriers to Blockchain Technological Innovation in Trade Finance Faced by U.S. Banks

Clotilda Mujeyi Chinyanya, DBA, MBA, BBA, PMP, ACP, SSM | Capella University, Minneapolis, Minnesota, USA

Contact: clotildac@gmail.com

Abstract

The major U.S. banks have been reluctant to adopt blockchain technology in trade finance because of several barriers associated with the technology. The hesitancy in adopting the technology has led to higher costs, inconvenience to customers, vulnerability to cyber-attacks and susceptibility to forgery, and predicted losses in trade finance revenues of up to 10.5% per year for the next four years. This modified Delphi project identified 18 feasible and desirable forward-looking approaches to overcoming barriers to adopting blockchain technological innovation in trade finance within U.S. banks. A panel of 13 blockchain implementation experts in the financial industry was recruited through User Interviews and LinkedIn. Qualitative and quantitative data were collected, analyzed, and documented using four iterative rounds of electronically administered surveys on the SurveyMonkey platform. The panelists selected the top five approaches, and 92.3% of the participants were confident with the results and rated the findings as reliable or very reliable. Some of the reasons participants were confident with the results included: 69% of the participants mentioned people or talent; 61% mentioned leveraging existing infrastructure; 30% mentioned the importance of investing in R&D, and 23% mentioned financial resources and collaboration as critical to achieving the goal of blockchain technological innovation in trade finance.

Keywords*:* blockchain technology, letter of credit, trade finance, smart contract, innovation, toe framework, modified Delphi technique

Introduction

Trade finance enables global trade (International Finance Corporation, 2020). As dependable agents, banks play a critical role in facilitating that trade by arranging payments, financing, document processing, and guaranteeing payments to help reduce the risk of either party not fulfilling their obligations (Bank for International Settlements, 2014; Niepmann & Schmidt-Eisenlohr, 2014b). Letters of credit and documentary collections are two of the most common trade finance products to help mitigate the risk (Niepmann and Schmidt-Eisenlohr, 2014a), and this project focuses on blockchain technology as an alternative to letters of credit. A letter of credit guarantees the exporter payment once the importer receives proof of shipment, and the banks of both parties act as intermediaries and guarantors in the trade process (Niepmann & Schmidt-Eisenlohr, 2014a). Although letters of credit help minimize risk, they have several disadvantages, including extensive paperwork that is slow to process, expensive, complicated, and susceptible to forgery and cyberattacks (Chang et al., 2020).

Background

Financial technology firms (fintechs) are leading banks in innovation and siphoning their potential revenue (Bedford & Gilder, 2020; Global Fintech Report, 2019). Fintechs are active in banking, capital markets, investment management, insurance, and real estate and leverage innovative technology like blockchain (Eckenrode & Friedman, 2017). By contrast, banks' "innovations" are mainly upgrades of existing products—hardly innovations compared to the more profound, revolutionary, and disruptive innovations of fintech start-ups (Das et al., 2018; Schindler, 2017).

Blockchain Technology

Nakamoto (2008) demonstrated that banks lose their intermediary role with blockchain technology. Trading parties can transact directly without involving a third party based on the integrity of cryptography (Nakamoto, 2008). Though blockchain technology has been in use for over ten years since Nakamoto envisioned Bitcoin in 2008, its use, particularly in the finance industry, has been limited.

Halaburda and Müeller-Bloch (2019) conducted a case study of Bitcoin to determine whether blockchain could deliver on the promise of decentralization and found that the governance of design and updates is centralized; however, the governance of transactions and consensus contains elements of centralization and decentralization. According to Sherman et al. (2019), 90% of transactions go through only 20 mining pools, a typical example of centralization in permissionless blockchains.

Ethereum, launched in 2015, was the first blockchain platform with smart contract scripting capabilities (Herweijer et al., 2018). According to Hileman and Rauchs (2017), Ethereum opened doors for other blockchain applications and possibilities. Corda and Hyperledger Fabric are permissioned blockchains with smart contract capabilities (Sherman et al., 2019). Popular blockchain technology trade finance platforms include Corda, Hyperledger Fabric, Ethereum, and Quorum. Some new platforms reflect genuine innovation and address issues raised with existing platforms (Hileman & Rauchs, 2017).

According to Hileman and Rauchs (2017), 19% of cryptocurrency payments supported international trade. Practitioners have identified different blockchain technology applications, including trade finance, but implementing this technology at the industry level beyond cryptocurrency is limited (Casino et al., 2019). Some banks like JP Morgan Chase with its JPM Coin (JPMorgan Chase, 2022) and other parties like IBM have started some form of blockchain technology in trade finance on a small scale.

Blockchain is predicted to account for 10% of the global GDP by 2025 (Herweijer et al., 2018). Unless practitioners in banks are proactive in launching new products, these cornerstone institutions of the modern economy could lose their finance industry position. Indeed, the OECD (2020) predicts a wave of disruption in the finance industry. More fintechs are expected to enter the market, with hubs in Australia, Switzerland, and China (Shine Group, 2018), and technology-driven models may soon replace the finance industry's current business models (Chen, 2018).

Business Problem and Gap in Practice

The financial services market was a US$22 trillion industry in 2020 (The Business Research Company, 2020), and banks are such "systemically important financial institutions" that their failure threatens global economic and financial stability (Rafique et al., 2018, p. 2). Major U.S. banks face possible losses in trade finance revenues of up to 10.5% per year for the next five years, starting in 2021 (Browne, 2020), primarily because of their lack of innovation. Current bank users are looking for alternatives to letters of credit that are inexpensive and efficient (Kant, 2017). For example, letters of credit contribute to shipment delays by up to 10 days (World Blockchain Summit, 2019). Banks could lose customers to other trade finance platforms unless practitioners become more proactive in developing new products (PwC, 2017). The innovations must help capture new markets, protect existing ones, and prevent market share loss to newcomers. Blockchain technology is one such innovation.

Brunner et al. (2016) identified fraud, unpredictability, and complexity of transacting as the three main reasons the current trade finance model needs disruption. Khoza (2019) revealed how reluctance to share knowledge among team members can be a critical factor stifling innovation. Failure to innovate leads to loss of first-mover advantage and market share, and even closure of the business (Bloch et al., 2012; Crawford, 2015; Guzzini & Iacobucci, 2017). Nevertheless, the major U.S. banks, i.e., JP Morgan Chase, Bank of America, Citi, HSBC, and Wells Fargo, continue to use paper-intensive transaction methods without developing blockchain technology because of its many associated risks: technology, regulatory, privacy, counterparty, security, and transition risks (Janssens et al., 2017; Vysya & Kumar, 2019). Although most other business processes have gone digital, letters of credit, which currently account for 15% of all trade finance (a figure expected to continue to grow until 2027), still rely on paper trails rather than digital chains (Allied Market Research, 2020; The Bank for International Settlements, 2014).

Smart contracts that employ blockchain technology are an alternative to paper-intensive letters-of-credit payment systems. In more technical terms, smart contracts are secured digital instructions coded to automatically permit contract terms' performance that eliminate the need for a trusted third party and reduce the risk of human error (Herweijer et al., 2018; Youssef, 2020). A smart contract's advantages include cost and speed. Its advocates claim that it enables trustless trading, openness, data integrity, tamper-proof transactions, and guaranteed payment (Youssef, 2020).

The possible erosion of the market dominance of traditional banks by fintech is not a new problem. Indeed, Das et al. (2018) identified barriers to innovation in banks more than four years ago. However, no meaningfully innovated products have been released, or initiatives launched to address these barriers. The barriers include reluctance to capitalize on new ideas, unresponsiveness due to systems design, opposing internal structures, risk-averse managers, lack of formal R&D, and hesitancy to accept external knowledge. These obstacles to innovation are also not unique to the finance industry; they are endemic in many industries that must deal with red tape and archaic systems and processes. Several specific factors contribute to this innovation gap, including outdated technology, reluctance to accept new technology, lack of an innovation culture, and lack of technical knowledge in leadership, all of which discourage technologically gifted employees from staying with the organization for long enough periods to affect meaningful changes (Ansari, 2020; Das et al., 2018).

Furthermore, practitioners who would otherwise choose to commit funds to research, develop, or purchase new technology are discouraged because there is no guarantee of investment return. The situation stagnates without a formal structure to stimulate innovation that is not dependent on an immediate cost-benefit analysis (Das et al., 2018). The innovations coming through fintechs are numerous and cover all aspects of banking and finance (Schindler, 2017). To avoid banks' failure, practitioners must start innovating and collaborating with fintechs to merge both institutions' strengths (PwC, 2017).

Project Questions

This modified Delphi project investigated two research questions:

> PQ1. What are the forward-looking approaches to overcoming barriers to adopting blockchain innovation in trade finance within U.S. banks, as identified by a nationwide panel of blockchain implementation experts?
>
> PQ2. Is there consensus among a nationwide panel of blockchain implementation experts regarding the desirability and feasibility of specific forward-looking approaches to overcoming barriers to adopting blockchain innovation in trade finance?

Terms and Definitions

Blockchain is a technology that uses a distributed ledger across a network of computers based on mathematics and advanced cryptography that is either permissioned or permissionless (Beck & Müller-Bloch, 2017). A permissionless blockchain is public, where anyone can join, and all participating nodes have full access (Clohessy & Acton, 2019). In contrast, a permissioned blockchain is either private or a consortium, and the initiator can admit specific nodes to perform certain functions (Chang et al., 2019).

Disruptive innovation serves an unserved market or creates a new market (Christensen et al., 2015).

A *distributed ledger* is a digital system that logs transactions of assets with details and records them in multiple nodes simultaneously (Troy & Pratt, 2017).

Fintech is technological innovation in the financial industry that delivers significant changes in services or products (Financial Stability Board, 2019).

A *letter of credit* is an irrevocable undertaking that an issuing bank will pay the exporter upon delivery of the goods or services to the importer (United Nations, 2012).

Organizational learning is creating and sharing knowledge to integrate new insights into future processes (Siddiqui et al., 2019).

A *smart contract* is a secured digital instruction coded to automatically permit a contract terms' performance (Youssef, 2020).

Importance of the Project

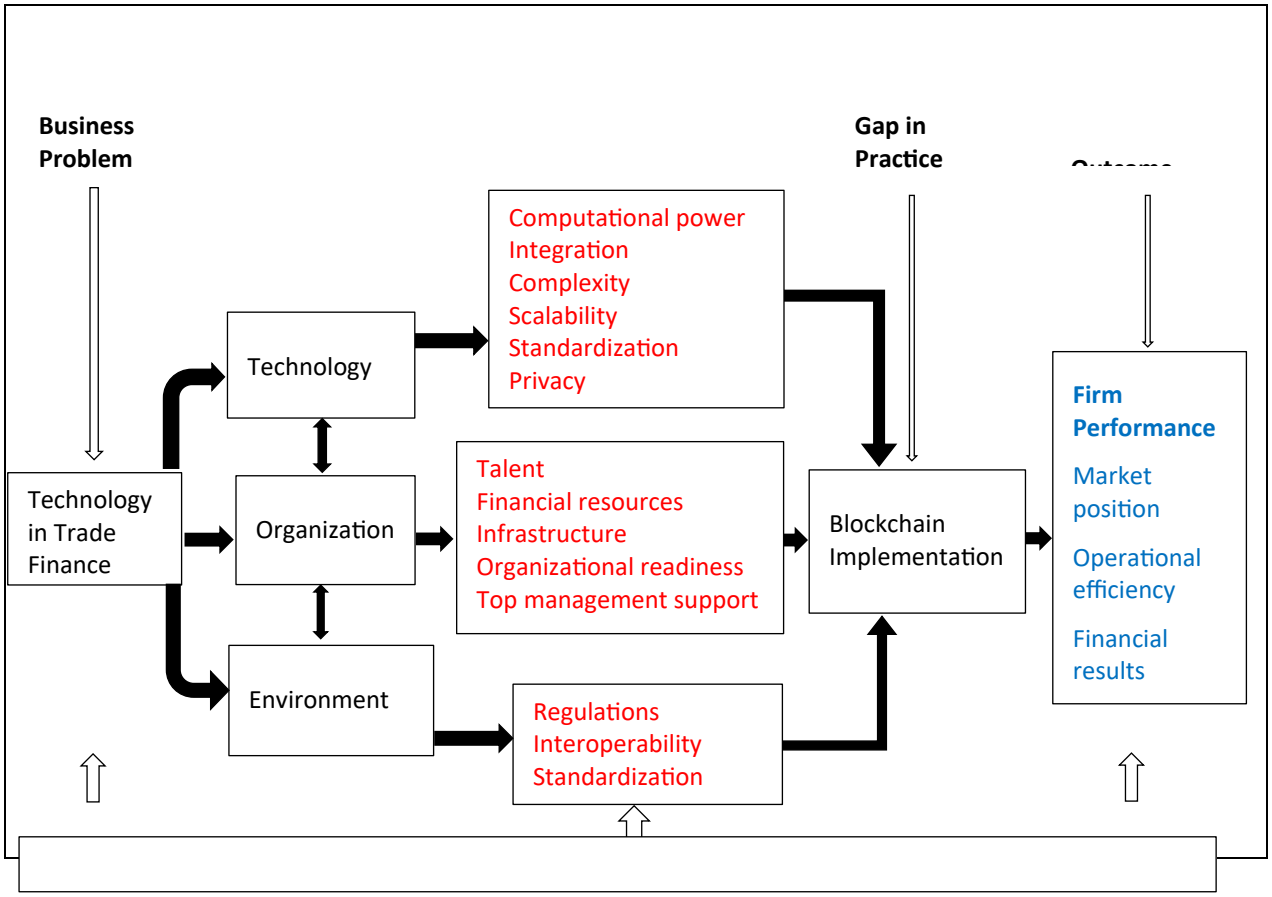
Banks operate in a highly regulated environment. To avoid a repeat of the global financial crisis of 2008, practitioners have concentrated on compliance with regulatory reforms at the expense of innovation (Bank for International Settlements, 2018; Das et al., 2018; Helleiner, 2011). The COVID-19 pandemic presented challenges to bank executives in trade finance as their ongoing use of paper-based processes made remote working impossible (Murad & Daly, 2021). Banks have not developed smart solutions to navigate the regulatory requirements, managing most regulatory processes manually at the cost of up to US$4 billion annually (PwC, 2017). Practitioners can access innovations through licensing, collaborations, joint ventures, mergers, and acquisitions (Ahuja & Katila, 2001; Dell'Era & Verganti, 2010; Haucap et al., 2019; Hensmans, 2017; Katz & Shapiro, 1985). In short, several organizations are forming ecosystems to manage trade finance more efficiently using blockchain technology.

Applied Framework

The concepts of the technology-organization-environment (TOE) framework (Tornatzky et al., 1990) as proposed by Baker (2011) inform the methodology and analysis of this modified Delphi project. The TOE framework explains how the technological, organizational, and environmental concepts impact technological innovation in the firm by examining these concepts as the result of a "model of innovation orientation: drivers, actions, and outcomes" (Siguaw et al., 2006, p. 563). Past applications of this framework demonstrate that its models can identify how organizational competencies produce innovation outcomes that improve firm performance (Baker, 2011; Clohessy & Acton, 2019; Li, 2020; Oliveira & Martins, 2010; Pan & Jang, 2008; Siguaw et al., 2006; Teo et al., 2006; Zhu & Kraemer, 2005; Zhu et al., 2006). This project uses a hybrid framework (see Figure 1) to examine a specific innovation, i.e., blockchain technology, in a specific industry, i.e., trade finance, which includes several barriers identified in the extant literature on blockchain technology adoption.

Figure 1

Innovation Framework for Adopting Blockchain Technology in Trade Finance



Literature Review

Technology Focus

The technology concept of the TOE framework helps practitioners identify gaps between the technology within the firm and what is available to fill those gaps (Baker, 2011). Key factors that impact the adoption of IT innovations include required expertise, perceived comparative benefit, and how they fit and integrate with existing technology (Rogers, 1995). Several technology barriers are specific to blockchain technology. For example, the computational power required in the mining process to produce proof-of-work is excessive, leading to environmental fears (Koteska et al., 2017). Most of the mining is done in China, and, according to the Center for Strategic and International Studies (2022), China is the world's leading producer and user of coal. Bitcoin mining alone could emit enough carbon to increase global warming by 2 degrees Celsius by 2048 (Mora et al., 2018). Scalability is also a crucial barrier to adopting blockchain technology in trade finance (Koteska et al., 2017). Lack of standardization across

blockchains prevents adoption (Chen et al., 2020; Vysya & Kumar, 2019). Public blockchains are also prone to attack because the setup of a blockchain is such that if 51% of the miners control a node, they can manipulate it, erase transaction history, and compromise the integrity of the block (Bakos et al., 2021; Koteska et al., 2017; Vysya & Kumar, 2019). The privacy issues, especially for public blockchains, are a significant deterrent to adopting this innovative technology (Koteska et al., 2017).

Global technological developments have fostered blockchain, with several companies launching platforms in 2018 and over 550 patents under review in 2019 worldwide (Herweijer et al., 2018; Sherman et al., 2019). Some banks have formed syndicates to tackle trade finance issues through blockchain technology and other technologies; however, none of the consortia identified by Patel and Ganne (2019) originated from the United States. Indeed, most banks participating in such syndicates are headquartered in China, Europe, Hong Kong, India, and Singapore. Scaling the operations of these syndicates remains challenging because of the heterogeneity of global trade regulations (Patel & Ganne, 2020).

Corda R3 is the most prominent blockchain consortium and is ideal for financial institutions comprising more than 40 global banks, including Bank of America and Morgan Stanley (Guo & Liang, 2016). Platforms like Corda and Quorum conducted successful interoperability trials (Accenture, 2019). The trials are insufficient to cover all variables in a trade finance transaction, cannot account for all variations in platform designs, and do not incorporate legacy systems (World Bank Group, 2021). The World Economic Forum (2020) identified gaps, starting from basics like terminology. Applications like Vottun, Overledger, and LiquidApps address the interoperability issue with blockchain platforms (World Bank Group, 2021). Different platforms, however, have different security protocols, which may compromise interoperating platforms and allow malicious interference like the oracle attack against Synthetix (Todd, 2019). The World Bank Group (2021) recommends establishing a governance body comprised of stakeholders to oversee the interoperability in blockchain, focusing on monitoring standards about the technical framework and examining the security and legal framework to supervise design and implementation.

Miners play a critical and pivotal role in providing computational power to validate new blocks, and 58% of miners operate from China (Hileman & Rauchs, 2017). Mining requires a massive investment in equipment. Several platforms, including Bitcoin, use proof-of-work as a consensus mechanism to confirm a transaction and create a new block. Executing proof-of-work consumes a considerable quantity of power, which raises environmental concerns. Aggarwal and Kumar (2021) suggested other consensus mechanisms to consider like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, and proof-of-ownership.

Clohessy and Acton (2019) found that all the five large companies in their study that successfully launched blockchain did so on private permissioned blockchains. A permissioned consortium blockchain is best for trade finance because it addresses privacy, security, transaction speed, and scalability concerns associated with permissionless blockchains (Chang et al., 2019). Furthermore, permissioned blockchain enables administrators to prevent illegal activities (World Bank Group, 2021).

Asim and Sorooshian (2019) assessed process, infrastructure, and strategic capabilities related to technology management. In reviewing the literature on knowledge, innovation, and technology published between 1990 and 2018, the authors found that technological infrastructure is crucial in

creating and sharing knowledge. Catalini and Gans (2019) suggested creating ecosystems and collaborative platforms to share, manage, and reduce infrastructure costs. The approach of an ecosystem with a shared platform could simultaneously address the integration and cost barriers.

Organization

The organization view examines those factors affecting the adoption of innovative technology specific to a firm, i.e., the skills of its labor, its leadership, size, knowledge concentration, company preparedness, and policies toward resource allocation (Clohessy & Acton, 2019). Resource allocation must align with the strategic direction, or practitioners cannot explore all possibilities (Hekkert et al., 2007). Blockchain technology is new, so its potential has not yet been fully explored (Iansiti & Lakhani, 2017; Varma, 2019). Also, there is little depth in the technical workforce, with only a few people having the necessary skills to design and implement the technology at a large scale without extensive and often expensive staff retraining (Beck & Müller-Bloch, 2017; Clohessy & Acton, 2019; Vysya & Kumar, 2019). The high capital outlay not only to procure specialized equipment but also to hire the personnel to design, implement, and manage it is a significant deterrent to blockchain adoption (Zamani & Giaglis, 2018). Moreover, the lack of robust, time-tested standards makes it difficult for the different banks to collaborate on innovative products in trade finance because the different blockchain platforms have no uniformity (Vysya & Kumar, 2019). Before practitioners invest in blockchain technology, executives must determine whether blockchain is the right solution to their business problems and if the organization is ready for the technology (Herweijer et al., 2018).

Collaboration across functional teams and organizations is critical for blockchain technology innovation because skills are scarce (Beck & Müller-Bloch, 2017). Cross-functional collaboration also stimulates internal innovation (Malhotra et al., 2017). Demirkan (2018) claimed that collaboration helps pool resources to seize opportunities efficiently, but firms need slack in human resources to contribute to innovation initiatives within the network. However, Mousa and Chowdhury (2014) studied all US public firms between 1993 and 2011 and found that slack in human resources does not impact firm innovation.

Beck and Müller-Bloch (2017) recommended using innovation labs to test ideas before implementation. In their study of companies in the financial, IT, education, and other industries represented by 11 large companies and nine SMEs in Ireland, Clohessy and Acton (2019) reported that all participants said it was important to conduct experiments before adopting blockchain technology.

Slack in financial resources within a firm significantly impact innovation if the external environment is calm (Demirkan, 2018). Mousa and Chowdhury (2014) found that slack in financial resources positively influences innovation because practitioners allocate more funds to R&D. Firms with well-resourced R&D were more likely to adopt blockchain technology than those with limited resources (Clohessy & Acton, 2019).

Blockchain technology requires specific skills that are lacking in the current workforce. Decision-makers, therefore, must introduce formal training in blockchain technology to bridge the skills gap (Clohessy & Acton, 2019). Malhotra et al. (2017) emphasized the importance of human resources as a source of innovation. According to Veena et al. (2019), employees are an essential knowledge resource. In a four-year study across ten companies involved in internal crowdsourcing in different industries, Malhotra et al. (2017) found that one way to stimulate innovation within the firm is to give employees

slack time to be creative. However, Demirkan (2018) disproved this assertion saying there is no direct relationship between slack time and creativity among employees. According to Malhotra et al. (2017), internal innovation works best when employees have a clear concept of the idea selection criteria.

Clohessy and Acton (2019) analyzed organizational size, readiness, and support from top-level management to determine the factors influencing blockchain innovation adoption. Of the companies analyzed, 15% demonstrated that organizational readiness must be combined with top management support to influence blockchain adoption positively. Also, 25% demonstrated that large organizations with organizational readiness and support from top-level management adopted blockchain. Support and involvement from top-level management are critical factors in blockchain adoption (Clohessy & Acton, 2019). The leadership of the CEO has a direct influence on innovation (Zuraik & Kelly, 2019).

Leadership must inspire enthusiasm and provide platforms that encourage idea sharing among employees to help refine the ideas (Beck & Müller-Bloch, 2017; Malhotra et al., 2017). Khoza (2019) found that employees withhold knowledge if managers do not reward them for their ability. Malhotra et al. (2017) and Khoza (2019) concurred that employees would not share if they did not personally benefit from the innovation. However, Beck and Müller-Bloch (2017) found that employees invested their free time while expecting only the satisfaction of being part of a significant milestone in the firm, not monetary compensation.

Environment

The environmental component of the hybrid TOE framework focuses on such external factors deterring the adoption of innovative technology as competitors, regulators, government departments, customers, and other stakeholders (Clohessy & Acton, 2019). Because banks are cornerstones of modern economies, they are more regulated than many other industries. The requirements to follow specific standards designed for traditional trade finance makes it difficult for executives to embrace blockchain technology (Patel & Ganne, 2020). Compliance with regulations for settling disputes, identification of regulators, the legality of smart contracts, record keeping, tax-paying, and reporting is a challenge because legislation is constantly changing (Vysya & Kumar, 2019). The Anti-Money Laundering Act of 2020 expanded its reach to include cryptocurrency (Gibson Dunn, 2020).

The abundance of ideas and level of risk in developing blockchain technology makes collaboration with external parties indispensable, especially for firms with weak R&D or limited resources (Demirkan, 2018; Hensmans, 2017; Lee et al., 2016; Pisano & Verganti, 2008). However, a lack of interoperability between separate blockchain networks makes sharing data necessary for collaboration between different stakeholders well-nigh impossible (Lewis et al., 2019; Zamani & Giaglis, 2018). Technological innovation works best through collaboration (Demirkan, 2018). However, Na et al. (2016) cautioned against collaboration when goals are unclear because it could waste resources. According to Brown et al. (2020), banks could partner with fintechs to benefit from technology, products, and talent while offering better infrastructure to move banks more efficiently.

According to Kumar et al. (2011), market orientation is not forward-looking because it focuses on current customers; therefore, the organization may lose future opportunities. Market orientation is ideal for sustained profitability in the long term because it focuses on customer retention rather than acquisition (Kumar et al., 2011). Still, there is no guarantee of customer retention if technology changes.

Radical innovations are less likely with customer involvement because customers may make more complex suggestions and revisions than the firm can implement, resulting in conflict within implementation teams (Storey & Larbig, 2017). On the positive side, products co-created with customers are more likely to succeed on the market, have new uses, and be more user-friendly (Storey & Larbig, 2017).

Project Design and Participant Recruitment

The Delphi technique is ideal when investigating something unknown because it supports brainstorming and critical thinking in teams and attempts to gather consensus (Linstone & Turoff, 2002; Skulmoski et al., 2007). Blockchain technology is still developing, and practitioners do not yet understand all its applications, capabilities, and shortfalls (Iansiti & Lakhani, 2017). This study adopted a modified Delphi technique proposed by Miller et al. (2020) that uses extant scholarly and grey literature and expert opinion gathered utilizing online questionnaires to reach a consensus on the barriers to blockchain technology adoption in U.S. trade finance. These questionnaires were distributed via the online service SurveyMonkey because it is automated, ensures the anonymity of participants using codes, accommodates longer surveys, and has no limit to the instrument's number of questions or rounds.

Keeney et al. (2001) discussed some concerns with the experts in a modified Delphi technique, most notably that in modified Delphi projects, the expert usually self-identifies. This project, however, applied strict inclusion criteria. Each participant must be a(n) "innovation manager," "project manager," "IT manager," or "blockchain implementation expert" at a major U.S. bank for at least three years, have knowledge and experience in blockchain technology, and have completed one blockchain technology project within the banking industry in the past three years. Participants needed to meet two of the three criteria to be eligible to participate, and all the participants who completed all four phases of data collection did.

Following established methods (Kelly, 2010; Palinkas et al., 2015), purposive sampling was used to identify participants who were blockchain experts who had worked on at least one successful blockchain project in the banking industry in the past three years. The panelists were U.S.-based nationwide experts recruited using third-party services, namely User Interviews and LinkedIn. Keeney et al. (2001) also critique purposive sampling as a methodology because of the strong selection bias associated with purposive sampling. Following the recommendations of Skulmoski et al. (2007), a starting sample of 21 was recruited to ensure an adequate number of participants (i.e., 10 to 15) after attrition. Participant recruitment was conducted on the User Interviews platform and began on September 7, 2021. On September 14, 2021, a parallel recruitment drive was initiated on LinkedIn that targeted individuals whose profile information matched the participant selection criteria. Recruitment ended on October 1, 2021, after 21 participants had signed up to complete the study. Table 1 provides a demographic summary of the participants. Panelists P3 and P5 dropped in Round 2; their profiles appear underlined in Table 1.

Table 1

Participant Demographic Information

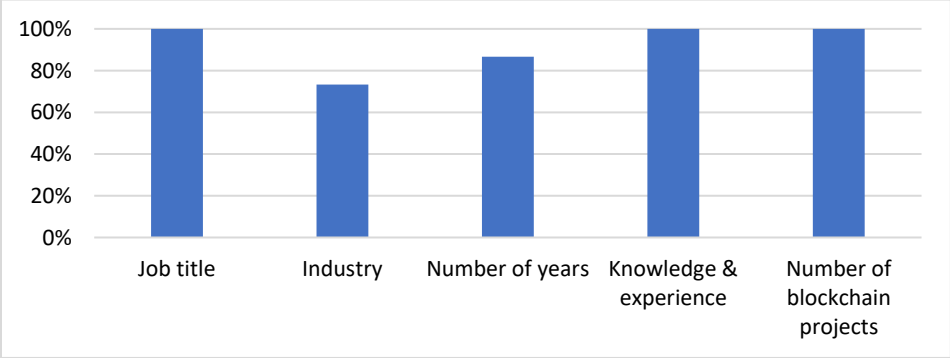
Panelist	Age	Geographical region	Job title	Industry	Years in role	# of blockchain projects
P1	55+	West	Project Manager	Finance	>3	3 +
P2	25-34	Southeast	Project Manager	Finance	>3	2
P3	45-54	Southwest	Directory Technology & Innovation	Health	>3	1
P4	25-34	Southwest	Project Manager	Finance	>3	1
P5	25-34	Southwest	Senior Solidity Architect & Senior Manager	Finance	>3	3+
P6	45-54	Southwest	Technology Consultant	Technology	>3	1
P7	25-34	Northeast	Crypto Analyst	Government	1	2
P8	25-34	Northeast	IT Manager	Technology	>3	1
P9	35-44	Southwest	Project Manager	Finance	>3	2
P10	18-24	Northeast	Senior Analyst – Strategy	Finance	1	2

P11	45-54	Northeast	Project Manager	Finance	>3	1
P12	25-34	Northeast	Blockchain Implementation Manager	Finance	>3	2
P13	45-54	Midwest	Project Manager	Finance	>3	3+
P14	45-54	Southwest	Innovation Manager	Finance	>3	1
P15	35-44	Northeast	Project Manager	Finance	>3	2

The job title in the criteria is non-exhaustive, so any job title that matched or matched the role described in the criteria was accepted as a good match. Figure 2 analyzes the degree to which participants matched the criteria.

Figure 2

Participants' Criteria Match



Data Collection

This modified Delphi project consisted of four rounds of participant involvement. Participants reviewed the approaches from scholarly and practitioner literature sources and then listed, modified, and added new approaches in the first round. The categories of the approaches were technology, organization, and environment. The second round allowed participants to rate the desirability and feasibility of the approaches in the modified list on a five-point Likert-type scale. Those approaches that received a rating of 4 or 5 for both desirability and feasibility from at least 70% of the participants proceeded to the third round. The participants ranked the desirable and feasible approaches in order of importance in round three. Participants ranked all the three categories combined. The weighted average score of the rankings

was distributed to participants in the fourth round to record their degree of confidence in the selected approaches. In this modified Delphi project, participants did not know each other and never met during the project. Anonymity helped participants express themselves more freely without pressure to align with their peers and modify opinions they had already determined to be correct. The process occurred in rounds because iteration allowed participants to change their opinions based on a narrowing scope of options (Eubank et al., 2016). Two Delphi technique experts reviewed the Round 1 instrument before it was sent to participants, and it was adjusted to reflect their feedback.

Trustworthiness

The qualitative standards for trustworthiness are "credibility, transferability, dependability, and conformability" (Lincoln & Guba, 1985, p. 314). Credibility is the certainty that the information captured reflects the actual lived experiences of participants and is also known as the truth value. In modified Delphi, the truth value relies on the fourth round, where participants rate their confidence with the study results. Sandelowski (1995) identified two ways of ensuring credibility in a qualitative method: purposeful sampling and adequate sample size, especially when there is some homogeneity; thus, this study meets Sandelowski's assessment for credibility. Transferability establishes the relevance of the results of a study to other situations. Documenting the data analysis process from the first to the fourth round allows anyone to duplicate the study in the same or a different geographical setting. Dependability determines the study's reproducibility. Clear and precise documenting allows another researcher to transfer the results to another population. However, Krefting (1991) argued that most qualitative studies do not need to make sweeping statements because each study is distinct and usually inflexible. Conformability assesses the impartiality of the researcher's analysis of the data. In this modified Delphi project, data analysis and presentation were critical throughout the process so that all opinions were recorded with high accuracy. Data were analyzed after each round to ensure that the information going into the subsequent round reflected the accurate feedback from the preceding round.

Ethical Considerations

The study did not commence until IRB approval was obtained in compliance with Capella University's policies. This study was not human subject research, so informed consent was not required. Participants were given a unique identification code used to protect their anonymity during the data gathering process, which used the SurveyMonkey platform. Participation was voluntary and not remunerated in any way.

Data Collection Results

Round 1: Data Collection and Analysis

The SurveyMonkey platform sent out the Round 1 questionnaire to 21 participants on October 3, 2021. Participants were given a questionnaire with the different approaches organized into three categories: technology, organization, and environment (see Table 2, text in black). The questionnaire defined the three terms and what they entailed. Participants were then asked to review the approaches suggested in each category and add anything they believed was missing from the list.

Seven participants had been recruited via User Interviews, and the other 14 through LinkedIn. One participant opted out, and the email was not delivered. An email reminder was sent out on October 5, 2021. By the end of the first phase of data collection and analysis on October 9, 2021, 15 participants had responded, three had opened the survey emails but had not completed the survey, and two emails remained unopened. Efforts to reach those with unopened emails through User Interviews and LinkedIn failed. It took participants an average of 17 minutes to complete the survey.

The round 1 data collection tool included 29 approaches and six demographic questions. If participants agreed with the approach, they did not need to write anything. If they disagreed with or wanted to amend an approach, space was provided. Space was also provided at the end of each section for free-form responses that the experts wanted to contribute to the study. The panelists generated 15 proposed amendments to the approaches included in the SurveyMonkey questionnaire and four new ones. Table 2 provides a comprehensive list of the approaches with the experts' amendments highlighted in red for comparison against the original text in black. Each of the 33 approaches in Table 2 was converted to a five-point Likert-type scale item for distribution to participants in the second round of data collection and analysis.

Table 1

Revised Approaches after Round 1 Input from Experts

1. Leverage existing ecosystems to share, manage, and reduce infrastructure costs to overcome integration, and cost barriers.
2. Adopt permissioned consortium blockchain for trade finance because all members of the consortium will be using the same platform. Permissioned consortium will also address privacy, security, transaction speed, and scalability issues associated with permissionless blockchains.
3. Use other consensus mechanisms to verify transactions besides proof-of-work like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, proof-of-ownership, proof-of-state, and proof-of-history.
4. Invest in infrastructure and people that can support technological advancement through access and application of knowledge.
5. Collaborate across functional teams to utilize the scarce skills in blockchain technology innovation by identifying where those skills are concentrated within the firm through HR.
6. Blockchain is complex and mission critical, therefore, developers must work with minimum distractions. To improve implementation of blockchain innovations, developers must focus on the task at hand without the added pressure of being expected to work with people across multiple teams.
7. Collaborate across organizations to form consortiums and benefit from the resources held at the consortium level like skills.
8. Hold financial resources at the collaboration level because they positively impact innovation compared to a firm's internal financial resources.
9. Collaborate with other partners to pool resources together to seize the blockchain technological innovation opportunity in time.
10. Firms must have slack human resources to participate in a collaborative platform that encourages sharing of ideas and process improvements which is key to blockchain.

11. Create and invest in innovation labs to test ideas before implementation with the involvement of both internal and external partners.
12. Business should participate more than lab as project moves towards implementation because business owns and operationalizes any innovation.
13. Blockchain is decentralized and distributed, therefore, business rarely takes ownership. Lab should always be highly active as this is a technology-based solution and business should assume an active role in the project oversight.
14. Firms must have slack financial resources to innovate.
15. Provide resources to R&D to go towards blockchain technology initiatives (deleted 'adequate' from the original).
16. Leadership support and involvement is a key determining factor in the successful implementation of blockchain technological innovation in the firm.
17. The leadership of the CEO has a direct influence on innovation.
18. Introduce formal training for blockchain that is customized to close the skills gap within the firm.
19. Financial resources reflect organizational readiness and are essential components for successful implementation of blockchain innovation.
20. Talented workers reflect organizational readiness and are essential for successful implementation of blockchain innovation
21. Technological infrastructure reflects organizational readiness and is essential for successful implementation of blockchain innovation.
22. Inspire enthusiasm in people by promoting a culture of idea sharing.
23. Reward people for sharing knowledge to encourage them to share more.
24. Involve all interested employees, keep them engaged, and updated on progress.
25. Give employees slack time to be creative and find ways to capture the creativity in those employees to improve the outcomes of blockchain technological innovation in the firm.
26. Technological innovation requires constant collaboration, communication, commitment, and dedication of the overall project team to the success of a delivery and continued improvement.
27. The lack of understanding of how blockchain technology works by top management is what sets firms behind. While training employees on blockchain is useful, training the management teams is critical.
28. Establish a governance group comprised of stakeholders to oversee the improvements and integration in blockchain.
29. Create user software that can run on different blockchain platforms.
30. Customize knowledge acquired from collaborating with external partners like research institutions and academic institutions to suit local circumstances.
31. Establish clear collaboration goals so that practitioners can determine the proper deployment of resources.
32. Partner with internal and external parties to build a self-supporting ecosystem where all members benefit from technology, products, and talent while offering better infrastructure to move banks to innovate more efficiently.
33. Co-create products with customers to increase innovation

Round 2 – Data Collection and Analysis

The round 2 survey was emailed to the 15 participants on October 10, 2021. A Likert-type scale was employed in rounds 2 through 4 of the data collection phase because this measure helps determine the level to which participants concur with or dispute a statement (Sullivan & Artino, 2013). The experts rated both their opinions as to the desirability and the feasibility of each approach using an ordinal Likert-type scale where 1 signified "very undesirable" or "very unfeasible," and a 5 signified "very desirable" or "very feasible." Participants rating an approach with a 3 (neutral) or lower were asked to justify or explain their ratings. A consensus in Delphi studies is not an exact science. For example, scholars have defined consensus as a level of agreement of 51% (Loughlin & Moore, 1979), 70% (Sumsion, 1998), and 80% (Green et al., 1999). This modified Delphi project defined consensus as 70% according to Sumsion (1998) because it was in the middle range of the scale suggested by other scholars. However, there were 13 participants; the next whole number was 10 participants, or 76.9%, so an approach with either a 4 or a 5 for both desirability and feasibility was deemed a consensus. The approaches that met the consensus criteria were used to generate the data collection tool for Round 3.

Only 13 participants had completed Round 2 of data collection by October 13 despite an email reminder sent on October 12. The survey asked participants to rate 33 approaches for both desirability and feasibility and took an average of 17 minutes to complete. Table 3 summarizes the results for desirability and feasibility for all 33 approaches in the order they were presented to the participants.

Table 3

Round 2 Results

	Approach	Participants rating 4 or 5 for desirability	Participants rating 4 or 5 for feasibility	Participants rating 4 or 5 for both
1.	Leverage existing ecosystems to share, manage, and reduce infrastructure costs to overcome integration, and cost barriers.	100%	84.6%	84.6%
2.	Adopt permissioned consortium blockchain for trade finance because all members of the consortium will be using the same platform. Permissioned consortium will also address privacy, security, transaction speed, and scalability issues associated with permissionless blockchains.	84.6%	84.6%	84.6%
3.	Use other consensus mechanisms to verify transactions besides proof-of-work like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, proof-of-	92.3%	92.3%	92.3%

	ownership, proof-of-state, and proof-of-history.			
4.	Invest in infrastructure and people that can support technological advancement through access and application of knowledge	100%	92.3%	92.3%
5.	Collaborate across functional teams to utilize the scarce skills in blockchain technology innovation by identifying where those skills are concentrated within the firm through HR.	92.3%	76.9%	76.9%
6.	Blockchain is complex and mission critical, therefore, developers must work with minimum distractions. To improve implementation of blockchain innovations, developers must focus on the task at hand without the added pressure of being expected to work with people across multiple teams.	53.8%	15.4%	15.4%
7.	Collaborate across organizations to form consortiums and benefit from the resources held at the consortium level like skills.	92.3%	53.8%	53.8%
8.	Hold financial resources at the collaboration level because they positively impact innovation compared to a firm's internal financial resources.	61.5%	46.2%	46.2%
9.	Collaborate with other partners to pool resources together to seize the blockchain technological innovation opportunity in time.	100%	61.5%	61.5%
10.	Firms must have slack human resources to participate in a collaborative platform that encourages sharing of ideas and process improvements which is key to blockchain.	53.8%	38.5%	30.8%
11.	Create and invest in innovation labs to test ideas before implementation with the involvement of both internal and external partners.	100%	76.9%	76.9%
12.	Business should participate more than lab as project moves towards implementation because business owns and operationalizes any innovation.	76.9%	53.8%	53.8%

13. Blockchain is decentralized and distributed, therefore, business rarely takes ownership. Lab should always be highly active as this is a technology-based solution and business should assume an active role in the project oversight.	53.8%	53.8%	53.8%
14. Firms must have slack financial resources to innovate.	46.2%	23.1%	15.4%
15. Provide resources to R&D to go towards blockchain technology initiatives.	100%	76.9%	76.9%
16. Leadership support and involvement is a key determining factor in the successful implementation of blockchain technological innovation in the firm.	100%	69.2%	69.2%
17. The leadership of the CEO has a direct influence on innovation.	76.9%	92.3%	76.9%
18. Introduce formal training for blockchain that is customized to close the skills gap within the firm.	100%	84.6%	84.6%
19. Financial resources reflect organizational readiness and are essential components for successful implementation of blockchain innovation.	100%	84.6%	84.6%
20. Talented workers reflect organizational readiness and are essential for successful implementation of blockchain innovation	100%	84.6%	84.6%
21. Technological infrastructure reflects organizational readiness and is essential for successful implementation of blockchain innovation.	100%	76.9%	76.9%
22. Inspire enthusiasm in people by promoting a culture of idea sharing.	76.9%	69.2%	69.2%
23. Reward people for sharing knowledge to encourage them to share more.	100%	84.6%	84.6%

24. Involve all interested employees, keep them engaged, and updated on progress.	100%	76.9%	76.9%
25. Give employees slack time to be creative and find ways to capture the creativity in those employees to improve the outcomes of blockchain technological innovation in the firm.	92.3%	53.8%	53.8%
26. Technological innovation requires constant collaboration, communication, commitment, and dedication of the overall project team to the success of a delivery and continued improvement.	100%	76.9%	76.9%
27. The lack of understanding of how blockchain technology works by top management is what sets firms behind. While training employees on blockchain is useful, training the management teams is critical.	76.9%	61.5%	61.5%
28. Establish a governance group comprised of stakeholders to oversee the improvements and integration in blockchain.	84.62%	53.8%	53.8%
29. Create user software that can run on different blockchain platforms.	92.3%	84.6%	76.9%
30. Customize knowledge acquired from collaborating with external partners like research institutions and academic institutions to suit local circumstances.	92.3%	84.6%	84.6%
31. Establish clear collaboration goals so that practitioners can determine the proper deployment of resources.	92.3%	92.3%	92.3%
32. Partner with internal and external parties to build a self-supporting ecosystem where all members benefit from technology, products, and talent while offering better infrastructure to move banks to innovate more efficiently.	92.3%	69.2%	69.2%
33. Co-create products with customers to increase innovation.	84.6%	30.8%	30.8%

Eighteen of the 33 approaches received a rating of either 4 or 5 for desirability and feasibility from 76.9% of experts. Five approaches, however, scored above 90% in desirability but received meager ratings for feasibility: collaboration across organizations to form consortiums (7); collaboration with other partners to pool resources (9); leadership support and involvement (16); giving employees slack time (25); and partnering with external and internal parties to build self-supporting ecosystems (32).

Following Xu & Zammit (2020), thematic analysis was used to interpret the open-ended responses from participants, i.e., their explanations for ratings of 1 or 2, because this data collection tool sought to access participants' in-depth narratives of facts or opinions. Data analysis for the open-ended responses followed Braun and Clarke's (2006) six-step process as follows: "familiarizing yourself with your data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report" (p. 87).

The process of becoming familiar with the data involved extracting the raw data into a table to organize it in a way that made it easier to analyze. The data gathered from the Round 2 survey was categorized into three groups: technology, organization, and environment, which also served as its initial codes. The main ideas in all categories were highlighted in yellow to reveal a pattern. Searching for themes involved comparing responses to identify a pattern that could give meaning to the data. Seven themes emerged from Round 2 of data collection and analysis (see Table 4). These themes were reviewed against the original categories. The keywords used by the participants in their responses helped define and name the themes. The final step in the coding process involved producing the report to summarize the themes captured in Table 4. Most comments explained why an approach was not feasible, often specifically in the banking sector. Details will be covered in the results section.

Table 4

Major Themes from Round 2 Comments

Major themes	Comments
Silo organizational structure in banking	3
Collaboration challenges	10
Technology team versus business team	8
Financial resources	4
Incentives and employee engagement	3

Leadership	2
Innovation labs	5

Round 3 – Data Collection and Analysis

On October 13, 2021, the Round 3 survey was emailed to participants. The participants ranked the 18 approaches identified as feasible and desirable in Round 2 in order of importance, with 1 being the most important. Each rank was attributed a corresponding score; a ranking of 1 had a score of 5, a ranking of 2, a score of 4, a ranking of 3, a score of 3, a ranking of 4, a score of 2, and a ranking of 5, a score of 1. Items that did not make a participant's top five scored zero. The 13 approaches that did not meet the criteria for consensus in round 2 were excluded from this data collection tool. All participants responded within 23 hours, and the survey was closed on October 14, 2021. It took an average of five minutes for participants to complete the survey.

Data were analyzed using Excel. The scores were added and divided by 13, the number of participants in the third round, to find the weighted average score. Table 5 summarizes the full results of Round 3, sorted by category

Table 5

Round Three Results Sorted by Category

Category	Approach	Weighted average
Technology	1. Leverage existing ecosystems to share, manage, and reduce infrastructure costs to overcome integration, and cost barriers.	2.92
	3. Use other consensus mechanisms to verify transactions besides proof-of-work like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, proof-of-ownership, proof-of-state, and proof-of-history.	1.31
	4. Invest in infrastructure and people that can support technological advancement through access and application of knowledge.	1.00
	2. Adopt permissioned consortium blockchain for trade finance because all members of the consortium will be using the same platform. Permissioned consortium will also address privacy, security, transaction speed, and scalability issues associated with permissionless blockchains.	0.31

Organization	11. Talented workers reflect organizational readiness and are essential for successful implementation of blockchain innovation	1.85
	7. Provide resources to R&D to go towards blockchain technology initiatives.	1.46
	5. Collaborate across functional teams to utilize the scarce skills in blockchain technology innovation by identifying where those skills are concentrated within the firm through HR.	1.23
	15. Technological innovation requires constant collaboration, communication, commitment, and dedication of the overall project team to the success of a delivery and continued improvement.	0.85
	9. Introduce formal training for blockchain that is customized to close the skills gap within the firm.	0.77
	13. Reward people for sharing knowledge to encourage them to share more.	0.62
	8. The leadership of the CEO has a direct influence on innovation.	0.38
	6. Create and invest in innovation labs to test ideas before implementation with the involvement of both internal and external partners.	0.31
	14. Involve all interested employees, keep them engaged, and updated on progress.	0.31
	10. Financial resources reflect organizational readiness and are essential components for successful implementation of blockchain innovation.	0.23
	12. Technological infrastructure reflects organizational readiness and is essential for successful implementation of blockchain innovation.	0.23
Environment	16. Create user software that can run on different blockchain platforms.	0.69

18. Establish clear collaboration goals so that practitioners can determine the proper deployment of resources.	0.54
17. Customize knowledge acquired from collaborating with external partners like research institutions and academic institutions to suit local circumstances.	0.00

Round 4 – Data Collection and Analysis

The Round 4 survey was emailed to all 13 participants on October 14, 2021. Participants received the list of the top five approaches with weighted scores generated in Round 3 (see Table 6). They were asked to review and rate their confidence in the findings on a five-point Likert-type scale (1 being "very unreliable" and 5 being "very reliable") as well as express their general opinions through an open-ended question: "In this round, your role is to express your confidence in the results of this project presented on a five-point Likert-type scale as follows 1 (very unreliable), 2 (unreliable), 3 (neutral), 4 (reliable), 5 (very reliable). Please support your confidence rating in the space provided." All participants had responded by October 15, 2021, and it took an average of five minutes for respondents to complete the survey.

Table 6

Round 3 Top Five Approaches

Approach	Weighted average
1. Leverage existing ecosystems to share, manage and reduce infrastructure costs to overcome integration and cost barriers.	2.92
2. Talented workers reflect organizational readiness and are essential for the successful implementation of blockchain innovation	1.85
3. Provide resources to R&D to go towards blockchain technology initiatives.	1.46
4. Use other consensus mechanisms to verify transactions besides proof-of-work like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, proof-of-ownership, proof-of-state, and proof-of-history.	1.31
5. Collaborate across functional teams to utilize the scarce skills in blockchain technology innovation by identifying where those skills are concentrated within the firm through HR.	1.23

Round 4 Data Analysis

Following Lemon & Hayes (2020), participants in Round 4 received the list of the five approaches from Round 3 and rated their confidence in these approaches on a five-point Likert-type scale to establish the study's credibility. The quantitative data were analyzed using Microsoft Excel, expressed as a percentage. A single participant (7.7%) rated the findings as unreliable. The rest of the participants rated the finding as reliable 38.5% (n=5) and very reliable 53.8% (n=7). Respondents were also allowed to share their opinions on the rating in an open-form question, and their responses will be covered in the results section.

Results

Participants rated 18 of the 33 approaches as desirable and feasible in Round 2. The rest of the approaches failed for multiple reasons. The silo organizational structure in the banking industry was seen as an impediment to collaborating within functional units. Collaboration, in general, raised several issues, including intellectual capital, trade secrets, and difficulty in implementation. Another concern was the ownership of innovations, where some thought operationalization should be left to business, and others thought it should remain with technology. Practitioners must not wait until they have slack in financial resources to innovate. The incentives that employees expect could be financial, which is not feasible. Also, giving employees slack time is not feasible because everyone's schedule is full.

The participant that rated the findings from Round 3 as "unreliable" commented that they disagreed with the weighted importance on the list of shared infrastructure over training employees and allocating funding for blockchain projects. Specifically, the participant argued that infrastructure is no longer the main priority with recent developments in a cloud-based architecture.

The dozen other participants were confident in the reliability of the findings to varying degrees and for different reasons. In particular, 69% of the participants cited people or talent as the reason for their confidence. 61% of the participants mentioned leveraging existing infrastructure as a key factor in their confidence. Infrastructure with tried-and-tested processes is already in place; therefore, practitioners must determine how their firms could benefit. Identifying the proper infrastructure will require expertise, so practitioners must depend on people and talent to acquire the best solution for the firm. Existing infrastructure will quicken the process and move firms to the implementation phase. Three of the experts used the opportunity of the open-ended question to emphasize the importance of investment in R&D for blockchain technology, precisely because it is a relatively new field. Financial resources and collaboration were each flagged by 23% of participants as critical for blockchain technological innovation in trade finance. One person who rated the overall reliability of Round 3's findings as "reliable" expressed their lack of confidence that collaboration in banking is only feasible on paper. Table 7 provides a comprehensive list of participants' open-ended comments collected in Round 4.

The following are excerpts from two comments about the importance of blockchain technology:

This isn't just a technology upgrade, and it's not really about finance. Blockchain technology will change how everything around us works and how we interact with the world. Just like when the Internet

went commercial, those who moved fast and adopted survived. Those who couldn't move quickly are no longer with us. (Participant A)

Blockchain is the banking of the future. While early adopters have a chance of leveraging first-mover advantages, latecomers will have the advantage of riding on established infrastructure and tried and tested processes. (Participant B)

Despite self-identifying for the study, none of the participants thought blockchain was just a fad. This project supports that blockchain is worth pursuing even if these barriers remain. If bank practitioners cannot eliminate the barriers, they should find a way to work around them to move forward. All the experts thought that executives should do more to ensure their businesses are prepared for the new reality that is already here. The full comments and the rest of the submissions are in Table 7 for further review.

Table 7

Open-Ended Responses to Round Four

Confidence rating	Support for the confidence rating
Unreliable	• *Shared infrastructure is no longer a #1 priority in cloud-based architecture—who in the world ranked this above all others. Focus should be given to training employees and obtaining sufficient budget.*
Reliable	• *It first focuses on the costs and the training of people before anything else.* • *Blockchain is the banking of the future. While early adapters [*sic*] have a chance of leveraging first-mover advantages, late come [*sic*] will have the advantage of riding on established infrastructure and tried-and-tested processes.* • *Confident because approaches are not only desirable, but also feasible. The approaches also cover systems, people, and processes.* • *If existing systems can be used as a base for development and enough money/resources are put into this space, it is likely that any financial firm can be successful with blockchain.* • *I support these findings and would rate them as reliable. It takes talent + drive + resources to innovate and move the needle forward and implement blockchain. Leveraging existing frameworks can lower the number of resources and greenfield development, but it still takes a dedicated line item in the budget and knowledgeable people with prior expertise. The only item which I find someone [*sic*] unreliable is the cross-functional teams. I have spoken about this in the past, with how difficult this can be in the real world. Different groups have different priorities, resources, and reporting hierarchy, which adds layers of complexity and bureaucracy, and ultimately slows down the process.*

Very reliable	• *The findings are very reliable. I find the ranking of the approaches reasonable and believe that all the approaches listed out are feasible and highly desirable. Additionally, I find these findings reliable because they collectively cover the key considerations with regards to innovation—HR/talent, financing, and operational risk.* • *Very confident with the outcome of this study due to the following reasons: a) Practitioners at banks must not waste resources building new ecosystems, but find ways to utilize or improve existing ones in ways that benefit the banks and other partners of the ecosystem. Doing so will enable banks to embrace blockchain quicker than starting from scratch. There is no need to reinvent what is already in existence. b) Investing in people is key in any strategic initiative. Talented and skilled human resources are a key component in the successful launch of blockchain technological innovation in trade finance. People may need to be trained or retrained and having people with those skills will put the firm at a competitive advantage. c) Investing in R&D is crucial for any company that is serious about innovation, let alone blockchain innovation. Banks should have a budgetary allocation for R&D specific for blockchain to avoid trailing other industries. d) [Proof-of-work] has caused enough environmental issues, and other consensus mechanisms must be explored. e) Collaboration of any kind is important and should never be trivialized. That is why my confidence level with the results is 'very reliable.'* • *I am confident with the process and the results. The approaches can help overcome barriers to adopting blockchain innovation. The three categories of organization, technology, and environment are all represented, so this is balanced.* • *Henry Ford didn't build both the road and the cars to ride on them. There are some fantastic blockchain ecosystems out there to build on. The best thing would be to leverage one of them; otherwise, you are just building another road. There are many excellent consensus mechanisms besides proof-of-work. For example, Cardano and Polkadot are using the same proof-of-stake algorithm. Ethereum will also be moving to proof-of-stake soon. The issue with Ethereum is the gas fees. Polygon and a few other layers two protocols for the Ethereum blockchain can elevate the gas fee issue, scale, and add security, among features. Talented workers, R&D resources, and cross-functional team collaboration are always a plus. However, none of those things will matter without support from senior management and the CEO. This isn't just a technology upgrade, and it's not really about finance. Blockchain technology will change how everything around us works and how we interact with the world around us. Just like when the Internet went commercial, those who moved fast and adopted survived. Those who couldn't move quickly are no longer with us.* • *The approaches are holistic and not focused on one area. The technological barriers will be addressed by leveraging existing ecosystems. The solutions also place importance on talent and skill development which is critical for*

the success of blockchain implementation. Blockchain is new, so more resources are needed in R&D to ensure we keep exploring new things including consensus mechanisms. Collaboration is key to succeeding because the person with the right skill may be in the wrong department.

- *The approaches listed above seem feasible and are very desirable to ensure the long-term success and growth in blockchain within the banking sector.*
- *This [is] very reliable because [these] are things that allow blockchain Technology to thrive in our world today.*

Findings and Discussion

The project questions were as follows:

> **PQ1**: What are the forward-looking approaches to overcoming barriers to adopting blockchain innovation in trade finance within U.S. banks, as identified by a nationwide panel of blockchain implementation experts?
>
> **PQ2**: Is there consensus among a nationwide panel of blockchain implementation experts regarding the desirability and feasibility of specific forward-looking approaches to overcoming barriers to adopting blockchain innovation in trade finance?

All the project questions were addressed. The experts were confident with the findings, with 92.3% rating the findings as either reliable or very reliable. Below is an overview of the top 10 approaches and a comparison between the findings of this project and existing literature.

Catalini and Gans (2019) suggested creating ecosystems and shared platforms to share, manage, and reduce infrastructure costs. The experts disagreed with creating new ecosystems because several are already in place. The experts rephrased the approach: Leverage existing ecosystems to share, manage, and reduce infrastructure costs to overcome integration and cost barriers. This adapted approach got the highest ranking. Experts' comments indicate that practitioners must not waste resources trying to create new infrastructure but must leverage what is already in place to move quicker (see Table 7).

"Talented workers reflect organizational readiness and are essential for successful implementation of blockchain innovation" was ranked highest by the experts in the organization category and second overall. The experts also ranked eighth the approach of introducing formal training for blockchain customized to close the skills gap within a firm. Malhotra et al. (2017) emphasized the importance of human resources as a source of innovation. The experts also stressed the importance of talent, skills, HR, and training to overcome the barriers.

Firms with well-resourced R&D were more likely to adopt blockchain technology than those with limited R&D resources (Beck and Müller-Bloch, 2017; Clohessy & Acton, 2019). The experts highlighted that blockchain technology is still new, so more R&D resources must be allocated specifically for blockchain. The experts ranked this approach number three.

Several platforms use proof-of-work as a consensus mechanism to confirm a transaction and create a new block, but this technological process consumes excessive electricity, which raises environmental concerns. Aggarwal and Kumar (2021) listed other consensus mechanisms to consider like proof-of-stake, proof-of-retrievability, proof-of-burn, proof-of-capacity, proof-of-activity, proof-of-importance, proof-of-elapsed time, and proof-of-ownership to deliver the same results. The experts added proof-of-state and proof-of-history to the list. The approach was ranked fourth.

Studies identified collaboration across functional teams as critical for blockchain technology because of the scarcity of skills (Beck and Müller-Block, 2017; Malholtra et al., 2017). One expert was unsure if the cross-functional aspect would work in the banking industry, and some experts raised questions about ownership rights over collaboratively developed technology and trade secrets. Nevertheless, all but one expert believed that collaboration was feasible, and the approach was ranked fifth overall.

"Investment in infrastructure and people that can support technological advancement through access and application of knowledge" was ranked sixth as an approach. "Technological innovation requires constant collaboration, communication, commitment, and dedication to the project team to delivery and continuous improvement" ranked seventh. The experts emphasized that robust technology alone (without investing in people) will not work and emphasized how the project team environment should offer structured opportunities for talented employees to learn through internships to gain skills.

One surprising find was a lack of prioritization of standardization by the experts. Standardization was the only approach to appear in two categories, and its lack has been flagged explicitly by the World Bank as a significant barrier. Although the experts did include "create user software that can run on different blockchain platforms" on the list, its ninth place was not consistent with the extant literature.

Rewarding people for sharing knowledge to encourage them to share more ranked tenth; here, the experts also placed real caveats on the scholarly recommendations. The main concern was that employees usually expect monetary rewards, which may not be ideal in a business environment.

Project Application and Recommendations

This study may benefit banks in trade finance and other related businesses like supply chain management and insurance firms. The project findings show how practitioners could start implementing blockchain innovation in trade finance at U.S. banks. Though the study was limited to U.S. banks, the principles apply to all banks involved in trade finance.

Practitioners do not have to overcome all barriers to implement blockchain innovation in trade finance (Hekkert et al., 2007). Several "quick wins" are low-hanging fruit within a firm's control. Moreover, many of the approaches are related and support each other. For example, five approaches have human resources, talent, skill, or training elements, meaning 50% of the top ten desirable and feasible approaches can be achieved through HR initiatives. Future research could focus on how practitioners can help develop employees' skills to support blockchain technology development and improve

collaboration in the banking industry. Though some approaches were desirable, they were deemed unfeasible due to the nature of the silo organizational structure in the banking industry.

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