Trust in "Trust-free" Digital Networks: How Inter-firm Algorithmic Relationships Embed the Cardinal Principles of Value Co-creation

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Abstract:

In this exploratory research, I develop new knowledge on trust in inter-firm cooperation that leverages recent technologies such as blockchain and the Internet of things in a digital platform ecosystem. In a digital network, advanced algorithms govern and shape inter-firm business processes. While such algorithms introduce efficiency in inter-firm business processes, their limitations, especially their apparent lack of transparency, may affect the key trust dimensions (i.e., reliability, fairness, and goodwill) in the relationships among the participating firms. I introduce algorithmic relationship, a label that embeds the concepts of smart contracts in inter-firm cooperation. Algorithmic relationships involve autonomous and semi-autonomous implementations of smart contracts in all lifecycle stages of inter-firm cooperation. By analyzing extant literature on trust, inter-firm cooperation, business model innovation, and digital platforms, I demonstrate how various factors influence whether firms adopt smart contracts: perceptions about other participants' trustworthiness, participants' own propensity to trust, participants' shared goals and resource embeddedness in the network, perceived risks in inter-firm interactions, and complexity and time criticality of inter-firm interactions. Taking a temporal perspective, I also recognize the present lacunae with smart contracts from various perspectives (algorithm development, algorithm implementation, algorithm governance, and the availability of appropriate legal resources in the event that disputes occur) and demonstrate how these drawbacks impede shared value creation.

Keywords: Algorithmic Relationships, Blockchain, Internet of Things, Inter-firm Cooperation, Smart Contracts, Trust.

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1 Introduction

As traditional vertical value chains in business ecosystems give way to loosely coupled coalition and multisided platforms, business have increasingly begun to rely on smart contract technology to promote effective cooperation with other firms in value stakeholder networks (Osterwalder, Pigneur, & Tucci, 2005; Pagani, 2013). To better understand this phenomena, I present and discuss the concept of "algorithmic relationships". In this paper, I discuss algorithmic relationships—which I define as codified rules embedded in a digital device network that manage an arrangement among firms that participate in exchanging and sharing resources and/or co-developing products and services—as a way to better explain these new forms of cooperation with other firms in a value stakeholder network.

Firms that pursue innovation in their business models have begun to explore blockchain-based smart contracts to create and capture value through adopting newer technologies. A blockchain is a distributed ledger for maintaining persistent and tamper-proof record of transactional data. It functions as a decentralized database that a network of collaborating partners manages. A smart contract, a self-executing contract, is a software-based transaction on a blockchain that digitally enforces, verifies, or facilitates a contract between two or more parties. Thus, while blockchain may promote trust among parties via truthfully executing code, business collaborations in general and inter-firm business processes in particular can use smart contracts to implement business collaborations (Mendling et al., 2018). Blockchain's potential application in various business transactions alongside artificial intelligence (AI), machine learning (ML), the Internet of things (IoT), and 5G communication technologies has led management scholars and technology consultants to examine the technology's business benefits and practical implementation in intra-firm and inter-firm business processes. While firms have increasingly developed and invested in these autonomous inter-firm business interface solutions over the years, their adoption in several industry sectors remains moderate (Columbus, 2019). Janssen, Weerakkody, Ismagilova, Sivarajah, and Irani (2020) identified that technical, market, and institutional factors that deter firms from adopting technologies such as blockchain but that the reference literature has predominantly dealt with technological issues and cultural aspects such as resistance to technology adoption. As such, we do not sufficiently understand how inter-firm trust shapes value co-creation in technology-enabled business processes. As Etzioni (2019) points out, trust plays a crucial role in commercial transactions and for economic activity in general, and, considering the fact that that businesses and individuals tend to trust apparent strangers in popular cyber platforms such as Uber, Airbnb, and so on, we need to better understand the role trust plays in digital platforms, what factors enhance it, and what factors deter it.

In this paper, I do not review how firms have applied blockchain and smart contracts (for a review, see Yli-Huumo, Ko, Choi, Park, & Smolander, 2016; Casino, Dasaklis, & Patsakis, 2019). Instead, following a phenomenon-based research approach (Krogh et al., 2012), I develop a new perspective on trust in inter-firm cooperation by reflecting on some key questions associated with technology-based smart contracts in digital platforms and go beyond the technology's implementation issues and business benefits. Using classical trust model (Mayer, Davis, & Schoorman, 1995) and technology acceptance models (Lee, Kozar, & Larsen, 2003; Söllner, Hoffmann, & Leimeister, 2016) as references, I discuss whether algorithmic relationships embed the key elements of traditional inter-firm cooperation and, thus, value co-creation. As firms increasingly adopt advanced technologies, they can expect smart contracts to complement and supplement, if not replace, their existing contracts and agreements. Consequently, firms can anticipate algorithmic relationships to appear across their vertical and horizontal boundaries. In this paper, I develop new knowledge on trust in "trust-free" digital networks by synthesizing insights from different domains. The results not only help address the knowledge gap on technology's role in trust, but also provide future directions towards developing global standards in technology-enabled inter-firm processes.

Inter-firm cooperation results from the choices firms make about market transactions and internalization in seeking to capitalize on and increase their capabilities and endowments while minimizing costs (Combs & Ketchen, 1999). Such cooperation takes multiple forms that range from transactional cooperation in which firms exchange resources and information in the value chain to alliances and joint ventures in which firms collaborate to pursue a shared vision. In the past decade, we have witnessed myriad newer forms of inter-firm cooperation through digital platform ecosystems where multiple firms create, deliver, and capture value through collaboration using technological solutions. By participating in and orchestrating such digital platform ecosystems, firms add new dimensions to inter-firm relationships. Computer algorithms now largely shape and govern these relationships. Some pertinent issues in such algorithmic relationships relate to the mechanisms through which firms form these relationships and, consequently, how these algorithmic relationships alter the role of trust in inter-firm cooperation (Hawlitschek, Notheisen, & Teubner, 2018).

This paper proceeds as follows: in Section 2, I review business models, inter-firm cooperation, and trust's role in inter-firm cooperation, especially in sharing economy business models (SEBMs). In Section 3, I introduce the technological transformations, which blockchain and the IoT drive, that have lead organizations to adopt algorithmic relationships that manifest via smart contracts. In Section 4, based on my findings from reviewing the extant research, I develop several perspectives with which to view trust in algorithmic relationships among firms. Finally, in Section 5, I discuss emergent challenges, suggest paths for future research, and conclude the paper.

2   Trust and Shared Value Creation through Inter-firm Business Processes

A business model constitutes a firm's architecture for its value-creation, value-delivery, and value-capture mechanisms the complementarity among the activities that underlie these mechanisms (Osterwalder & Pigneur, 2010; Foss & Saebi, 2018). These mechanisms also involve cooperation and collaboration with other business entities at varying complexity, interdependency, and payoff levels—from formal joint venture engagements at one end of the spectrum to arms-length market transactions at the other end. Firms can gain many benefits from inter-firm cooperation, such as activities with a broader scale and scope, shared costs and risks, improved ability to deal with complexity, enhanced learning effects that lead to improved returns on research and development (R&D) investments, and enhanced flexibility and efficiencies and a shorter time to market. The factors that help firms realize these gains include resource commitment, reciprocal trust, conflict-resolution techniques, and relational embeddedness (Squire, Cousins, & Brown, 2009). Thus, the level at which firms participate with other firms depends on not only their own resources and capabilities but also their strategic intent, which may co-evolve with changes in their business model, environment, and managemerial performance (Koza & Lewin, 1998). In addition, various governance mechanisms (e.g., a priori incentive structures, internal and collaborative monitoring processes, contractual provisions, reputations, norms, interpersonal and inter-organizational trust) coordinate and motivate parties' exchange activities (Ring & Van de Ven, 1994; Jap & Anderson, 2003). The source of inter-organizational competitive advantage lies in relation-specific assets, knowledge-sharing routines, complementary resources and capabilities, and effective relationship governance (Dyer & Singh, 1998). Firms' approach to sense operational-level complementarities and sustain organizational commitment through adhering to formal contracts and creating informal understanding also influences effective governance during an inter-firm cooperation's execution stage (Wu & Cavusgil, 2006).

Mayer et al. (1995, p. 712) define trust as:

> *Willingness of a party to be vulnerable to the action of another party based on the expectation that the other will perform a particular action important to the trust or, irrespective of the ability to monitor or control that other party.*

This definition has three key elements: 1) an actor's willingness to be vulnerable, 2) the expectation that the other party will perform an important action, and 3) the practical inability to control the other party. These elements constitute Mayer et al.'s (1995) trust model, which also include the trustor's propensity to trust and the other party's perceived trustworthiness. Emergent trust leads to each party's willingness to take risks in the relationship and drives its outcomes. Schoorman, Mayer, and Davis (2007) later identified additional dimensions in the trust model; namely, control systems, context specificity, reciprocity, time dimension, affective responses, and repair of trust post-violation.

Some early literature on transaction cost economics argued that a firm's decision to internalize a business activity or to outsource it to a partner depends on the cost of the transaction at hand and that trust might have minimal role in situations with unambiguous interests and interaction processes (Williamson, 1993, in Farrell, 2009). However, given the network aspects in many contemporary business environments in which actors' interests "encapsulate" their partners' interests, trust has a more critical and relevant role in inter-firm relationships today (Cook, Hardin, & Levi, 2005; Farrell, 2009; Özer, Subramanian, & Wang, 2017).

Several inter-organizational factors influence trust in inter-firm relationships: 1) contractual control, 2) inherent information asymmetry, 3) costly relationship-specific investments, and 4) adverse events. First, contractual control enhances outcomes' verifiability and makes it easier to detect divergence, which leads to efficient rational inference about partners and strengthens trust in inter-firm relationships (Lumineau, 2017). Second, inherent information asymmetry describes situations when one party has access to greater material knowledge than the other party, which enables the former to accrue better gains from the

relationship. Information asymmetry in inter-firm relationships leads to incomplete contracts; thus, contractual coordination, as opposed to contractual control, encourages parties to cohesively interpret objectives, reinforces information sharing, and allows for feedback and contingency plans(Baudry, 1998; Lumineau, 2017). Third, costly relationship-specific investments by a partner may serve to signal its trustworthiness (Beer, Ahn, & Leider, 2017). Such investments provide benefits only in the collaboration with a specific partner and may include investments in IT infrastructure or other physical assets. Fourth, when adverse events unrelated to the inter-firm relationship impact the business performance of one entity, the probability that partners will defect increases due to high stigmatization risks, associated sunk cost, and loss of value-creation opportunities (Bruyaka, Philippe, & Castañer, 2018).

In a platform ecosystem, economic value exchange among participants takes a hybrid form as they integrate value co-creation and capture mechanisms at different levels (i.e., strategy, processes, and systems) (Puschmann & Alt, 2016). We can attribute multi-sided platform business models' success to their complexity and the fact that they simultaneously use both innovation and imitation to create highly intricate activity systems (Zhao, Von Delft, Morgan-Thomas, & Buck, 2019). An inter-firm network in such an environment enables stronger knowledge-spillover mechanisms as the heterogeneity of knowledge distributed across clusters in the network enhances the degree to which participants work together to use knowledge (Schilling & Phelps, 2007). Inter-firm cooperation's flexible arrangements via networks and platforms that use digital ecosystems that go beyond the dyadic choice between markets and hierarchies ensure that social capital in the networks mitigate transaction costs through reciprocity and trust, while digital solutions help partners scale their return on their investments (Gulati, 1998; Holm, Eriksson, & Johanson, 1999; Banalieva & Dhanaraj, 2019). Additionally, the level of trust among actors moderates how effectively they transfer knowledge in the network, and social processes such as backward-looking elements (i.e., prior alliance experience with a partner and reputation), current interactions (i.e., communication, cultural sensitivity), and forward-looking elemens such as expected relationship length should produce trust (Squire et al., 2009; Khalid & Ali, 2017).

To summarize, effective inter-firm cooperation, especially in platform ecosystems, requires trust among players, legitimacy, and shared goals. These elements positively influence network cohesion and resilience, which, in turn, positively influence alliance performance. In other words, distributed trust not only transforms organizations' boundaries but also challenges assumptions about internalizing organizational functions (Seidel, 2018).

With the above observations, I extract a high-level process flow of inter-firm cooperation that represents inter-firm cooperation in various forms—from closely linked joint ventures and arms-length alliances to supplier-buyer relationships and outsourcing—that apply to traditional inter-firm cooperation and sharing economy business models. I illustrate the multi-stage process flow with mechanisms at each stage in Figure 1. Several important factors can influence the interactions' effectiveness. First, the quasi integration between firms can be vertical on value chain function or horizontal on time scale. Second, information asymmetry that continues to exist between partners result in bounded rationality and influence specific actions at micro-level in a process element. Finally, the opportunistic behavior from actors' representatives may lead to sub-optimal performance in the overall relationship.

In Section 3, I explore how recent technologies such as blockchain and the IoT have begun to transform business models and inter-firm interactions. Subsequently, in Section 4, I develop new perspectives on trust in technology-enabled inter-firm cooperation.
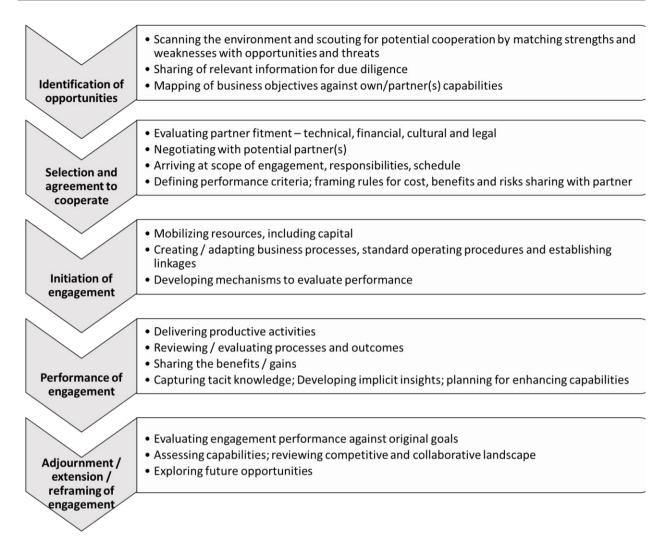
Identification of opportunities
- Scanning the environment and scouting for potential cooperation by matching strengths and weaknesses with opportunities and threats
- Sharing of relevant information for due diligence
- Mapping of business objectives against own/partner(s) capabilities

Selection and agreement to cooperate
- Evaluating partner fitment – technical, financial, cultural and legal
- Negotiating with potential partner(s)
- Arriving at scope of engagement, responsibilities, schedule
- Defining performance criteria; framing rules for cost, benefits and risks sharing with partner

Initiation of engagement
- Mobilizing resources, including capital
- Creating / adapting business processes, standard operating procedures and establishing linkages
- Developing mechanisms to evaluate performance

Performance of engagement
- Delivering productive activities
- Reviewing / evaluating processes and outcomes
- Sharing the benefits / gains
- Capturing tacit knowledge; Developing implicit insights; planning for enhancing capabilities

Adjournment / extension / reframing of engagement
- Evaluating engagement performance against original goals
- Assessing capabilities; reviewing competitive and collaborative landscape
- Exploring future opportunities

Figure 1. Generic Lifecycle and Process Flow of Inter-organizational Engagement

3   Technology-enabled Business Model Transformation

Business model innovation relates to novel changes that firms introduce into their value-creation, value-capture and value-delivery activities and the complementary relations between them (Foss & Saebi, 2018). As external and the internal environments evolve over time, a firm innovates its business model by anticipating and respond to the sequence of voluntary and emergent changes in its business's core components (Demil & Lecocq, 2010; Teece, 2014). Such business model innovation may also guide the firm to explore cooperative relationships with other firms and potentially leverage one another's resources and capabilities to enhance how well their value chain activities perform, which can lead to superior value creation and an inter-organizational competitive advantage.

While several roadmaps for business model innovation exist, digitalization over the past two decades has prompted firms to apply technological innovation to evolve their business models for improved value creation and enhanced inter-firm cooperation. Business model transformation refers to the significant changes that a firm makes to any or several components of its business model such that it significantly alters its value proposition to its customers, its business processes, its cost structure, and its revenue streams. Firms typically begin digitally transforming their business model with "digital sensing", which external triggers enable, and then perform "digital seizing", which includes rapid prototyping and the creation of digital business portfolios (Warner & Wäger, 2019). External developments drive and internal enablers and barriers moderate these two processes (i.e., digital sensing and seizing). Digital transformation eventually leads to the strategic renewal of a firm's business model and novel mechanisms for inter-firm cooperation. In a nutshell, a digital platform ecosystem integrates cooperative value-creation logic, value-capture mechanisms, and value-delivery architecture in a value stakeholder network (Al-Debai & Avison, 2010).

Blockchain and the Internet of things (IoT) represent two recent technological breakthroughs that can transform the way firms cooperate. These technologies have given rise to blockchain-based shared economy business models (BSEBMs), which have a highly decentralized nature compared to conventional SEBMs in digital platform ecosystems (Tumasjan & Beutel, 2019). In Section 3.1, I focus on role that these two technologies play in business model innovation and inter-firm cooperation.

Though business-to-business integration through legacy technologies such as electronic data exchange (EDI) has been in place for several decades, blockchains' distributed ledger technology enhances the integration functionality. As the in-built reconciliation process in a blockchain eliminates the need for trustworthy intermediaries, business processes become less complex and faster, which makes disintermediation a key benefit that blockchain provides. Thus, blockchain can potentially alter a firm's business model by authenticating transactions in real time, facilitating disintermediation, enabling a fault-tolerant security model, and codifying not only the contractual engagement terms but also the ethics and integrity dimensions into its business processes, which can improve operational efficiency and reduce moral hazards (Tapscott & Tapscott, 2017; Lacity, 2018). Because peer-to-peer networks with no central system transmit transactions securely and cost-effectively, one can expect them to strengthen inter-firm ties in the supply chain (Korpella, Hallikas, & Dahlberg, 2017; Morkunas, Paschen, & Boon, 2019). Secure information sharing and improved visibility build trust, which lead to operational improvements in inter-organizational processes (Wang, Singgih, Wang, & Rit, 2019). Thus, blockchain-based solutions provide an ideal opportunity for inter-firm business processes that require shared common database with an objective and immutable log, that have multiple partners with conflicting objectives, that have different rules and trust barriers, and that require firms to avoid intermediaries or third parties (Lacity, 2018; Pedersen, Risius, & Beck, 2019).

One can categorize blockchains according to 1) whether they adopt public or private access to transactions and 2) whether they adopt permissioned or permissionless transaction validation. While the cryptocurrency domain features many more permissionless public blockchains, permissioned blockchains suit inter-firm business processes where actors know one another's identity. Thus, the participating actors in a permissioned blockchain strive to foster collaboration among themselves with agreed-on validators and other enforcing systems to maintain the ledger. In contrast, more efficient consensus algorithms such as proof-of-stake consensus algorithms rather than mining drive network maintenance. The value of the stored data in the permissioned blockchains still depends on its unambiguity, which fostersparticipants' common interests and sense of togetherness (Zheng, Xie, Dai, Chen, & Wang, 2018).

The other recent industrial breakthrough, the IoT, helps connect a broad spectrum of physical devices in and between organizations to automate tasks and transform business models with the premise that anything can be connected with everything else to exchange data (Shim et al., 2019). Blockchain-enabled IoT solutions integrate, automate, record, and validate human-machine as and machine-to-machine interactions in a distributed environment that may not have a central authority or central data repository (Huckle, Bhattacharya, White, & Beloff, 2016). Even though businesses have transformed from traditional models to digital business models through IT-based business processes, BSEBMs may help an ecosystem to further evolve with seemless interfacing of decentralized business processes across organizations. Thus, BSEBMs pose different challenges from the more prevalent, centralized sharing economy platforms such as Uber and Airbnb (Chong, Lim, Hua, Zheng, & Tan, 2019; Tumasjan & Beutel, 2019).

Blockchain solutions coupled with the IoT have key characteristics such as disintermediation, decentralization, persistency, transparency and immutability, auditability, trustless exchange, increased user control of information, secure decentralized networks, and the ability to maintain high-quality and accurate data with device-level connectivity (Zheng et al., 2018). While these features have the potential to transform any business model, the diversity of technological implementations and features present hard interoperability issues that hinder standardization. Some key issues that require investigation include: 1) addressing blockchain technological limitations such as throughput and latency in managing high-speed transaction-oriented business processes in and across organizations; 2) managing the cultural shift and addressing trust issues in blockchain adoption; 3) developing consensus on decision rights, accountability, and incentive-structuring issues; 4) formalizing ambiguous business protocols; and 5) examining governance in decentralized autonomous organizations (Beck, Müller-Bloch, & King, 2018; Mendling et al., 2018; Rossi, Müller-Bloch, Thatcher, & Beck, 2019; Waltl, Sillaber, Gallersdörfer, & Matthes, 2019). Thus, we can expect organizations to adopt blockchain technology and realize concomitant value slowly and in a staged fashion since they need to coordinate across across organizational boundaries and must contend

with a complex technological, regulatory, and social landscape (Iansiti & Lakhani, 2017; Casino et al., 2019; Riasanow, Burckhardt, Soto Setzke, Böhm, & Krcmar, 2018; Hughes et al., 2019; Wang et al., 2019).

Notwithstanding the role of technology, humans have a critical role in designing, developing, and governing the symbiotic relationship among firms in a digital platform ecosystem. Employees in organizations with complex adaptive systems may develop the capabilities to produce effective mechanisms to develop, produce, and rapidly distribute technology solutions. Such contributions from humans enable firms to evolve as autonomous, synchronized, and interactive units. As Pazaitis, De Filippi, and Kostakis (2017) argue, while technology can facilitate distributed systems to scale and become viable, the genuine dynamics of sharing and the underlying human sociality should guide efforts to design and deploy technological solutions. Accordingly, I explore the emergence of autonomous inter-firm transactions in Section 3.1. In Figure 2, I present an illustrative digital platform ecosystem that involves supply chain functions with multiple business entities and their interactions on the platform as a reference for the following discussion. While the list and the flow of activities have a representative nature, the diagram underscores the importance of inter-firm cooperation in creating and capturing value and how information sharing and decision-making occur across organizational boundaries. Some activities in this schematic belong to the ecosystem's public model, whereas other activities can belong to an individual actor's private model. The platform may choose an orchestrator-based execution in which a key central player orchestrates how different participants move, or it can operate as a decentralized choreography in which players coordinate activities autonomously (Carminati, Ferrari, & Rondanini, 2018). Also note that the firms in the platform may choose to execute a part of their inter-firm transactions on an autonomous smart contract that runs on a blockchain using business modeling execution language, while they can perform their remaining activities "off the chain" (Fdhila, Rinderle-Ma, Knuplesch, & Reichert, 2015).

3.1   Smart Contracts and Algorithmic Relationships in Digital Platform Ecosystems

Traditionally, researchers have described an algorithm as:

> *A finite procedure, written in a fixed symbolic vocabulary, governed by precise instructions, moving in discrete steps, whose execution requires no insight, cleverness, intuition, intelligence, or perspicuity, and that sooner or later comes to an end.* (Berlinsky, 2000, in Zia, Kauffman, & Niiranen, 2012).

While algorithms have existed in business software for decades and primarily focused on solving computational problems, organizations have begun to move towards algorithmic and autonomous decision making in business process as they adopt digital technologies, which leads to advanced automation (Gasser & Almeida, 2017). Consequently, smart contracts—software systems that conditionally enforce contract clauses—now govern many inter-firm business processes. Being disintermediated and self-sustained, they promise increased commercial efficiency, reduced transaction and legal costs, and anonymous transacting to organizations engaged in a contract (Giancaspro, 2017; Savelyev, 2017). Applying agency theory, we may see a smart contract as an organizational agent: an organization (the principal) authorizes the algorithm's decisions, and the algorithm's decisions bind the organization. As an engine for auto-enforceable smart contracts that "machine consensus" powers, Blockchain could, in essence, disrupt traditional governance structures by reducing bureaucracy via reducing transaction costs, solving principal-agent issues, and reducing subsequent moral hazards (Shermin, 2017). However, firms can also execute a smart contract in a centralized hub-and-spoke network without implementing a blockchain solution.

Some business functions where smart contracts may proliferate include areas with a greater purpose and urgency for reliable, automatable, information-sharing networks, such as when firms need to 1) provide extended visibility and traceability to stakeholders; 2) simplify, digitalize, and optimize global supply chain operations; 3) automate shipment validation; and 4) abolish disintermediation to improve efficiency (Wang et al., 2019).
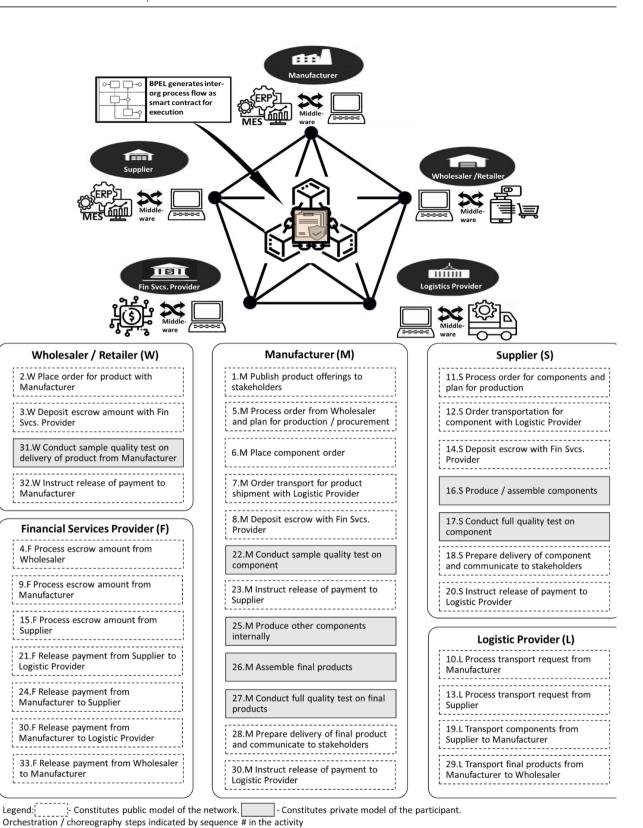
Figure 2. Generic Lifecycle and Process Flow of Inter-organizational Engagement

The figure presents a network diagram with a central blockchain node connecting the following participants: Manufacturer, Supplier, Wholesaler/Retailer, Fin Svcs. Provider, and Logistics Provider. Each participant has ERP/MES, Middleware, and computing systems. A callout states: "BPEL generates inter-org process flow as smart contract for execution."

Below the network diagram are activity boxes organized by participant:

Wholesaler / Retailer (W)
- 2.W Place order for product with Manufacturer
- 3.W Deposit escrow amount with Fin Svcs. Provider
- 31.W Conduct sample quality test on delivery of product from Manufacturer
- 32.W Instruct release of payment to Manufacturer

Financial Services Provider (F)
- 4.F Process escrow amount from Wholesaler
- 9.F Process escrow amount from Manufacturer
- 15.F Process escrow amount from Supplier
- 21.F Release payment from Supplier to Logistic Provider
- 24.F Release payment from Manufacturer to Supplier
- 30.F Release payment from Manufacturer to Logistic Provider
- 33.F Release payment from Wholesaler to Manufacturer

Manufacturer (M)
- 1.M Publish product offerings to stakeholders
- 5.M Process order from Wholesaler and plan for production / procurement
- 6.M Place component order
- 7.M Order transport for product shipment with Logistic Provider
- 8.M Deposit escrow with Fin Svcs. Provider
- 22.M Conduct sample quality test on component
- 23.M Instruct release of payment to Supplier
- 25.M Produce other components internally
- 26.M Assemble final products
- 27.M Conduct full quality test on final products
- 28.M Prepare delivery of final product and communicate to stakeholders
- 30.M Instruct release of payment to Logistic Provider

Supplier (S)
- 11.S Process order for components and plan for production
- 12.S Order transportation for component with Logistic Provider
- 14.S Deposit escrow with Fin Svcs. Provider
- 16.S Produce / assemble components
- 17.S Conduct full quality test on component
- 18.S Prepare delivery of component and communicate to stakeholders
- 20.S Instruct release of payment to Logistic Provider

Logistic Provider (L)
- 10.L Process transport request from Manufacturer
- 13.L Process transport request from Supplier
- 19.L Transport components from Supplier to Manufacturer
- 29.L Transport final products from Manufacturer to Wholesaler

Legend: [dashed box] - Constitutes public model of the network. [shaded box] - Constitutes private model of the participant.
Orchestration / choreography steps indicated by sequence # in the activity

Implementing smart contracts follows a layered approach where the technical layer deals with data management, algorithms, and standards, the logical layer deals with the criteria and principles, and the social and legal layer deals with norms, regulations, and legislations. A firm can deploy a business network model (BNM) using business process execution language (BPEL) to conduct setup activities, form proto-contracts, and negotiate contracts in an electronic collaborator community (Norta, 2015). One can define BNM as the blueprint of an electronic community of firms engaged in inter-firm collaboration. It captures the roles and business processes that pertain to a business scenario and contains legally valid template contracts whose relevant parameters firms can fill in in during automated negotiations. To improve a deployed contract's trustworthiness and fairness, researchers suggest that smart contracts use fiduciary nodes or observers as participants who can ensure transparency and data provenance through a verifiable audit trail (Angrish, Craver, Hasan, & Starly, 2018).

While smart contracts have drawn attention from practitioners and technology enthusiasts, they have several limitations in how firms can conceive of and implement them in inter-organizational business processes. They are egalitarian and may appear just and fair to all parties; however, issues with smart contracts range from legal implications to the fact that algorithmic decisions lack the nuance that a human mind can offer. For example, letting algorithms dynamically determine the terms in a contract through ML may lead to a possible situation that the algorithm's creator did not foresee, especially with bounded parameters in the decision-making universe. Consequently, the algorithm may choose actions that a human would consider incorrect or illegal. Also, since code encapsulates the terms, courts cannot interpret the actual content and may have to rely on extrinsic material. The argument that algorithmic smart contracts not only improve operational efficiency but also address contract enforcement's ethical and integrity dimensions (Tapscott & Tapscott, 2017) makes a strong assumption about the developed algorithm's fairness. However, considering ML algorithms' opacity and dynamic learning process, potential questions regarding their transparency and, consequently, their fairness arise. Thus, we need to address the transparency angle to claim algorithm's ethical superiority.

I classify these challenges, especially with respect to trust, into three temporal dimensions: 1) trust ex ante, 2) trust through the platform ecosystem's governance, and 3) trust ex post. In Table 1, I summarize some key issues that extant research has identified and categorize them according to the three dimensions. In the table, I also provide pointers as to how I address these issues in Section 4.

Table 1. Limitations of Smart Contracts in Improving Inter-organizational Relationship

Relationship dimension	Challenges in current implementation / conceptualization of smart contracts	My approach to resolve the issues
Intent to adopt smart contracts	The fundamental assumptions that each algorithm engrains about behavior rules, intelligence, creative decision making, learning, uncertainty, and so on constrain the way one can model self-organized, adaptive complex systems (Zia et al., 2012). In addition, algorithms' in-built opacities (see the next point in this table) limit their transparency to stakeholders ex ante; in particular, non-tech-savvy business owners can develop concerns about embedded contract rules' accuracy (Burrell, 2016). When two partners engage in transactions, they may perceive two types of risks: 1) the risk that the other partner does not commit themselves to joint efforts due to self-interest and payoff inequity and 2) the risk that participants do not meet their objectives due to external hazards despite their best interests (Das & Teng, 1996).	I break down the smart contract adoption challenges to the following dimensions: 1) participant's propensity to trust, 2) perceived trustworthiness of the platform and other participants, 3) process-level and resource-level interconnectedness in transactions, and 4) how one can design contracts via algorithms such that participants better accept them.

Table 1. Limitations of Smart Contracts in Improving Inter-organizational Relationship

Design and development of underlying algorithms and their transparency, governance model and executive decisions	While algorithms may make objective and, thus, potentially fairer decisions compared to the decisions that humans make, algorithmic decision making has received criticism for its potential to enhance discrimination, information and power asymmetry, and opacity (Lepri, Oliver, Letouzé, Pentland, & Vinck, 2018). Specifically, information asymmetry between a smart contract's developers and stakeholders, and stakeholders' inability to establish causal relationships hinder stakeholders from arriving at a normative consensus (i.e., what is desirable and what is not is not clear) (Zia et al., 2012). In addition, as business circumstances change, protocols and rules can become inappropriate for the new environment and require modification. However, by principle, modifying blockchain code occurs through majority consensus; thus, if stakeholders who may have unaligned interests in a distributed multi-stakeholder network face great complexity in reaching consensus, then it may lead to additional agency issues (Shermin, 2017). It is also difficult to transpose legal rules' ambiguity and flexibility into formalized language that machines can interpret (De Filippi & Hassan, 2018; Werbach, 2018a). Appropriate governance frameworks need to include provisions on the respective parties' liability, rules to approve/reject authorized participants, correction mechanisms, and applicable law in case disputes arise (Janssen et al., 2020)	I identify causes that lead to managerial and process issues in algorithm-based governance of inter-firm relationships.
Transparency of causal relationship, ex post, legal recourse	ML algorithms are more complex and dynamic than the structured rules engines from years past: they learn constantly and decide heuristically, which can lead to poor explainability and transparency. Explainability refers to the degree to which AI can translate how it operates in human terms to users, and transparency refers to the degree to which a user can clearly see how an algorithm makes decisions (Robert, Bansal, & Lütge, 2020). Thus, different types of opacities—such as intentional opacity (when an algorithm's inventors focus on protecting their intellectual property), illiterate opacity (when people lack the technical skills to understand how an algorithm, works), and intrinsic opacity (when certain ML methods such as deep-learning techniques prevent one from easily interpreting them)—collectively and significantly affect stakeholders' ability to accept a smart contract's causal outcomes (Burrell, 2016; Scholz, 2017). In essence, a smart contract becomes a black box algorithmic agent that can act far beyond their authorizing entities' intent and capability and, thus, exceed the mandate that they bestow on it. While a participant cannot breach a smart contract, a smart contract may not create obligation in its legal meaning, and illegal smart contracts can arise since vitiated consent or intent does not nullify smart contract's validity (Savalyev, 2017). Thus, when disputes arise, the current legal system may provide little recourse to contract participants as technology attempts to provide an alternative, deterministic solution.	I explore the dichotomy of whether code should be more like the law or whether the law should be more like code. I also investigate the temporal effect that inter-firm cooperation experience has on building trust in platform-based shared economy business models.

A smart contract-based organization constitutes a a decentralized autonomous organization (DAO)—a virtual organization on the Internet that raises internal capital from investors and carries out its business decisions and value chain activities autonomously through algorithmic governance by leveraging blockchain technology. When necessary, it also relies on hiring individuals or on outsourcing to perform certain tasks that the automaton itself cannot do. While the concepts behind DAO are interesting and differ significantly from today's formal organizations, they also underestimate the nuances of intra- and inter-organizational transactions and the important role that humans play in them. Indeed, given The DAO's (a specific DAO implementation) failure, we can better appreciate the potential of algorithmic decision making, the fallibility

of incentive design and modeling actions, the limitations of fully autonomous governance, and the role of legal authority (DuPont, 2017).

Based on the above discussion, one needs to ask how effectively "trust-free" technology solutions in digital platform ecosystems shape and govern inter-firm relationships and contribute to shared value creation. In particular, I focus on exploring the role that trust plays in these new sharing economy business models that use technology-based autonomous inter-firm interactions with or without blockchain technology (i.e., BSEBMs or SEBMs). Here, one needs to recognize that firms may want to consider smart contracts, encryption, and distributed ledgers separately (i.e., firms may not want to completely implement blockchain and still have a smart contract to improve productivity in the platform) (Halaburda, 2018). In Section 4, I develop a perspective that integrates my findings from analyzing the literature on trust, smart contracts, and the implementation of smart contracts in business models.

4   Developing New Perspectives on Trust in Technology-enabled Inter-firm Cooperation in Platforms

In this section, I synthesize extant knowledge on trust in autonomous inter-firm interactions. The way in which firms conceptualize trust differs substantially among traditional inter-firm cooperations, sharing economy-based platform collaborations, and the most advanced blockchain-based digital platforms. In a traditional environment, a firm develops trust in a partner based on the partner's ability, benevolence, and integrity and on its own propensity to trust based on its past experience, leadership traits, and overall culture (Mayer et al., 1995). The original technology acceptance model (TAM) (Lee et al., 2003) that recognizes four major constructs (i.e., perceived usefulness, perceived ease of use, behavioral intention, and behavior) may not be able to address the additional challenges that inter-organizational tensions and constraints offer. The trust TAM that Söllner et al. (2016) have proposed recognizes the role that trust plays in information systems, the technology provider, and the user community. However, trust relationships in a platform microeconomy can be more complex than what the trust TAM captures (Glaser, Hawlitschek, & Notheisen, 2019). In the sharing economy, the concept of the trust TAM involves dimensions encompassing trust among peers in the network, trust in platform, trust in products or services, and trust in the combination of these dimensions. On the other hand, blockchain-based networks promise as a "trust-free" technology based on algorithms' technological prowess to replace trusted third parties such as platform intermediaries (Hawlitschek, Notheisen, & Teubner, 2018).

Using the classical trust framework that Mayer et al. (1995) developed and additional perspectives from Schoorman et al. (2007) as a reference, I redefine the role that trust plays in algorithmic relationships (i.e., inter-firm collaboration with autonomous or semi-autonomous smart contracts). I root my framework in the extant knowledge on how organizations design, deploy, govern, and adapt inter-firm processes in platform economy business models, which makes it more specific than the enhanced trust TAM that Söllner et al. (2016) proposed.

4.1   Trust in Algorithmic Relationships Ex Ante

Considering the focus on "trust-free" interactions in technology-based solutions, I make my first argument around the construct lack/absence of trust in inter-firm interactions. I argue that trust represents a nuanced concept and that technological sophistication alone cannot create a complete "trust-free" solution because interaction between humans remains a fundamental element in every digital platform ecosystem (Hawlitschek et al., 2020). Thus, the way a participant perceives other participants' trustworthiness in a platform becomes a critical factor in addressing lack of trust in the ecosystem. Following Mayer et al. (1995) and Gefen, Benbasat, and Pavlou (2008), I argue that three characteristics decide a platform's trustworthiness: 1) capability (i.e., having the knowledge, skills, or competencies that allow a participant to provide the desired product and services in the ecosystem), 2) integrity (i.e., adhering to a set of principles that the other participants find acceptable, and 3) benevolence (i.e., willingness to do good to other participants aside from self-fulfilling motives). Perceived social presence and sense of virtual community fosters these three characteristics. In other words, trust in participants' products and services, their integrity, and their benevolence shapes how one perceives their trustworthiness. Thus, I propose:

> **P1a:**   Lack of trust in inter-firm relationships inversely relates to other participants' perceived trustworthiness.

On the other hand, a participant's propensity to trust lies in participant's inherent characteristics, which its own experience, personal leadership traits, and organizational culture shape. Considering a large digital platform network with different types of participants, these two factors (i.e., the way a participant perceives others' trustworthiness and a participant's own propensity to trust) will have a compound effect that will lead to lack of trust in the system. Thus, I propose:

P1b: Lack of trust in inter-firm relationships inversely relates to a participant's propensity to trust.

While trust elements constitute a critical dimension that contribute to cooperative value creation and capture in a network, participants' complementing value propositions also characterize a network. In this context, we need to recognize the servitization trend. Servitization, which began as platform as a service (PaaS) in the 2000s, has taken myriad shapes over the past decade andchanged the way firms cooperate and collaborate. Today, we essentially have "* as a service" where the asterisk stands for any business value proposition. For example, we can observe mining as a service, which provides services related to mining blockchain tokens to participants (Riasanow et al., 2018). Servitizing products/services/collaborations in this way not only creates new opportunities to co-create value with different partners but also creates additional dependencies that demand standardized protocols with well-calibrated outcomes. Note that inter-firm relationships do not exist independently. They connect to one another because a given relationship not only affects the two partners but also affects these two partners' other relationships. These interconnected relationships may result in diverse outcomes such as combination advantage, exclusivity, competition, and so on (Ritter, 2000). I define this concept as value network interconnectedness and argue that a digital platform network tends be more interconnected and complex when participants have diverse shared goals and significant dependencies among them in order to create and capture value from the network. Thus, I propose:

P2a: Value network interconnectedness is directly proportional to the presence of shared goals among participants.

P2b: Value network interconnectedness is directly proportional to how much actors in the network depend on the network's resources and other participants' value-creation routines.

Consequently, I posit that lack of trust and value network interconnectedness together drive firms to adopt algorithmic relationships that manifest via smart contracts. When a participant does not or only weakly trusts other participants and the participant also has a low propensity to trust, a utility such as a smart contract may enable participants to engage with other participants. I introduce the construct likelihood to adopt algorithmic relationship and propose:

P3a: Lack of trust directly influences the likelihood that a firm will adopt algorithmic relationships.

Furthermore, one can see that perceived execution risks in inter-firm processes mediate the influence that lack of trust has on smart contract adoption. Following Schoorman et al. (2007), I argue that, if the risk associated with a specific process is high, participants in a network that lack trust in other participants will tend to adopt a control system, such as a smart contract, which can lower the perceived risk to a level that trust can manage. In other words, I propose:

P3b: Perceived risk in an inter-firm process mediates the influence that lack of trust has on firms' likelihood to adopt algorithmic relationships.

While lack of trust in a network calls for "trust-free" solutions for inter-firm interactions, high interconnectedness (i.e., low centrality and low clustering) necessitates that firms adopt algorithmic relationships to manage the complex web of inter-firm interactions. I present a stylized version of such interactions in Figure 2. In this context, we need to understand how participants proliferate in the ecosystem, which Figure 2 does not depict. A typical platform ecosystem not only has different types of participants that each bring different value propositions to the platform but also can have a high number of players under each type, which can lead to a vast, high-density, heterogeneous network. While a traditional digital platform ecosystem may have one orchestrator who drives the cooperation rules, BSEBMs would operate in a distributed choreography without any central monitoring agency. Such multiplicity of participants in the ecosystem not only increases the complexity of the network operations but also calls for higher adoption of automated inter-firm interactions. Thus, I propose:

P3c: A value network's interconnectedness directly influences the likelihood that firms will adopt algorithmic relationships.

On the other hand, inter-firm processes' complexity and time criticality will moderate the influence that network interconnectedness has on smart contract adoption. The more complex and time critical an inter-organizational process, the higher the chances that firms will adopt smart contracts in a dense and interconnected network. Thus, I propose:

P3d: Inter-firm processes' complexity and time criticality moderate the influence that the value network's interconnectedness has on the likelihood that firms will adopt an algorithmic relationship.

While lack of trust, a value network's interconnectedness, and mediating and moderating factors explain the likelihood that firms will adopt algorithmic relationships, we also need to consider another key dimension: the platform's and associated technologies' familiarity. Technology familiarity reduces social or technical complexity (i.e., if a user is familiar with a technology, the user can address undesirable consequences that arise when the user or other stakeholders use it) (Söllner et al., 2016). Considering the "newness" of technologies such as blockchain, which firms can use to execute smart contracts, not everyone will be familiar with the technology, which means it may be a critical factor in whether firms adopt algorithmic relationships. Thus, I propose:

P3e: A firm's familiarity with a platform and associated technologies directly influences the likelihood that it will adopt algorithmic relationships.

4.2   Trust in Algorithmic Relationships via Implementing Smart Contracts

If we consider the workflow in Figure 2, we see that firms can create a smart contract that designs and monitors participants' interdependent activities (i.e., the activities that constitute the network's public model). Such a smart contract can express information regarding transactions in a conditional format and ensure that all network players can explicitly see its terms and conditions. The smart contract can monitor participants' transactions and deal with any deviation via its pre-designed rules, which can save time and potentially reduce disputes. Digital rights management (DRM) in the music industry represents a successful early example in which firms codified regulations. In this example, the code effectively works as law (i.e., the code itself enforces the law ex ante rather than a third party ex post) (De Filippi & Hassan, 2018), and it works more smoothly than the way legal institutions resolve copyright disputes. In other words, key smart contract features (i.e., accurate transactions, clear communication and transparency, speed, and efficiency) contribute to improving the shared value that participants in a platform ecosystem create. Thus, I propose:

P4a: Adopting algorithmic relationships enhances collaborative value creation and value capture.

However, as extant research has argued (which I summarize in Table 1), smart contracts, while promising seamless inter-firm interactions, may have serious lacunae due to their design and implementation being opaque to many stakeholders. The challenges may stem from the inability to model a smart contract in advance that consider all possible business situations, uncertainties, and corresponding actions that participants would accept. For example, it may not be possible to design and codify the returns (gains and losses) that would appear as equitable once a contract is in force. In addition, dispute resolution through a smart contract would differ from that dispute resolution through a traditional legal system as one cannot easily transpose legal rules' the ambiguity and flexibility into formalized language. Apart from assuring participants that the smart contract correctly executes process steps, algorithm designers also need to consider issues such as data confidentiality (i.e., they need to provide participants with selective access to smart contract data). The algorithm also needs to ensure process confidentiality (i.e., it needs to share only those information on the process activities at each participant to other participants that inter-firm cooperation requires). I also recognize three considerations that affect collaborative value creation. First, participants may not view the claim that smart contracts offer transparency as just and fair during a contract's period due to opacities that I show in Table 1 and a lack of familiarity to technology that I discuss above. In other words, I question the assumption that smart contracts represent a superior option based on ethical and integrity dimensions. Second, governance concerns stewardship as much as it concerns regulation enforcement. Third, as The DAO's failure shows, a purely algorithmic system's governance limitations mean that firms in an inter-firm cooperation requires provisions for manual, off-the-chain executive interventions as a governance mechanism. Thus, I posit:

P4b: Algorithm design quality moderates the influence that algorithmic relationships have on collaborative value creation and value capture.

P4c: Algorithmic relationship governance moderates the influence that algorithmic relationships have on collaborative value creation and value capture.

Combining these perspectives, I develop a trust framework in digital platform ecosystems governed by autonomous and semi-autonomous smart contracts. I depict the framework through a nomological network diagram in Figure 3. I represent the direct relationships with solid lines and the mediating and moderating relationships with dotted lines.
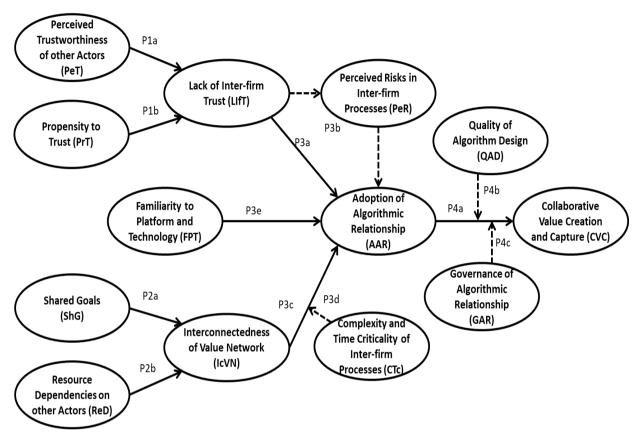

Figure 3. Trust in Digital Platform Ecosystems: Proposed Relationships

4.3 Trust in Algorithmic Relationships Ex Post

Lastly, following Schoorman et al. (2007) and Gefen et al. (2008), I introduce temporal dimension in the relationships with feedback loop that reinforces or weakens initial trust antecedents. As firms cooperate in a network and create and capture value, their experience influences other participants' perspectives, their own propensity to trust, and their future orientation about the network in terms of shared goals or commitments. Such experience not only pertains to economic returns but also includes developing the capability to achieve future business objectives and acquiring intangible assets such as knowledge about processes and technology. A positive collaborative value-creation experience should contribute to the trust constructs that I discuss above (i.e., other actors' perceived trustworthiness and propensity to trust). In addition, a positive experience and awareness of partners' competencies improves a participant's reliability on other partners' resources and capabilities, which prompts them to create more shared goals and embed resources in collaborative processes. On the other hand, following Bruyaka et al. (2018), I argue that the probability that partners will defect from the network either due to performance issues or due unrelated adverse business effects can pose a concern for the leadership due to the associated sunk costs and fewer value-creation opportunities. I propose a construct called collaborative value-creation and value-capture experience that researchers can assess through the synergy and complementarity that the collaboration generates or fails to generate for a focal firm and its partners through inter-firm business processes. Thus, I propose:

P5a: Collaborative value-creation and value-capture experience directly influences familiarity with a platform and associated technology over time.

P5b: Collaborative value-creation and value-capture experience directly influences other participants' perceived trustworthiness.

P5c: Collaborative value-creation and value-capture experience directly influences participant's propensity to trust.

P5d: Collaborative value-creation and value-capture experience directly influences whether firms develop shared goals.

P5e: Collaborative value-creation and value-capture experience directly influences a participant's dependence on other participants' resources and value-creation routines .

Therefore, as familiarity improves over time, it directly influences the extent to which firms in inter-firm relationships adopt smart contracts in the future. However, we need to expand our discussion on smart contracts' governance and dispute-resolution mechanisms. As Werbach (2018a) has argued, blockchain-based immutable smart contracts may build consensus, enforce rules as designed, and create a single version of a system's global state, but firms can find them difficult to understand due to their cryptographic method and the opacities that I discuss in Table 1. The challenge concerns creating a fair balance between ex ante design and ex post resolution. Firms may resolve a dispute that arises from executing a smart contract through "off-the-chain" intervention and arbitration, or they may reach formal legal institutions for resolutions, which suggests strong interplay between smart contracts and legal institutions. In other words, code can become more like the law and the law can become more like code (Werbach & Cornell, 2017; Werbach, 2018b), and, thus, both these elements can contribute to repairing trust in inter-firm business processes. Legal institutions can support such repair of trust by transferring regulatory requirements to the software-development process, by acting as gatekeepers who control and incentivize data quality, or by enabling and intervening in situations that require settlement (Zavolokina, Ziolkowski, Bauer, & Schwabe, 2020). Firms can also achieve such repair of trust by pairing a smart contract that incorporates legalese with a modularized legal contract. Robust repair mechanisms for when a breach occurs positively influence trust dimensions and collaborative business dimensions. I propose a construct, trust repair, and recognize the moderating role it has on the experience of collaborative value creation and capture over time. Thus, I propose:

P5f: Trust repair moderates the influence that collaborative value-creation experience has on perceived trustworthiness.

P5g: Trust repair moderates the influence that collaborative value-creation experience has on propensity to trust.

P5h: Trust repair moderates the influence that collaborative value-creation experience has on firms' efforts to develop shared goals.

P5i: Trust repair moderates the influence that collaborative value-creation experience has on a firm's dependence on other firms' resources and value-creation routines.

Combining these propositions, I developed the nomological network for the feedback path that I present in Figure 4.

As digital platform ecosystems evolve to include more and more organizations by transforming their business models, we need to better understand the role of trust in such platforms (Sundararajan, 2016). We also need to understand how digital technologies change the facets of trust among organizations and the people who run them. In this paper, I comprehensively explain trust in SEBMs in which algorithmic relationships manifest via (centralized or decentralized) smart contacts. In doing so, I develop mechanisms that firms can use to co-create and capture more value and sustain such value over time.
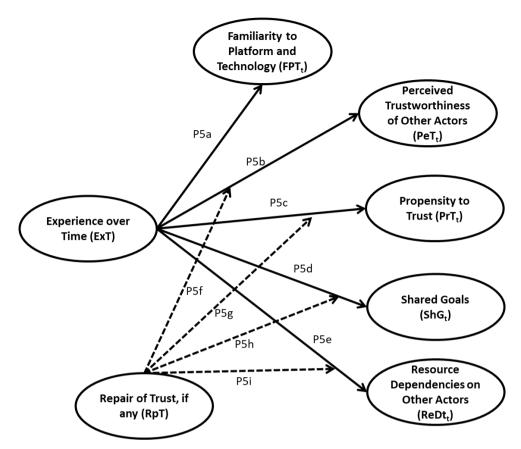
Figure 4. Trust in Digital Platform Ecosystems: Proposed Temporal Relationships

5   Conclusion and Future Research

In this paper, I analyze how value creation in firms has evolved over time and observe that traditional vertical value chains in business ecosystems have begun to give way to loosely coupled coalition and multisided platforms and that the effectiveness of inter-firm collaboration and cooperation plays an important role in creating and capturing value (Osterwalder et al., 2005; Pagani, 2013). Corporations across geographic boundaries have begun to invest in blockchain and IoT-based solutions in digital platform ecosystems given that these technologies can enable their visions. However, they have used various methods to address the challenges associated with standards, regulations, shared governance, and building viable ecosystems (Lacity, 2018). However, when measured through business value creation, the resultant outcomes have been less encouraging possibly because we do not comprehensively understand the way in which technological solutions intertwine with these platform ecosystems' human dimensions. We need to recognize that today's organizations are as much digital as they are social in nature. Accordingly, in this paper, I develop insights into the trust dimensions that shape inter-firm interactions.

I pose the "how" question on smart contracts and focus on some important conditions that shape the trust equations among network participants engaged in algorithmic relationships. I demonstrate how perception about other participants' trustworthiness, a participant's own propensity to trust, participants' shared goals and resource embeddedness in the network, perceived risks in inter-firm interactions, and inter-firm interactions' complexity and time criticality drive firms to adopt smart contracts. Subsequently, I propose that a smart contract algorithm's design and governance moderates the eventual value co-creation and capture. Finally, I argue that, given the lacunae and opacity in their development and implementation stages, smart contracts may not help network participants increase the value they create and capture together. Therefore, the temporal perspective (i.e., participants' experience over time, associated trust repair if a breach occurs, and legal recourse) shape participants' willingness to trust the platform and other participants. I used the classical trust model (Mayer et al., 1995), the TAM (Lee et al., 2003), and the enhanced trust TAM (Söllner et al., 2016) to develop several propositions that capture the interplay of technological advances and legal frameworks in value co-creation by firms.

By drawing on diverse literature from organizational behavior, technology, law, and ethics, I advance our understanding of trust in a seemingly "trust-free" digital network. I find that, even though trust does not constitute a necessary initial condition for a firm to participate in a digital platform network, different trust dimensions contribute to enhancing shared value creation and technological implementations such as smart contracts reinforce these dimensions. Finding support for Hawlitschek et al. (2020), I argue that one need not categorize SEBMs as "trust-free" systems that position smart contracts as an alternative to trust or legal infrastructure. Instead, trust dimensions, smart contract technology, and the legal infrastructure should co-exist to help firms co-create and sustain superior value. Such integration may be necessary when we consider that smart contract technology's building block, black-box AI algorithms, often demonstrate poor explainability and transparency (Robert et al., 2020). These limitations affect all the key trust dimensions in inter-firm relationships—reliability, fairness, and goodwill (Krishnan, Martin, & Noorderhaven, 2005)—and, thus, influence the opportunity for value co-creation. By breaking down smart contract-adoption challenges, identifying the causes that lead to managerial and process issues in algorithm-based governance, and exploring the dichotomy about whether code should be more like the law or the law should be more like code, I explain the associations among important constructs that define trust in technology-enabled inter-firm processes. The term algorithmic relationship that I develop in this paper imbeds these constructs and represents as a significant contribution to the literature on trust in digital platforms. Considering the rapid rate at which businesses across the world continue to adopt smart contracts, the algorithmic relationship concept should play play an important role in specifying how firms may need to collaborate and cooperate among themselves through inter-organizational engagement's lifecycle stages.

Thus, researchers need to empirically assess, define appropriate measures for, and develop hypotheses for the propositions that I propose in this paper. Consequently, these concepts can contribute to efforts to develop global standards for smart contracts in SEBMs, which researchers have identified as a key opportunity area for smart contracts (Chan et al., 2020). These standards may include guidelines for conceptualizing, designing, deploying, and governing smart contracts, which includes mechanisms for legal recourse. Some other critical issues that future research could explore include the perceived opacity in modeling and executing smart contracts and the concomitant legal recourse that pertains to disputes. We may require algorithm developers to follow an open development and implementation approach so that we can maximize algorithmic fairness and transparency to support decision making for social good (Lepri et al., 2018). Considering the growing relevance of algorithmic relationships in inter-firm cooperation, especially in digital platform networks, we need to develop further insights on how smart contracts can recognize the role of trust in inter-firm transactions and optimize shared value creation.

Acknowledgments

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