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A transaction cost perspective on blockchain governance in global value chains

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Abstract

This study advances theoretical insights into blockchain adoption in the context of global value chains from a transaction cost theory perspective. The research has adopted an exploratory qualitative approach using the Netnography method to scrutinize the case of TradeLens—a thriving blockchain-enabled ecosystem that Maersk and IBM jointly developed. This study applies textual and audiovisual data from company websites and social media. Our findings indicate blockchain technology's salient and strategic relevance in streamlining business processes, improving efficiency, enhancing visibility, transparency, and traceability for value creation in the global value chains. This investigation supports the notion that blockchain, as a disruptor, will transform global trade with the digital tools to share real-time information and collaborate security to reduce search and information cost, policing and enforcement cost in global economic transactions and administrative friction in trade. In contrast, the bargaining cost will increase if the information for the transaction is hard to verify where human actor intervention will be required, implying relatively higher designing costs in codifying the agreements in smart contracts.

KEYWORDS
blockchain, ecosystem, global value chain, governance, platform-based business model

JEL CLASSIFICATION
L14, L16, M15, M16

1 | INTRODUCTION

Over the last several decades, global economic activity has changed significantly due to trade and investment liberalization, the rise of emerging economies and advancement in technologies (Kano, 2018). These factors have enabled multinational enterprises (MNEs) to operate and compete in the world economy with fragmented and geographically dispersed international business activity to offshore production sites in low-cost developing countries to pursue margin improvement (Kano, Tsang, & Yeung, 2020). Over time, these firms have evolved from vertically integrated organizations to network orchestrators that coordinate geographically dispersed economic activities through global value chains (GVCs) (McWilliama et al., 2020). The latest global trade update from United Nations indicates the whole global trade is expected to continue growing into 2021. It is predicted that the value of global trade in goods and services is expected to reach $6.6 trillion in Q2 2021 (UNCTAD, 2021). GVCs are increasingly attracting the attention of academics, practitioners and policy makers on innovations at multiple levels to focus on the sustainability-related elements of upgrading (De Marchia

et al., 2020). GVC concepts and activities have helped companies understand and assess value creation patterns given the global production and labor division. The literature on GVCs focuses on the decisions on its configuration such as location, the chosen governance modes, the ways of coordinating those activities (Hernández & Pedersen, 2017).

However, GVCs have grown in strength and complexity as firms expanded across the world to seek specialization and economies of scale that bring productivity gains and lower production costs (Andrews, Gal, & Witheridge, 2018). Most recently, companies are rethinking how they operate due to the rising phenomenon of digitization accelerated by many disruptive trends in terms of advancement in technologies and the shift toward more digital ways of working, communicating, and transacting with customers (PWC, 2020). In addition, the current pandemic has illuminated underlying vulnerabilities in the GVCs that drive economies worldwide, and it is suggested that the paradigm behind the GVCs needs to be re-assessed (Silverthorne, 2020). It is noted that GVCs may undergo certain reconfiguration in the post-pandemic world, including strategic supply chain diversification (Gereffi, 2020; Verbeke, 2020), structural changes to GVCs in the realm of managerial/strategic governance (Kano & Oh, 2020).

The current intricate global production networks were designed for efficiency, cost and proximity to the market but not necessarily for resilience or transparency (Lund et al., 2020). The recent survey conducted by Cointelegraph Consulting and Insolar reveals that 60% of firms in Western Europe overpay their supply chain vendors; 70% of them have visibility gaps between initial supplier and internal clients' systems, making traceability very difficult or impossible. A further study shows that 80% of enterprise data is prone to reduced integrity as information is not always up to date from some parties, and some data may be hidden (Wood, 2019). CEOs across the globe are seeking new ways to reconfigure their operations with new technological tools to create value across every industry from finance, manufacturing, government, healthcare, logistics, and retail (PWC, 2020). Many companies have turned blockchain into a solution to the increased call for transparency and traceability in many GVCs to enhance sustainability (Tröster, 2020). Blockchain technology is increasingly gaining attention from scholars (Biais, Bisière, Bouvard, & Casamatta, 2019; Brennan, Subramaniam, & van Staden, 2019; Cong & He, 2019; Goldstein, Jiang, & Karolyi, 2019; Gomber, Kauffman, Parker, & Weber, 2018; Hinings, Gegenhuber, & Greenwood, 2018; Iansiti & Lakhani, 2017a, 2017b; Kumar, Liu, & Shan, 2019; Moll & Yigitbasioglu, 2019; Ølnes, Ubacht, & Janssen, 2017; Yermack, 2017; Yin et al., 2019; Zachariadis, Hileman, & Scott, 2019). Most recently, the study of Hastig and Sodhi (2020) seeks to guide operations management research on the implementation of blockchain for supply chain traceability by identifying business requirements and factors critical to successful implementation. The study of Toufaily, Zalan, and Dhaou (2021) proposes a framework of blockchain technology adoption, illuminating the expected social-economic values of blockchain adoption at the ecosystem level from a multi-stakeholder perspective and the environmental, organizational, and technological challenges associated with blockchain adoption. Platform-based ecosystems enable the existing firms to develop dynamic capabilities for value co-creation (Siaw & Sarpong, 2021). From an organization science perspective, the recent study of Lumineau, Wang, and Schilke (2021) advances blockchain governance as a new way of organizing collaborations to achieve both cooperation and coordination. Ziolkowski, Miscione, and Schwabe (2020) pay special attention to the governance of blockchain systems in open and inter-organizational settings and illustrate decision problems in blockchain applications in the land registry, supply chain, cryptocurrency, and IPR.

The most recent review article by Toufaily et al. (2021) published at Information and Management Journal indicates that scholarly literature on blockchain technology is mainly conceptual. The number of business-related qualitative or quantitative research is limited; theory-driven empirical research on blockchain-related phenomena is generally scarce. These findings are broadly consistent with other studies such as Angelis and Ribeiro da Silva (2019), Lo et al. (2019), and Janssen, Weerakkody, Ismagilova, Sivarajah, and Irani (2020). The lack of empirical studies on this new phenomenon suggests case studies are certainly needed to help understand the complex issues of blockchain adoption within business context to uncover embedded insights (Du et al., 2019; Moll & Yigitbasioglu, 2019) and advance theoretical understanding of the disruptive nature of blockchain technology in transforming the contemporary businesses models and processes (Brennan et al., 2019). Businesses are still at an early stage of understanding and evaluating the potential value and possible use cases with blockchain technology. As predicted by some industry stakeholders, mass-market adoption is expected in approximately 5 years (BEIS, 2020).

As such, the main motivation of this article is to advance transaction cost theory in the context of blockchain governance in facilitating global collaboration as a new way of achieving cooperation and coordination, simplifying the business process, driving new value creation in GVCs. In addition, the study is also motivated by the following three rationales. First, businesses face new challenges of maintaining visibility into the origin, authenticity and handling of products due to unprecedented complexity in GVCs and the ever-changing consumer behaviors and expectations in ethical or ecological practices in production (BEIS, 2020). Second, technological advancement has accelerated the digital economy, which unlocks new opportunities for value creation and captures in different ways to transform value chains (UNCTAD, 2019). Digital technologies such as blockchain can simplify trade in goods, facility service trade and enable new services to emerge (WTO, 2018). The recent PwC's "Time for trust" report predicts blockchain technology has the potential to add $1.7 trillion to the global economy by 2030 and enhance 40 million jobs globally by 2030. The report also indicates that between 10 and 15% of worldwide infrastructure will use blockchain within a decade (PWC, 2020). Gertner predicts the business value of blockchain will reach more than $3 trillion globally in 2030 (Gartner, 2018; UNCTAD, 2019; WTO, 2018). Third, the demand for container freight transport is projected to grow significantly as the world develops. Most global traded goods are transported by container shipping. The value of container shipping is estimated to increase $5.2 trillion per year by 2050 if global actors work together and scale digitization and exchange to

replace paper-based trade and manual document handling that traps around 15% of the value of containerized freight (TradeLens, 2021). Supply chains are becoming more integrated with multiple value chain partners in the increasingly digital marketplace (Schrauf et al., 2020).

Based on these observations, the purpose of this study is to explore how businesses can harness and leverage the capabilities of a blockchain enabled the platform-based ecosystem to help govern the GVC in the digital economy using the case study of TradeLens from a transaction cost theory perspective. Our study intends to fill the gap to provide business-related qualitative research based on empirical evidence. TradeLens is a blockchain-enabled digital platform jointly developed by Maersk and IBM in concert with the shipping industry. It represents the successful use case of blockchain technology in facilitating global collaboration across supply chains to enhance innovation and promote efficiencies in global trade using real-time data gathering across the supply chain and smart analysis.

Our findings provide three key contributions to research on technological impact in digitalization facilitated and enabled by blockchain technology in the context of GVCs in driving container logistics. First, this study advances the theoretical understanding of the new phenomenon of blockchain application in GVCs using blockchain platform-based ecosystem to boost innovation, gain efficiencies in global trade through digitalization from transaction cost theory perspective to enhance value creation. Second, this research illuminates the empirical and theoretical insight into blockchain technology's salience and strategic relevance in addressing the transparency and traceability issues faced by sustainability concerns in the contemporary GVC. Third, this article contributes to the advanced governance dimension of GVC literature using blockchain technology to govern the flow of real-time information between global actors to enhance global collaboration in value chains.

After articulating the research's purpose, motivation, and the context in the introduction, this study presents the relevant literature review in Section 2. Section 2.1 examines GVC governance. Following that, Section 2.2 notes the blockchain solution to transparency and traceability in the GVC. Section 2.3 outlines the digitalization and transaction cost theoretical lens on GVCs. Section 3 details the qualitative case study approach adopted by this investigation using Netnography (an online research method). Then, the article marshals the findings and presents these in a research framework in Section 4. Finally, Section 5 provides a detailed discussion on the theoretical and practical implications of the study, specifies limitations and outlines opportunities for further research.

The insights of this investigation intend to be utility to academics, policy makers, and industry actors in GVCs to help understand how business can build resilience on accurate end-to-end visibility and boost value creation in the era of digital transformation.

2 | LITERATURE REVIEW

This section of this study presents extensive literature review on GVC governance, and the salient relevance of blockchain technology in enhancing transparency and traceability in product provenance to promote sustainability in GVCs, and strategic relevance of blockchain governance in managing and organizing global collaborations within its platform ecosystem to create value through expanded network.

2.1 | GVC governance

The most important features in the world economy are the globalization of production and international trade. The increasingly fragmented economic activities in international trade and industrial organization can be coordinated in the notion of a value-added chain in a global scale (Gereffi, Humphrey, & Sturgeon, 2005). The lengthening value chains indicate firms' strategic decisions to outsource productions to the lowest overall costs locations, enabling finer division of labor and more significant gains from specialization across countries (Silverthorne, 2020).

The concepts and activities of GVCs define how firms organize economic activities such as commodity chains, supply chains, and value networks (Hernández & Pedersen, 2017). GVCs have attracted much attention from multidisciplinary research in international business, general management, supply chain management, operations management, economic geography, regional and development studies, and international political economy (Kano et al., 2020; McWilliama et al., 2020). To date, scholarly literature on GVCs has focused on the concept of GVCs and their activities and the strategic decisions involved in its configuration on chosen location, governance modes, and coordinating methods (Hernández & Pedersen, 2017). Gereffi (1994, 1995) has identified four dimensions for GVCs: (a) an input–output structure, which describes the process of transforming raw materials and other inputs into final products; (b) geographical configuration, which describes the geographical scope; (c) a governance structure, which describes top-down or bottom-up view of GVCs; and (d) institutional framework, which describes the "rules of the games" on the organization and operation of GVCs.

According to De Marchia et al. (2020, p. 3), the surge of GVC literature dates back to the scholarly work by Gereffi and Korzeniewicz (1994). They introduced buyer-driven and producer driven commodity chains, which can be used to explain the integration of trade and disintegration of production in the global economy (Feenstra, 1998). The commodity chain provides an alternative view to a trade-based framework to explain fragmented economic activities on a global scale (Bair, 2009). The global commodity chains framework helps global actors to understand the coevolution of the cross-border industrial organization via networks (Gereffi et al., 2005), like the "modular production networks" introduced by Sturgeon (2002) to add or subtract competent suppliers from the global production arrangements on an as-needed basis. Driven by the growing attention on value creation, the work of Gereffi and Lee (2012) explains why the world suddenly cares about global supply chains. Since then, Global commodity chain concept was modified and enriched to become GVC. Examples of value chains are

established in textile and apparel, electronic goods, automobiles, or processed foods (Tröster, 2020).

Gereffi and Fernandez-Stark (2011, p. 4) define the GVCs as "the full range of activities that firms and workers perform to bring a product from its conception to end use and beyond." The study of Gibbon et al. (2008, p. 318) refers to GVCs as "the set of intra-sectoral linkages between firms and other actors through which this geographical and organisational reconfiguration of global production occurs. As a critical infrastructure of economic globalisation, GVCs can be thought of as the integrative counterpart to the current processes of geographical dispersion, economic specialisation and differentiation and risk externalisation." Cattaneo et al. (2010, p. 7) describe GVCs as "the world economy's backbone and central nervous system." Kano (2018) notes that GVCs have transformed the global marketplace from trading in goods to trading in activities. GVC literature defines "a theory managing externalisation in a global context" (De Marchi, Di Maria, & Ponte, 2014, p. 465).

Following the seminal work of Gereffi et al. (2005), who have developed a theoretical framework to help explain governance patterns in GVCs. The GVC literature begins to bloom, focusing on how value can be created, captured and distributed along with different forms of global interfirm networks that help corporations and countries understand and assess value patterns in GVCs (Bair, 2009; Cattaneo et al., 2010). For example, firms that successfully implemented a global lean manufacturing model have captured more value through improvement in inventory levels, on-time-in-full deliveries and shorter lead times (Lund et al., 2020). The GVC literature also focuses on the power of leading firms to decide the conditions on how, where, when, and by whom value is added and appropriated for thriving in their GVCs governance (Dallas, Ponte, & Sturgeon, 2019; De Marchia et al., 2020). International policy makers have extensively adopted the GCV framework to inform sustainability and inclusive development policies in GVCs (De Marchia et al., 2020; Gereffi, 2019; Li, Frederick, & Gereffi, 2019).

GVC governance has received the most attention in scholarly works in GVCs to help firms understand how to gain access to global markets and participate in GVCs (Gereffi, 1994; Gibbon et al., 2008; Kano, 2018; Kano & Oh, 2020). Governance is one of the cornerstone concepts in GVCs (De Marchia et al., 2020), which defines the "authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain" (Gereffi, 1994, p. 97). It refers to "the institutional and regulatory arrangements shaping interactions between the production network and the external environment" and "the organisation and control of GVCs" (McWilliama et al., 2020, p. 1). The goal is to coordinate the relations between various actors in a value chain to manage and direct the practices and organizational forms in global industries (Gibbon et al., 2008).

Based on the streams of transaction costs, economics, production networks, technological capability, and firm learning literature, Gereffi et al. (2005) have developed a theoretical framework that explains how GVCs are governed and changed. They have identified three variables (the complexity of the interfirm transactions, the ability to codify transactions to mitigate complexity, and the capabilities in the supply-base to meet buyer's requirements) in determining the types of GVC governance. Their work outlines five analytical types of GVC governance: hierarchy, captive, relational, modular, and market—which range from high to low levels of explicit coordination and power asymmetry (P78). The market form of governance relies on a low level of coordination and control, while the hierarchy form of governance characterized by vertical integration requires high level of coordination and control. Modular, relational, and captive forms of governance rely on intermediate levels of coordination and control (Gereffi et al., 2005; Hernández & Pedersen, 2017; Sturgeon, 2002). The mode of governance needs to ensure quality criteria and conventions are met in the complex, fragmented, and geographically dispersed production processes to coordinate and manage the diverse activities (Tröster, 2020). Gibbon et al. (2008) have reviewed three main interpretations of GVC governance that have been advanced: governance as driving, coordination and normalization. The initial approach of governance "as driving" identifies that the led firms, either buyers or producers, can exert power to influence the evolution of the entire industry on rules and standards (De Marchia et al., 2020; Gereffi, 1994; Gibbon et al., 2008). Since the mid-2000s, the governance attention has shifted toward coordination to help understand the different forms of integration and coordination of dispersed global economic activities. Sturgeon's (2002) concept of modular value chains explains the network relations between lead firms and turn-key suppliers. Further, based on convention theory—"sets of mutual expectations that draw on a variety of criteria of justice or worth in order to lend normative sense to decision and actions occurring concerning management, production and consumption" (Gibbon et al., 2008, p. 325), Scholar works examine the dynamics of buyer–seller relations in wider normative context to govern a value chain to ensure quality criteria and conventions are met. Overall, the GVC governance literature provides useful insights to advance existing theories of power and control in MNEs (De Marchia et al., 2020).

Most recently, GVCs are experiencing unprecedented changes due to the recent pandemic (Gereffi, 2020; Verbeke, 2020) and the rising phenomenon of digitalization (UNCTAD, 2019). The recent study of Kano and Oh (2020) indicate that digitalization and global flows of data unlock new opportunities for multifaceted value creation in GVCs. They predict some structural changes to GVCs in managerial/strategic governance. Li et al. (2019) denote that digitalization will help reduce the barrier for global actors to upgrade to high-value segments of GVCs through strategic innovations. Now we live in a world where disruptions occur regularly (Lund et al., 2020). Organizations need to be agile and innovative to respond to the changing business environment and customer demands or disadvantage themselves in the fast-moving digital GVCs (Sturgeon, 2019). Silverthorne (2020) suggests that post pandemic global production networks shall become more diversified and rely on trusted nodes to enable higher transparency in data sharing to track the chain of subcontractors. Indeed, some corporations are already beginning to simplify their global

supply chains, to focus on external integration and end to end orchestration, with some digital champions who successfully transformed their business model and processes using innovative technologies, have already achieved saving of 6.8% annually in supply chain costs, along with a 7.7% revenue increase. Smart logics account for more than 50% of overall supply chain cost savings (Schrauf et al., 2020).

2.2 | Blockchain solution to transparency and traceability in GVC

Over the past few decades, the increased volumes of global trade have led to unprecedented complexity in GVCs that links suppliers, manufacturers, transporters, wholesalers, retailers, banks, trade organizations, systems, contracts, processes, and technology underlying global trade, which cause concerns on disruptions, work conditions, child labor, delays, inefficiencies, or even fraud (BEIS, 2020). For example, in the pharmaceutical industry, up to $200 billion is lost due to counterfeit medicines each year (Jones, 2021). Businesses face challenges tracing the provenance of the components or raw materials used in the fragmented global production processes. In addition, consumers are changing their preference on the ethical and ecological practices in the products they purchase, which challenges the sustainable sourcing practices in GVCs (BEIS, 2020; Hastig & Sodhi, 2020). Many businesses turn their attention to transparency, visibility and traceability to enhance trust in the supply chain (Sodhi & Tang, 2019) to connect the global actors in ecosystems to foster collaboration and spur innovation to capture more values in GVCs in the digital era.

Modern supply chains demand a better solution to combat current pain points of manual document handling, poor visibility, after-the-fact audits, inconsistency in record-keeping requires reconciliation, which is expensive, time-consuming, and error-prone (Microsoft, 2018). The need for secure and trusted supply chains with end-to-end visibility propels blockchain (Jones, 2021). Blockchain innovation can help achieve global sustainability in value chains (Kewell, Adams, & Parry, 2017).

Recently, scholarly interest in blockchain technology has been booming because it promises to be a disruptive technology that can transform industries with excellent efficiency and transparency (Ziolkowski et al., 2020). It is expected to be as revolutionary as the Internet (Tapscott & Tapscott, 2017). It is regarded as the fifth disruptive computing paradigm (Swan, 2015), or the fifth pillar of the IT revolution after mainframes, personal computers, the Internet and mobile/social media (Thakkar, 2019). Blockchain is underpinned by five basic principles: distributed database, peer-to-peer (P2P) transmission; transparency with pseudonymity; irreversibility of records and computational logic (Iansiti & Lakhani, 2017a, 2017b, p. 125). Hinings et al. (2018: 55) provides a detailed explanation of blockchain technology. They outline the key elements of blockchain technology are "data integrity and security (for example, no central institution that can be hacked), platform governance (for example, achieving agreement within the peer-to-peer network whether another row should be added to the spreadsheet), transparency (for example keeping accessible records of all transactions with a time-stamp), database maintenance (for example providing incentives to the crowd to donate computational power to maintain the database), and smart contracts (for example automatic execution of transactions if both exchange parties meet specific pre-defined criteria)."

Blockchain can transform supply chains to create more value in GVCs. The innovative technology offers potential solutions to the contemporary supply chain problems to foster trust in inter-organizational business collaboration to contribute significant business values (Hastig & Sodhi, 2020; Kumar et al., 2019; Sodhi & Tang, 2019). Blockchain provides new ways of recording, updating, validating, and sharing digital transparent records to participants in a decentralized manner to enhance trust based on consensus mechanisms. It is proven that blockchain technology has enormous potential in product provenance to combat counterfeits, prove sustainability credentials, and promote food or product safety (Jones, 2021). Blockchain enables transparency in validated product provenance information to ensure a reliable product authenticity and safety record to promote sustainability in value chains. The information stored on the blockchain provides an immutable trace of metadata on the origin and use of raw materials throughout production and transactions (Tröster, 2020). The technology is uniquely positioned to help create trust, transparency and accountability in supply chains to track asset's status in real time, and bring greater visibility for producers, consumers and end retailers (Microsoft, 2018). Companies such as Walmart, Kroger, Cargill, Coca-Cola, Carrefour, COFCO International Ltd, Starbucks (Addison et al., 2019) are embracing blockchain technology in their supply chains to track and trace the provenance of their products, materials, and services to gain efficiency, cost savings and capture more values in their value chains.

In addition, the great features of blockchain enable the technology to become a governance mechanism to facilitate and organize collaborations between different stakeholders in a platform ecosystem to codify and validate transactions (Lumineau et al., 2021). With blockchain technology, the business and transaction logic for every type of commerce could potentially change to enable digital assets to be managed or transacted securely and privately, people and organizations can trust each other directly without intermediaries by cryptography, collaboration, and some clever code (Tapscott & Euchner, 2019).

2.3 | Digitalization and transaction costs on GVCs

Transaction costs play a crucial role in finding an efficient economic entity and its decision boundary in addition to the production costs of goods. Transaction cost theory fundamentally analyses economic efficiency within the process of product or service exchange through the market (Coase, 1937). Williamson (1975) proposed three determinants of transaction costs—frequency, asset specificity and uncertainty as key dimensions depicting the traits of economic exchange among organizations. An asset is site-specificity when a natural

resource is only available at a certain location; physical specificity when a specialized tool is developed for a unique business purpose; human-specific when the required knowledge or skills are built through a learning-by-doing model with trading partners; time-specific when the value exchange between the user is dependent on a limited period of time (Malone, Joanne, & Robert, 1987; Williamson, 1983). In more recent years, transaction costs are categorized into three types: search, and information costs are incurred to reduce uncertainty before a transaction is executed; bargaining costs are incurred during negotiations before reaching a common agreement; and policy and enforcement costs are incurred during the supervision of a contract (Mahoney, 2004).

As transaction costs are resilient for all the stakeholders of GVCs, prior studies have demonstrated the transformation of these costs as innovation and advanced technologies emerge (e.g., internet, cloud-based technology, blockchain technology) and projected organizational reforms and business models innovation (Iansiti & Lakhani, 2017a, 2017b; Lajili & Mahoney, 2006; Tapscott & Tapscott, 2017).

Digitalization today enables corporate governance and business communications accomplished via electronic integration by relationship-IT systems rather than physical ownership of the upstream facilities (Lajili & Mahoney, 2006). This transfers the structure of institutions from hierarchies based on electronic commerce. Tapscott and Tapscott (2017) indicate that blockchain "allows companies to eliminate transaction costs and use resources on the outside as easily as resources on the inside" and claim that Internet has facilitated the interaction among agents and shaped organizational structure and reforms. Traditionally, smaller businesses are more vulnerable and affected by extra transaction costs while entering the multitude of short-term contracts compared to larger companies.

Smart contracts in blockchains enable managing many different short-term or long-term contracts that small businesses can operate as efficiently as larger companies on GVCs. Similarly, Iansiti and Lakhani (2017a, 2017b) state that blockchain technology reduces transaction costs and the need for intermediaries. Through smart contracts, blockchain can decrease transaction execution time and increase transaction volume efficiently in GVCs. In a fully decentralized market based on blockchain, participants can freely enter GVC networks to transact via the consensus mechanism to cut costs. The programmability, transparency, and traceability of the blockchain digital ledger will also significantly reduce the cost of validating trading partners (Catalini & Gans, 2016) to shorten the time used to collect the required information on a business transaction GVCs. The interactions and agreements are automatically checked by smart contracts, which also reduces the uncertainty of contract enforcement (e.g., human interference and error) (Catalini & Gans, 2016). Hence, smart contracts modify the cost of monitoring contracts' compliance and decrease policing and enforcement costs on GVCs by adopting blockchain technology. Also, the immutability of blockchain mitigates the possibility of an inaccurate data registry by reducing the uncertainty of each pre-transaction that the interchange between human specificity and decentralization changes the conventional communication in GVCs. However, these interaction effects increase an organization's negotiation efforts and bargaining costs by adopting blockchain technology to the existing business process.

Davidson, De Filippi, and Potts (2018) relate the functions of blockchains to the drivers of transaction costs that blockchains can substitute not only for traditional contracts between different business entities but also for contracts in the sense that "firms exist as a nexus of contracts" building on the transaction cost view that interactions between economic agents drive costs and that hierarchical organizations are nexuses of contracts limiting the opportunism of economic agents. Blockchains are a mechanism to control opportunism and outcompete traditional organizational hierarchies and relational contracts as general-purpose technology (Bresnahan & Trajtenberg, 1995), which is in line with the Iansiti and Lakhani (2017a, 2017b) conception of foundational technology. The primary function of this general-purpose technology is to decentralize the economy: "Blockchain is a technology of decentralisation" (Iansiti & Lakhani, 2017a, 2017b).

Blockchain technology is revolutionizing how we regulate and maintain administrative control and efficiently govern GVCs. Therefore, Blockchain technology fosters the organizational evolutions across all the entities on GVCs to improve global trade with reduced intermediaries and trade fictions and spark business model innovations to create and capture value more effectively. Our timely research intends to study Blockchain technology adoption and applications on GVCs and focuses on its applications and challenges on network governance in the context of GVCs from the theoretical lens of transaction cost theory. We focus on the interaction of the transaction cost theory factors (frequency, time specificity, human specificity, and uncertainty) (Malone et al., 1987; Williamson, 1983) to investigate and evaluate the programmability, decentralization, transparency, and immutability (Abadi & Brunnermeier, 2018; Catalini & Gans, 2016; Sun, Garimella, Han, Chang, & Shaw, 2020) features of blockchain adoption in GVCs.

3 | RESEARCH METHODOLOGY

This section illuminates the methodology applied by this investigation. Due to the emerging nature of blockchain technology, it is still at its early stage of adoption by leading industry players in a different institutional context. Blockchain large-scale implementation will take many years for the technology to become the foundation technology of the future to reshape our society to realize its social, economic benefits. The extant scholarly research is mainly conceptual (Toufaily et al., 2021). Studies such as Du et al. (2019); Moll and Yigitbasioglu (2019) suggested a qualitative case study approach to uncover the insights of blockchain applications with different use cases. A case study can help to generate more insights of dynamics presented within a single case setting, using qualitative or quantitative evidence from different data sources such as archives, interviews, some observations (Eisenhardt, 1989).

Therefore, this study adopts a qualitative case study approach using the Netnography method. Ethnography is a qualitative

scientific method using the information on the Internet on shared network spaces to generate rich and meaningful insights on a research subject (Kozinets, 2020). Prof Robert Kozinets introduced it in 1995, rooted in traditional ethnography in participants observation. Recently, this method is gaining more attention in academic research (Jeacle, 2021) due to the rich source of online data created by digital communications that made Netnography more appealing, naturalistic, objective and unobstructive and it is faster, simpler and less expensive (Jeacle, 2021; Kozinets, 2002, 2020). Compared to other qualitative research techniques, the distinctive value of ethnography is that it surpasses at revealing the story, understanding complex social phenomena, and supports the researcher in developing themes from different stakeholders of the research phenomenon.

Robert Kozinets defines Netnography as.

> "Netnography, or ethnography on the Internet, is a new qualitative research methodology that adapts ethnographic research techniques to study the cultures and communities that are emerging through computer-mediated communications."
> (Kozinets, 2002, p. 62)

Netnography data can be photographs, videos, images people draw, texts, or even stories (Kozinets, 2020). This study is one the first attempts to understand the potentials of blockchain enabled platform ecosystem in value creation and capture in GVCs to facilitate collaborations in global trade, boost innovation, reduce friction and enhance sustainability with increased visibility, transparency, and traceability, securitizing the case of TradeLens.

TradeLens is not a company. It is a blockchain-enabled solution jointly developed by Maersk and IBM entering the commercial stage. Powered by IBM Cloud and IBM permissioned blockchain, the TradeLens Platform provides every entity involved in global trade with the digital tools to share information and collaborate securely. Its ecosystem is made up of shippers, freight forwarders, ports and terminals, ocean carriers, intermodal operators, government authorities, customs brokers and more. TradeLens is already handling more than 700 million events and 6 million documents a year, lowering trade administration friction. The TradeLens marketplace accelerates supply chain innovation and value creation by leveraging the power of ecosystem data (TradeLens, 2021).

We have followed Kozinets' (2020) double-funnel process of netnographic investigation and 5S (simply, search, scout, select, and save) operations to guide our data collection process. Online interview data (e.g., interview videos and text scripts available from TradeLens.com, YouTube, Facebook, Twitter, and other social media platforms), involvement data (i.e., posts and comments regarding TradeLens from relevant platforms), and Innovative data (e.g., blogs, articles, and reports from TradeLens.com and other marketing and media websites). The rich online data are very meaningful and revealing, enabling our study to analyze the empirical evidence from transaction cost theory perspective to advance theoretical understanding to develop an informative narrative that is driving toward new concept development on blockchain adoption in digital GVCs to govern the global collaboration and create value in the digital era.

4 | DATA ANALYSIS AND FINDINGS

The conceptual understanding of blockchain adoption and the theoretical transaction cost lens guided us on subsequent data collection and analysis. This process is iterative and repetitive. The initial data collected from TradeLens.com and social media platforms have been coded using NVivo 12. We have transcribed the video data and extracted direct quotes from webpage contents, blogs, press, and media.

This study has repetitively collected rich qualitative data using netnographic techniques to reveal embedded insights from TradeLens senior executives and their executive business partners. These people are actively involved in designing, developing, and deploying TradeLens's platform-based ecosystem for its GVC enabled by blockchain technology. In this section, we analyze the qualitative data collected from the TradeLens case to understand the transaction costs of TradeLens GVC associated with blockchain adoption via exploring three types of transaction costs including search and information cost, bargaining costs, and policing and enforcement costs to inform and develop our research framework on blockchain enabled GVC Ecosystem from Transaction Costs Perspective. Figure 1 marshals the findings in the research framework on GVC Ecosystem underpinned by blockchain technology based on our case analysis of TradeLens through the lens of transaction cost theory.

4.1 | Search and information cost

Global trade and supply chain operations can be complex and involve many stakeholders such as shippers, freight forwarders, ports and terminals, ocean carriers, intermodal operators, government authorities, customs brokers, and more. Search and information costs on GVCs refer to the costs associated with determining if a required product or service is available on the chain, who offers the lowest price, the delivery lead time, the relative utility and detailed functionality of the product or service, potential service costs of using the product, and other related areas. Blockchain adoption has enabled the GVC ecosystem of TradeLens to have "a single line of sight" across all supply chain activities and be more reliability in getting goods to market, more agility in responding to changes in customer demand, and more collaboration in cross-organizational automation to decrease search and information costs. As the description from one of the TradeLens official documents illustrated:

> *"TradeLens offers a consistent and holistic view of reliable shipment event data and corresponding documents, all delivered directly from participating sources. It's a*

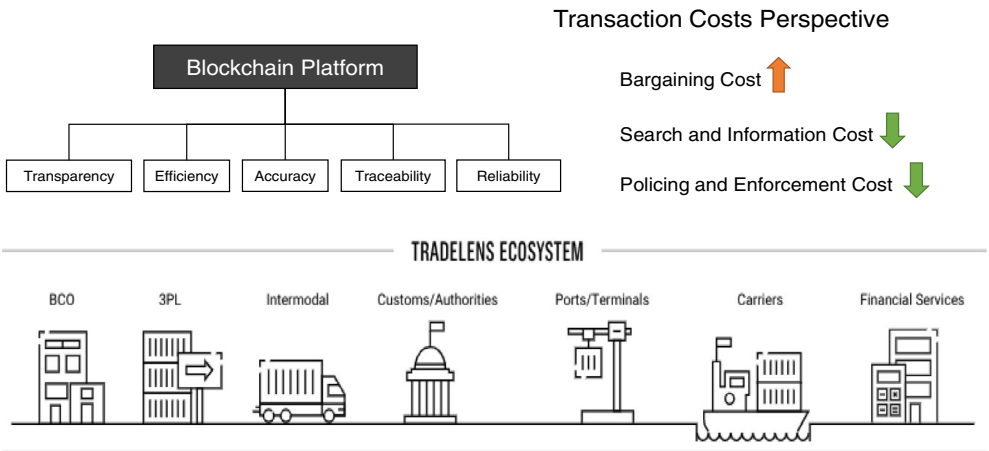

FIGURE 1 TradeLens blockchain underpinned global value chain (GVC) ecosystem [Color figure can be viewed at wileyonlinelibrary.com]

> *single source of truth shared by – and with – permissioned supply chain partners for collective success."*

In the GVCs, most business participants are both customers and suppliers. Customers expect high quality of products and services in the timeliness. Suppliers are committed to responding to customer demands as if they were your own. With the dynamic global trade environment affected by local politics and more COVID pandemic recently, delivering goods to the right place at the right time is becoming even more challenging for traditional global supply chain operations with extensive costs. Blockchain technology has provided a possible and promising solution, according to TradeLens:

> *"TradeLens makes this possible in powerful new ways, uniting permissioned participants through blockchain technology to deliver a single, holistic and trusted view of milestone events across the supply chain. Reliability of data directly from the source can lead to earlier and better decision making, increase speed to market, reduce buffer stock and improve overall performance… TradeLens helps you easily bring data from the world's largest containerised freight blockchain platform to your internal systems, giving you a single source of the truth for inventory location and the flexibility to move inventory to match demand."*

Digitalization and technology innovation and advancement have long promised new operations and resource optimization opportunities on GVC to reduce costs, improve efficiency, and maximize performance. For instance, speed of information and prompt responses are important not just for inventory management but also for customer satisfaction in the global supply chain world. Considering that up to 80% of revenue comes from existing customers, services across GVCs need to maintain strong customer relationships that provide faster customer responses becomes the top priority for businesses. To respond proactively to customers and increase their satisfaction. TradeLens delivers on this promise via its highly effective blockchain-based GVC ecosystem. As indicated from one of TradeLens published documents:

> *"TradeLens offers near real-time data, status updates and alerts for exceptions across your end-to-end supply chain, enabling earlier decision making and faster implementation of mitigating actions. Its scale and scope of data capture automates manual workflows across supply chain silos, reducing capital and operational costs, as well as third-party service provider management expenditures."*

Operations and communications among the business entities and relevant governments agencies and organizations across borders on GVCs are extraordinarily complicated and sophisticated. Conventional and legacy systems often encounter human manual errors on paper documents and frequently add to the time and cost required to process customs-clear shipments. GVCs supported with blockchain technology can reduce such costs, as mentioned in one of TradeLens Ecosystem documents:

> *"TradeLens helps you leverage structured document data to reduce keying errors and improve data quality. Compile source data from multiple parties to enhance and improve information exchanges throughout the chain, so that the latest version of the truth is available to all permissioned parties."*

4.2 | Bargaining cost

The bargaining power of supply chain parties underlies a surplus of interactions among trade partners and obtains a larger revenue share from the contract. Supply chain bargaining power influences profitability, trade partner relationships, and equity and debt capital (Campello & Gao 2017). To the extent that trade partners compete with one another along their industry's value chain for economic benefits. In supply chain negotiations, firms' bargaining power influences their operational decisions and future economic outcomes. Bargaining cost in transaction cost theory refers to the costs required to reach an acceptable agreement with the other party in the transaction and draw up an appropriate contract.

GVCs equipped with Blockchain technology can simplify partner collaboration via a shared, standard view of trusted operations and shipment data throughout the chain. The transparency, traceability and accuracy nature of blockchain platforms can reduce manual effort and help eliminate errors with the slightest human inference. For instance, as mentioned in the specification of Ocean Carriers of TradeLens ecosystem:

> *"TradeLens is the leading platform to enable full digitisation, offering the ability to digitise documents, automate many repetitive tasks through the use of blockchain smart contracts and create new ways of working across your supply chain. While carriers are central to the movement of containerised goods, you're only one part of a complex supply chain – and because of continued reliance on EDI, a costly one as well. With TradeLens, permissioned participants across the supply chain can use blockchain technology to work seemlessly with one another, establishing new levels of trust and transparency in every leg of a container's journey."*

Traditionally business trade partners can negotiate to achieve an acceptable agreement and price without sharing the information with other parties on the supply chain to maximize their profitability and develop strategic trade partner relationships for extended term contracts. Blockchain is essentially a permanent and immutable record of transactions within the GVC. The blockchain platform relies on references to other cryptographically secure blocks within the digital ledger is transparent than traditional approaches to sharing data across the value chain. However, trading entities on the GVC might not be able to achieve an agreement or price due to the immutability and less flexibility of blockchain settings. Recovering from such adverse effects can be even more costly since more parties are involved in GVC. Also, a minor error in a smart contract can jeopardize the one-to-one relationship among trading partners and disturb the trust of the whole supply chain if the smart contract rules are not coded correctly before implementing on each node in the blockchain. This error has the potential to increase the bargaining cost on GVC. A more balanced approach to improve bargaining flexibility and negotiate can be helpful. For instance, system developers (TradeLens) can consider the bargaining costs when setting up the blockchain nodes and defining the smart contract rules.

4.3 | Policing and enforcement cost

In transaction cost theory, policing and enforcement costs refer to the costs of making sure the other party sticks to the terms of the contract and taking appropriate action if this turns out not to be the case. In the traditional global supply chain systems, many expenditures are spent on policing and enforcement costs involving many government agencies and business entities across borders to prevent crime in international trade. The GVCs ecosystem supported with blockchain technology (e.g., TradeLens) enables secure information sharing and governance throughout the value chain transparently. It can be traced to government authorities and trading partners in real time. As part of IBM, a statement is mentioned on the 3PLs and Freight Fowarders of the Tradelens ecosystem:

> *"…data security and governance sit at the core of TradeLens. It's built to enterprise-grade IBM IT security standards, trusted by many of the world's largest companies, while data and document handling processes meet ISO 27001 compliance requirements. TradeLens uses blockchain technology to digitise documents shared between participants. You'll have access to embedded version control, traceability and data integrity to minimise re-work. This affords important validation with other data points."*

Governments' customs authorities and clearance processes are recognized as a critical asset for a country's trade ambitions ever more today. Balancing the need for secure borders with trade facilitation is a common challenge among governments and customs authorities on GVCs. The increasing number of fraudulent documents, counterfeit goods, misdeclaration of values, and HS codes brought custom authorities overwhelming challenge to monitor the flow of goods from an increasingly fast-changing and complex global supply chain across borders. The blockchain collaboration-based governance and security on GVCs reduces these policing and enforcement costs based on the statement provided from the Authorities of TradeLens ecosystem:

> *"… In addition to regulatory authority, your goal is to promote economic growth through fair and legitimate trade. By joining TradeLens, you're endorsing the movement among permissioned supply chain participants to share data, increase efficiency and generate greater transparency and trust… TradeLens has deep expertise in developing governance standards that encourage collaboration, foster environments for new business models and solutions, resolve disputes and more. And with a technical platform built on the IBM Blockchain Platform, TradeLens participants benefit from the security and privacy of the leading Hyperledger Fabric platform that's trusted by companies across industries and around the world."*

5 | CONCLUSION

This study investigates the adoption of blockchain technology on GVCs from the perspective of the transaction cost theory to understand how the technology can be an integral part of the GVCs to foster value creation and capture. TradeLens case provides empirical evidence on blockchain applications in ushering in a new era in digital GVCs to enable global partners to share real time data, collaborate, and realize the benefits of digitalization in global trade to create

opportunities for strategic innovation, efficiency, and growth. The study's findings support the notion that blockchain as a disruptive technology will transform global trade with the digital tools to share information and collaborate security to reduce search and information costs and policing and enforcement costs in global economic transactions. This research is among the few studies trying to provide empirical evidence of blockchain adoption using case study evidence to advance theoretical understanding of the capabilities of blockchain technology to address existing pain points in global supply chains and transform the industry in smarter way of diving container logistics with enhanced visibility, traceability, and transparency to spur innovation and make supply chains more competitive in the digital economy. The analysis is based on empirical data consisting of a wide variety of different online textual and audiovisual data collection from company documents and online medias to provide compelling analysis and insights on the value of permissioned blockchain-enabled platforms in global supply chains that lay the foundation for ongoing improvement and innovation in businesses today to capture value with new technological tools.

5.1 | Theoretical implications

This study contributes to advancing the theoretical understanding of blockchain adoption in global supply chains to reduce transaction costs and connect supply chain ecosystems to expand business opportunities, thrive growth, and create value in the digital GVCs.

First, the study supports the potential capabilities of blockchain technology in simplifying and streamlining business processes to spur innovation in global trade to combat pain points in existing legacy systems to enhance visibility in every part of the supply chains to capture value in GVCs. This study expands the extant blockchain literature from economic transaction cost theory perspective in the context of GVCs: (a) by identifying the relevance of substantive of blockchain in driving innovation, efficiency, and growth opportunities in global trade; (b) by revealing cost saving in *ex ante* and *ex post* transaction costs in digital forms shared across blockchain-enabled platform ecosystems; while the bargaining cost will increase if the information for the transaction is hard to verify where human actor intervention will be required that imply relatively higher designing costs in codifying the agreements in smart contracts; and (c) by articulating the potential of blockchain governance in organizing collaborations to facilitate cooperation and coordination between various actors in GVCs to reduce and mitigate monitoring costs, due to the high transparency of secured real-time data in blockchain can significantly simplify and reduce the average time to settle dispute resolution across different stakeholders involved in global trade.

Second, this investigation supports the close link between the use of blockchain technology and value creation in GVCs through true information sharing and collaboration across supply chains to boost innovation, reduce friction and gain efficiencies in global trade, and make supply chains more competitive in the digital economy with end-to-end visibility. Blockchain technology ensures secure and auditable documents and data. It automates cross-organizational business processes integral to global trade to unlock more values and reduce the manual handling of agreements and documents.

And third, the findings broadly support extant notion of digitalization in GVCs using new technological tools such as blockchain to add a digital layer upon the physical structure of supply chains to freely transact on platform networks where all actions can be tracked, visible and executed in an instant. To bring together all parties in the supply chain-including traders, freight forwarders, inland transportation, ports and terminals, ocean carriers, customs and other government authorizes onto a single, secure data sharing and collaboration platform to create value for the entire ecosystem to foster collaboration and trust, drive true information sharing, and spur innovation. Therefore, opportunistic behaviors will be easily detected in real time to reduce policing and enforcement costs to ensure all parties stick to contract terms. In addition, blockchain can help lower the costs of searching and gathering information to identify and evaluate potential trading partners.

5.2 | Practical implications

This study reveals the practical implications from technology, organization, people, and legal perspective. From a technological perspective, blockchain technology is an innovative tool that can transform business models and processes to meet the changing business environment in meeting the diverse stakeholders' needs to unlock business opportunities and capture value. TradeLens case has provided empirical evidence on how businesses can use blockchain technology to break down longstanding data and processing silos among trading partners to simplify the flow of documentation that accompanies every shipment to improve sustainability performance and enhance supply chain management. However, blockchain is still at its early stages of adoption by some leading industry actors. The large-scale adoption and implementation will take great efforts locally, nationally, and internationally. The sophisticated permissioned blockchain systems are adopted by global actors to maintain privacy to ensure only necessary parties can view specific types of information related to a shipment. TradeLens platform permits access to data according to a unified permission matrix by combining the organization's role and the data type. So far, this case demonstrates that the blockchain technological challenges can be solved by permissioned blockchain solution to maintain business privacy and interoperability. Scalability challenges can be achieved to share data on a need-to-know basis rather than sharing with the entire platform network.

From an organizational perspective, businesses need to collaborate and create an industrial approach to allow peer-to-peer transactions that cut out intermediaries and build trust to improve efficiency. However, for companies with less access to funds, the support from top management will affect their ability to leverage new capabilities from technological innovation to capture value in the digital transformation in GVCs. More industry support and collaboration are needed to drive inclusive of improving sustainability. In addition, businesses

must upgrade firm-level learning to ensure staff are upskilling with new technical competence on the emerging new innovative technologies to drive future businesses. Business entities on GVCs should have a proper digitization strategy to evaluate which technology is the best fit for the long term.

From a people perspective, automation means the need to reskill and upskill to stay relevant in future disruption (Braganza, Chen, Canhoto, & Sap, 2021). Technologies are designed by people, used by people, advanced by people. Automation cannot replace human's experience, judgment, knowledge, and skills. Blockchain only offers a technological tool to make people's jobs more accessible and efficient.

From a legal perspective, the uncertainties and lack of legal framework constrain the broader adoption of blockchain technology. Regulators must work closely with partners in supply chains to draft the relevant and appropriate regulatory and legal framework to guide the innovative use of blockchain technology in global supply chains to ensure accountability and sustainability in GVCs.

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