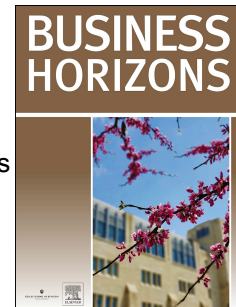


Journal Pre-proof

Mind the gap: Tech-based dispute resolution for disputes in global supply blockchains

Patricia Živković, Denise McCurdy, Mimi Zou, Anjanette H. Raymond



PII: S0007-6813(21)00202-0

DOI: <https://doi.org/10.1016/j.bushor.2021.10.008>

Reference: BUSHOR 1821

To appear in: *Business Horizons*

Please cite this article as: Živković P., McCurdy D., Zou M. & Raymond A.H., Mind the gap: Tech-based dispute resolution for disputes in global supply blockchains *Business Horizons*, <https://doi.org/10.1016/j.bushor.2021.10.008>.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 Kelley School of Business, Indiana University. Published by Elsevier Inc. All rights reserved.

BUSINESS LAW & ETHICS CORNER

Mind the gap:

Tech-based dispute resolution for disputes in global supply blockchains

Patricia Živković,¹ Denise McCurdy,² Mimi Zou,³ and Anjanette H. Raymond⁴

Journal Pre-proof

¹ Lecturer in Law, University of Aberdeen, United Kingdom

² Research Associate, Georgia State University, Center for Engaged Business Research, Georgia, USA

³ Associate Professor in Law, University of Reading, United Kingdom

⁴ Weimer Faculty Fellow; Director, Program on Data Management and Information Governance, Ostrom Workshop; Indiana University, Department of Business Law and Ethics, Kelley School of Business, Indiana, USA

Patricia Živković
University of Aberdeen, School of Law
Taylor Building, Old Aberdeen
AB24 3UB, United Kingdom
patricia.zivkovic@abdn.ac.uk
+44 (0)1224 272556

Denise L. McCurdy
Georgia State University, Center for
Engaged Business Research
3348 Peachtree Rd. NE
Atlanta, GA USA 30326
dmccurdy1@gsu.edu
1.404.405.2672

Mimi Zou
University of Reading, School of Law
Foxhill House, Whiteknights Road
Reading, RG6 7BA, United Kingdom
mimi.zou@reading.ac.uk

Anjanette H. Raymond
Indiana University, Department of Business
Law and Ethics, Kelley School of Business,
1309 E Tenth Street, Room HH 4080J,
Bloomington, IN USA 47405
angraymo@indiana.edu
(812) 855-3449

Correspondence concerning this article should be addressed to Patricia Živković, University of Aberdeen, School of Law, Taylor Building, Old Aberdeen, AB24 3UB, United Kingdom
Email: patricia.zivkovic@abdn.ac.uk

**Mind the gap:
Tech-based dispute resolution for disputes in global supply blockchains**

Abstract

Blockchain for supply chain use cases is quickly becoming a prevalent topic of discussion among distribution giants and smaller players. The actual and perceived benefits of blockchain have driven these discussions, as supply chain partners are well aware of the data protection, increased transparency, and end-to-end authentication of goods that blockchain technology can provide. Track and trace mandates from regulatory bodies are also driving the discussions. However, missing from the dialogue is how partners in this ecosystem manage and resolve disputes using smart contracts inherent in blockchain instead of existing dispute resolution mechanisms and processes. This gap is critical; trust will be eroded if supply chain partners do not have adequate dispute resolution mechanisms within the blockchain ecosystem. This paper highlights the areas of friction and potential disputes for supply chains arising from emerging technology such as Artificial Intelligence (AI), asset management using Internet of Things (IoT), and particularly blockchain, a type of Distributed Ledger Technology (DLT). We discuss the importance of regulation in how the use of DLT in supply chains is managed and suggest principles of resolving inevitable disputes with disparate information. We emphasize the need for portable and enforceable contractual terms and argue that standardizing how disputes are resolved may go a long way to technology adoption.

KEYWORDS: Blockchain, Dispute Resolution, Online Dispute Resolution, Supply Chains

1. INTRODUCTION

By 2026, supply chain experts predict much of the world's global supply chains will function with blockchain as the underlying technology (*Global Blockchain Supply Chain Market*, 2021). Fueling this change is accelerating e-commerce (Chevalier, 2021) and the belief that blockchain promises faster, more efficient, and economical supply chain operations. Indeed, industry practitioners believe that the benefits of blockchain will drive overall adoption, and recent strides have fired the imagination of organizations wishing to improve their supply chains. In a well-publicized example, Frank Yiannas, the former Vice President of Food Safety for Walmart, compared a standard supply chain process with a blockchain-based process to identify the source of sliced mangoes sold in its stores. It took over six days to find where the mangoes came from using the standard procedure. Using a blockchain-based solution, it took approximately two seconds to find the exact producer (Hackett, 2017).

Governments are also spurring blockchain in global supply chains, with supply chain traceability mandates in the United States, such as the Food Safety Modernization Act and the US Digital Supply Chain Security Act (FDA, 2018). The European Union has similar legislation, such as the Falsified Medicines Directive (European Medicines Verification Organisation, 2021). These new baskets of regulations affect many industries, including manufacturers, third-party logistic providers, retailers, and others throughout the ecosystem. Although regulators do not mandate specific technology, blockchain has become the de facto standard to provide the track and trace capabilities that allow businesses to comply with these emerging regulations.

Notably absent from this regulatory conversation is how to handle supply chain disputes when they occur. After all, transporting goods or services from point A to point B requires a

certain level of coordination and a great deal in some cases. The recent challenges of securing adequate Covid-19 vaccines and the subsequent blame-sharing and the \$1 billion in liabilities for missed deliveries for the stuck “Ever Given” in the Suez Canal (Paris, 2021) are stark reminders of the disputes that inevitably occur in highly complex global supply chains. While conventional dispute resolution mechanisms, including mediation, expert determination, arbitration, and litigation, are generally used for disputes arising from supply chains failures (such as the Ever Given case), technology promises to automate the resolution of such disputes. However, as we examine in this paper, tech-based systems of dispute resolution also generate their own problems. Moreover, for such systems to become widely adopted, they need to be designed to guarantee essential principles such as due process and party autonomy to obtain the trust of their users.

Prior to undertaking an in-depth analysis of dispute resolution systems for blockchain-based transactions in global supply chains, a basic understanding of some key terms and considerations of some aspects of the distributed ledger ecosystem is necessary.

A distributed ledger is a “consensus of replicated, shared, and synchronized digital data geographically spread across multiple sites, countries, or institutions” (*Distributed Ledger Technology: beyond block chain*, 2016). Understanding ‘distributed’ is crucial as an essential aspect of distributed ledger technology (DLT). It is generally argued that centralized systems have many positive aspects, such as data integrity. However, the systems are also controlled by a central administrator, and in some cases, this allows the monetization of a centralized system. This power of centralization has been criticized as enabling rulemaking and control by too narrow of participants, sometimes to the significant disadvantage of some individuals and institutions required to use the system. As such, the distributed nature of the distributed ledger, in

theory, allows multiple parties to organize and distribute power throughout the community. However, the absence of a traditional structure and a single authority, or global institution, can lead to issues previously managed by such a system. For example, distributed ledgers demand distribution of authority and some level of consensus. What will happen as entities disagree on the authority to be asserted or decision amongst those who make such determinations?

In this area, the most widely known type of distributed ledger is the blockchain. A 'blockchain' is a specific type of a distributed ledger. A blockchain is essentially a shared database filled with entries that must be confirmed and encrypted. An easy way to understand is to think of it as a highly secure and verified Office 365 document. Each document entry is dependent on a logical relationship to all its predecessors. The name blockchain refers to the "blocks" that get added to the chain of transaction records. To facilitate block management, the technology uses cryptographic signatures called a hash.

The blockchain is then often considered in terms of the structure of governance. For example, some blockchains are permissioned (or private). A permissioned blockchain is developed and maintained by a private organization(s) that has authority over the process and consensus algorithm. The private organization(s) decides who can join the network and download nodes. Permissioned blockchains allow for many customization options. These include allowing anyone to join the permissioned network after suitable verification of their identity and allocating select and designated permissions to perform only certain activities on the network. Such blockchains are built so that they grant special permissions to each participant. This allows participants to perform specific functions such as read, access, and write information on the blockchains. In contrast, in a permissionless blockchain, anyone is free to join and participate in the core activities of the blockchain network.

While this introduction to the technology is very brief, there are four main points regarding distributed ledgers relevant to this paper: (1) not all distributed ledgers are ‘organized’ in the same manner – some are permissioned, and some are permissionless; (2) as such, many entities create their own distributed ledger for their own purposes; (3) consequently, the distributed ledgers do not – nor are they designed – to speak to one another; and (4) there is a competitive advantage to having and controlling – or being in charge of – the permissions within a ledger.

One of the most exciting applications of DLT to date is the use of blockchain-based smart contracts. The concept of smart contracts preceded the arrival of blockchain technology. Perhaps the most cited definition is Nick Szabo in 1994 when he described smart contracts as ‘computerized transaction protocol that executes the terms of a contract’ (Szabo, 1997). The advent of blockchain has made Szabo’s notion of smart contracts practically significant. Smart contracts running on a blockchain network like Ethereum can enable the creation and enforcement of an agreement autonomously through computer code. As soon as the parameters or conditions laid down in the code are satisfied, the smart contract automatically executes the transaction in a distributed manner by the nodes in the network. Smart contracts are said to benefit from blockchain’s security and tamper resistance, which render transactions nearly unalterable and irreversible. There is also no need to rely on a single centralized authority, trusted intermediary, or external enforcement mechanism.

While blockchain-based smart contracts can automatically implement the terms of an agreement between parties and reduce the risk of human error or manipulation, smart contracts have real-world elements. These elements can result in disputes, for instance, when the relevant code does not perform as intended or when external contingencies occur in the performance of

the agreement that was not originally memorialized in the code.

In this paper, we analyze how best to resolve disputes that can arise from the use of blockchain technology in global supply chains, which exemplify one of the most common contexts in which such technology is being deployed. Drawing on the findings of semi-structured interviews with twenty supply chain practitioners responsible for blockchain deployments for their respective organizations (McCurdy, 2020), we identify the various types of disputes that arise from the use of distributed ledgers in global supply chains. We consider conventional mechanisms of dispute resolution (“DR”) that parties have used to resolve supply chain disputes. We then examine the challenges for tech-based DR. Finally, we consider what would constitute an effective framework for resolving blockchain-related disputes in a supply chain context. Such a framework should guarantee due process while maintaining party autonomy and efficiency of the process.

2. THE SUPPLY CHAIN ON A DISTRIBUTIVE LEDGER

There is considerable optimism among supply chain actors regarding the potential of blockchain to transform business and commerce. In our interviews, some industry players even stated that blockchain would become as pervasive and foundational as the Internet:

“It’s like the Internet, like a company that’s not on the Internet would just be strange. Right? Like it would be hard to imagine how they’re doing business. So I view eventually that’s how pervasive participation in a blockchain network and the data sharing that will be enabled by it will be.” (*CEO, small firm, Health and Life Sciences*)

And,

“I think the blockchain is going to be five to 10 years from now where e-commerce is today. We’re not even going to think about it. It’s just going to be running in the background.” (*CRO, large firm, Information Technology*)

As described above, blockchain’s various characteristics are viewed as ideal for addressing a range of typical supply chain failures, as shown in Figure 1 (Kamilaris et al., 2019). Using a simplified example of organic wheat, the provenance of the grain requires certifications of organic farming practices, including non-GMO seed and fair-trade practices. These certifications can be faked with relative ease (Kamilaris et al., 2019), introducing disputes from the very beginning of the supply chain should consumers – increasingly concerned about the origins of their food – become aware. Counterfeit or non-certified products can be disastrous for brands charging a premium for their organic product, and contract violations can trigger fines, revoke payments, or pause production (Kamilaris et al., 2019).

Environmental monitoring throughout the supply chain is another area where disputes can occur. In our example in Figure 1, organic wheat requires consistent and constant temperature and humidity levels, and these levels must be tracked from farm to table. Though the number of supply chain hand-offs in our example is simplified, in the real world, there are likely to be multiple farmers, carriers, factories, and distribution centers prior to the destination at the retailer (Salah et al., 2019). Environmental violations can be difficult to prove (or disprove), leading to disputes in the oft-fragmented process.

Delays are another prime source of disputes, as downstream delays from one supplier can affect the entire chain. The delays can be caused by several factors, including weather disruptions, fluctuating availability of raw materials, hold-ups in customs, driver shortages, and invoice discrepancies. These delays can impose excess freight and warehousing costs, including

disputes regarding the party responsible for bearing these cost overruns.

[Insert Figure 1 here]

To illustrate how a blockchain-based system can address a typical supply chain dispute, Figure 2 below represents a supply chain for a fictitious mining company. The image depicts the disputes that may arise throughout the process arising from the discontinuity of information at different stages. Using blockchain-based smart contracts, the data associated with each transaction is sent and recorded on each node of the relevant companies in the supply chain. As such, the system can integrate inventory, information, and financial flows between all transacting parties, even where the parties are not known to each other or trusted by one another.

[Insert Figure 2 here]

There are nevertheless challenges in such a system. Disputes may still arise because of the inability of parties to anticipate future contingencies, the difficulties to accurately identify and describe contingencies, and the need for negotiated courses of actions ex-ante should disputes occur. Of course, these challenges are not unique to blockchain-based supply chains but occur in business relationships without blockchain or other emerging technology.

There is currently a regulatory lacuna in specific processes and mechanisms for resolving these disputes on blockchain-based supply chains. Individual firms are left to their own devices, and many firms recognize the legal challenges that applications of DLT in the supply chain bring. We studied interviews with several firms in supply chain and logistics, which highlighted this problem:

“So, outsiders, start-ups, come in and say, you guys in the supply chain should be driving more efficiencies by doing this on a blockchain. Well, I had to brief the chief legal

counsel...he was very concerned...he goes, wah, you know, looks like a quagmire.”

(Manager, large firm, Supply Chain)

And,

“And I said [to the FDA lawyers], these things called smart contracts are coming up, and you’re going to have to at least interface or talk to technical folks to approve these contracts, and they’re going to be written in code, not in English. And they looked at me like I had two heads.” *(Founder, large firm, Pharmaceutical)*

These two reflections from our study highlight one of the main issues for adoption: the uncertainty of how the system will work without human intervention, especially when things go wrong. Appropriate mechanisms for resolving disagreement, conflict, and disputes must be a focus of any DLT ecosystem.

3. EXISTING MECHANISMS FOR RESOLVING DISPUTES

Before discussing how best to approach the mechanisms for dispute resolution for disputes within the DLT ecosystem from the regulatory point of view, a brief introduction to the conventional mechanisms to resolve commercial disputes arising from global supply chains is necessary. The default method for dispute resolution has been litigation before the courts, whereas the other methods are often called “alternative dispute resolution” (ADR) methods. However, the term ADR is misleading to an extent. Whereas litigation is traditionally the default route for many disputes, ADR methods have become increasingly popular in supply chain disputes, such as arbitration in international commercial matters. Hence, it would be more accurate not to address these methods as “alternative” but instead to speak about the most “appropriate” method for a specific dispute.

In the context of a blockchain-based system, when stepping “off-chain” to resolve a dispute, the parties will generally submit their disputes to more conventional forums involving human decision-makers. There is a continuum of these methods. When choosing a method or various methods from the DR continuum, parties will consider various factors, such as control over the process, the available outcome(s), formality, and flexibility. In most cases, there is one non-negotiable consideration for the parties, the fairness of the process, which should be served through any one of the DR methods.

In this paper, we focus on three main types of conventional ADR methods that are important for understanding (autonomous) tech-based DR in conceptual and practical terms. These are mediation, expert determination, and arbitration. There are also several other ADR methods, such as negotiation, conciliation, and early neutral evaluation. In contrast to litigation, ADR methods generally operate on a consensual basis, that is, the parties to the transaction must *agree* to the selected method(s) for resolving their disputes. Similarly, tech-based DR mechanisms operate based on the parties’ consensus.

3.1. Mediation

Mediation generally involves a neutral third party (the mediator) assisting the parties to reach an agreement to settle their dispute. Due to the consensual nature of the process, mediators do not have the power to impose a final and binding decision on the parties. If the parties reach an agreement to settle, the settlement agreement is enforced as a contract between the parties. If the dispute remains unresolved, parties can still resort to arbitration or other forms of ADR or litigation. Compared to other DR methods, mediation is less formal and typically cheaper and quicker and enables parties to maintain control over the process and outcome. As a less-adversarial form of ADR, mediation can be particularly useful where parties are keen to preserve

an ongoing relationship. A good mediator will usually encourage the parties to find solutions to the dispute that serve the parties' common interests. The process and outcome of mediation are also confidential (Shonk, 2021).

A traditional drawback of mediation is that it typically does not have the enforcement strength of litigation or arbitration. Settlement agreements have the binding force of a contract between the parties. In many jurisdictions, there is no other way of enforcing a settlement agreement except through initiating fresh legal proceedings. However, the United Nations Convention on International Settlement Agreements Resulting from Mediation ("Singapore Mediation Convention," *United Nations Commission on International Trade Law*, 2018) has bolstered the enforceability of cross-border settlement agreements. Settlement agreements are enforceable in the courts of signatory states without requiring the parties to commence new proceedings. The Convention sets out a few grounds based on which a competent authority such as a court may refuse enforcement of the settlement agreement. These grounds include the parties' incapacity, the invalidity or incomprehensibility of the settlement agreement, a breach of standards applicable to the mediator, issues relating to the mediator's lack of independence and impartiality, public policy, and the inability of a dispute to be subject to mediation as provided in Article 5 of the Singapore Mediation Convention (*United Nations Commission on International Trade Law*, 2018).

3.2. Expert determination

Expert determination involves impartial experts providing an opinion or determination on a specific matter referred to them by the parties. Expert determination can be particularly useful where the issue in dispute is relatively narrow and specific, *e.g.*, a valuation dispute where the answer can be determined by an appropriate technical expert (Gangjee et al., 2021). Depending

on the parties' agreement, the outcome of expert determination may be binding or non-binding. Like other ADR processes, expert determination can only take place if the parties have agreed to it. The parties may include an expert determination clause in their principal contract as a mechanism to deal with future issues or disputes arising under the contract (WIPO, 2021). If a dispute has already occurred, but there is no such clause in the relevant contract, it may be referred to expert determination upon the parties' agreement. Expert determination can be used on its own as a stand-alone process or as a part of or in connection with mediation, arbitration, or litigation.

3.3. Arbitration

Arbitration is an adjudicatory ADR method in which the parties voluntarily submit their dispute to a chosen arbitrator (or several arbitrators) who will give a binding and final decision (known as an award) based on the parties' rights and obligations. There must be an agreement between the parties to the contract to refer disputes to arbitration. The arbitration provision or clause in the parties' contract usually sets out the key aspects of the arbitral process, including the seat (place) of arbitration, the number of arbitrators to be appointed, and the procedural rules of the arbitration. The choice of the seat of arbitration can be an important consideration for parties since the arbitration will take place within a legislative framework that determines the level of support the courts in the selected seat will provide, the enforceability of any award, and the scope for parties to challenge the award. Generally, arbitration forecloses court options. One important difference between judicial determination by a court and an arbitral award is that the former will have *erga omnes* effects (i.e., binding third parties), whereas the latter will only have *inter partes* effects (i.e., binding the parties to the dispute) (Gangjee et al., 2021).

The procedural rules will depend on whether the arbitration is ad hoc or institutional.

Parties to an ad hoc arbitration choose their own arbitrator or arbitral tribunal without reference to an established arbitral institution and select their own rules and procedures governing the arbitration proceedings (including adopting or adapting a set of established arbitral rules such as the UNCITRAL Arbitration Rules). In general, the procedural rules would typically cover the entire process, including the commencement of the arbitration, constitution and establishment of the arbitral tribunal, the conduct of the proceedings, rendering of awards and other decisions, determination of fees and costs, and confidentiality.

Under most arbitral institutions' procedures, parties put forward their case via written submissions together with any documentary, factual, and expert evidence before the tribunal. There may be interim hearings to agree on timetables and other interlocutory hearings. The arbitration concludes in a hearing in the selected seat, and a final award is issued by the tribunal. Arbitral institutions regularly revise their rules in line with users' needs and preferences as well as related domestic and international regulatory developments (Gangjee et al., 2021). Numerous arbitral institutions have adapted their proceedings in light of the disruptions brought by the global outbreak of the Covid-19 pandemic, including protocols, model procedural orders, and guidelines for virtual hearings.

Arbitration is typically popular for large or high-value commercial disputes, particularly international commercial disputes. In practice, arbitration's relevance to claims of small or medium value has been limited to date (Cartoni, 2015). This is because arbitration tends to be expensive, time-consuming, and requires extensive legal advice and representation. The ease of cross-border enforcement of arbitral awards is commonly viewed as a key advantage of arbitration. The Convention on the Recognition and Enforcement of Foreign Arbitral Awards ("New York Convention," *United Nations Commission on International Trade Law*, 1958)

provides for the reciprocal enforcement of arbitral awards in over 160 countries. Awards falling under the New York Convention may only be challenged in limited circumstances or grounds, namely the contracting parties' incapacity, the invalidity of the arbitration agreement, procedural failures, scope of the arbitration agreement, arbitrability of the matter, and public policy.

3.4. Continuum of DR methods

[Insert Figure 3 here]

As Figure 3 shows, when choosing a conventional DR method, the parties usually consider how much control they wish to contain over the process. Methods other than litigation generally offer much more control over the procedure overall. Still, on the continuum, these methods differ by the level of formality and the control of the process. Another factor to consider is how much control parties seek to have over the outcome. If this is an important consideration, parties should opt for a method that allows them to reach a decision on their own, *i.e.*, settlement by way of negotiation or mediation, or at least to have a choice to accept a decision formulated by a third party, such as non-binding forms of conciliation or expert determination.

Given the role that blockchain technologies can play in evidencing the physical flow in global supply chains and the potential of a tech-based system in resolving disputes arising from supply chains, a question remains whether a DR mechanism intrinsic to the disputes on the distributed ledger would be a superior solution than the traditional methods of DR described above. We explore the key characteristics of tech-based DR in the next section.

4. A FRAMEWORK FOR (AUTONOMOUS) TECH-BASED DISPUTE RESOLUTION FOR DISPUTES ON A DISTRIBUTIVE LEDGER

Tech-based DR mechanisms should be contextualized as part of recent trends towards the digital transformation of DR. To date, the focus has been on the integration of digital

technologies in existing DR processes. This is reflected, for example, by the Draft Discussion Paper issued by the European Bank for Reconstruction and Development (EBRD) in October 2020 that examined the range of digital tools used in commercial disputes brought before courts in 20 jurisdictions, especially focusing on developments arising in the context of COVID-19 (Bradautanu et al., 2020). The Discussion Paper distinguished between the concepts of digitalization and digital transformation. Digitalization in the courts' context involves the "transfer of information or processes to digital form" while digital transformation concerns "rethinking court processes in their entirety to ultimately increase access to courts and court user satisfaction" (Bradautanu et al., 2020, p. 4). The Discussion Paper considered the development of "online courts" in numerous jurisdictions, which consist of electronic filing, electronic service of process, online payment of court fees, electronic court management system, online/remote hearings, and electronic enforcement. In some jurisdictions, online dispute resolution systems involving online negotiation, facilitation, or mediation are also being considered (Bradautanu et al., 2020). The Discussion Paper also highlights the importance of national legislation to support such reforms (Bradautanu et al., 2020).

Online Dispute Resolution (ODR) has emerged as an increasingly studied topic. There is no uniform and widely accepted definition of ODR. ODR can be conceptualized as a spectrum of DR mechanisms with the help of information communication technology (ICT) and the Internet, although the latter is not necessary in all cases. Richard Susskind, in his book on online courts, defined them as DR methods that "participants need [not] be available at the same time for a case to progress" and "as with email and text messages, those who are involved do not need to be on tap simultaneously – arguments, evidence, and decisions can be sent without sender and recipient being physically or virtually together at the same time" (Susskind, 2021, p. 60).

In this paper, we focus not only on digital tools that can be integrated into the conventional DR processes but also on autonomous tech-based systems that may achieve the digital transformation of DR in global supply chains. Just as the traditional DR continuum, there is a tech-based continuum, although the opposite points on such a continuum are defined through different criteria. The tech-based DR methods also do not need to encompass the whole full DR process, but it can involve a tech-based assisting system replacing aspects of the traditional DR or a fully autonomous adjudicative DR method.

Accordingly, we have identified five types of tech-based DR methods which fundamentals are necessary for understanding tech-based DR in conceptual and practical terms:

- Tech-based assistant in arbitration or litigation is a non-binding tech-based DR method used for factual or legal findings, which to become binding on the parties in dispute need to be accepted by the human decision-maker in litigation or arbitration (LexMachina, 2021);
 - Tech-based conciliation is a conciliatory (non-adjudicatory) tech-based DR method, in which an automated solution is provided by a program, which needs to be accepted by the parties to become binding for them;
 - Truth-seeking through technology is a tech-based DR method in which a program provides a report which is binding for the parties in terms of factual findings, to which the parties consent in advance;
 - Tech-based expert is an adjudicatory tech-based DR method, in which the program provides a binding expert report, to which the parties consent in advance;
- and

- AI-based adjudication is a full-blown adjudicatory tech-based method that delivers a decision binding for the parties and enforceable as a court judgment or an arbitral award.

[Insert Table 1 here]

It should be said that tech-based and traditional DR mechanisms are not mutually exclusive but are complementary and may best be measured by degree. For example, there are various instances where blockchain and other technologies are deployed to support conventional processes of arbitration or litigation, such as the verification of submitted evidence or the enforcement of an arbitral award. In contrast, there are other instances where disputes are resolved on-chain by smart contracts but are later challenged through conventional DR processes. Accordingly, the distinction can be blurry and should not be viewed in absolute terms. When compared with conventional DR methods, the consensus-based nature of tech-based DR mechanisms is more akin to that of ADR mechanisms instead of litigation.

When choosing a conventional DR method, the factors considered will probably not be leading aspects when selecting a tech-based DR method. The similarity can be found in the importance of the consideration on whether the parties want the binding decision at the end of the technological process or not. On the other hand, the formality of the process will not play a role at all in tech-based DR methods, whereas the control over the process will depend on the policymakers and future regulation. Another question that might be of more importance when it comes to tech-based DR methods is whether parties want a resolution of a factual dispute or a dispute on the application of the law. And lastly, the primary consideration is whether the parties in a supply chain are ready to increase efficiency, as the main concern in today's dispute resolution by decreasing human involvement in decision making as shown here:

[Insert Figure 4 here]

The continuum is spread between simpler forms of tech-based DR mechanisms that substitute an element of a dispute procedure, such as a research assistant or fact-finding aspects. Further, a tech-based DR can cover a more complex coded procedure that substitutes a whole conciliation process or an expert report. Finally, there is AI-based adjudication, a fully autonomous tech-based dispute resolution procedure that results in a binding decision, as will be discussed below. As defined above, tech-based DR mechanisms are to be defined, in simple terms, as a form of coded procedure for a full-blown dispute resolution process or for an aspect of the traditional DR. When combined with simpler forms of ODR, such as cross-examination of witnesses via videoconference or the use of e-documents, one inevitably concludes on the resemblance of these spectrums to the digital transformation. They reflect the digitization and digitalization process, focusing on how the information is recorded and on the effective use of information saved in digital form (Aron & Waller, 2014, p. 2; Schallmo & Williams, 2018, pp. 4-6). The systems can be isolated, such as in the case of videoconferencing or entirely immersed into the process, and as recognized in the ODR literature, digital transformation leads to the recognition of the technology as the 4th party in DR processes (Aron & Waller, 2014; Katsh & Rabinovich-Einy, 2017, p. 32).

At this stage of digital transformation, tech-based DR is still at the level of the business process reengineering stage as the existing tech-based DR systems are still rule-based, i.e., the processes are based on automated decision making following the set rules (Schallmo & Williams, 2018, p. 6). A fully autonomous system that would be data-driven rather than rule-based would present a next step in the digital transformation of DR (Schallmo & Williams, 2018, p. 6).

Such an *autonomous adjudicative tech-based dispute resolution mechanism* is to be defined, in simple terms, as a coded procedure for a final dispute resolution. The process of decision-making, the consideration of evidence and facts, and the final product of every dispute resolution process – a decision on the subject matter – is to be resolved *autonomously, i.e.*, through automated decision-making based on the coded rules prescribed in advance. An additional step may be added, which is the execution of the decision made by virtue of technology as well. However, the execution of a decision on the chain is not determinative for the process to be considered an *autonomous adjudicative tech-based DR mechanism*. What is determinative is the absence of human intervention in the decision-making process. In other words, an autonomous adjudicative tech-based DR system entails *automated decision-making*. This does not preclude human intervention that commits the dispute to different stages of the DR process or human intervention that is requested by the system, for example, the submission of additional evidence.

[Insert Figure 5 here]

Choosing these methods to resolve disputes arising in the supply chain context is most likely motivated by efficiency considerations. At the same time, tech-based DR mechanisms may promote accuracy in the process of decision-making and participation in terms of increasing access to justice (Devanesan & Aresty, 2012, pp. 270-271). It is a valid argument to say that tech-based DR mechanisms could increase the accuracy, while at the same time, one needs to be aware that the participatory aspect will heavily depend on digital literacy. To test the extent to which these methods serve procedural justice, it is left to see is whether they would also provide a required due process standard.

5. AN EFFECTIVE FRAMEWORK FOR TECH-BASED DR IN A SUPPLY BLOCKCHAIN

As described above, the tech-based DR process in a supply chain environment can serve as the first step of examination in the creation of dispute resolution more generally. This is because, in some sense, on-chain disputes may not be disputes at all as they are self-executing – a hallmark of the attractiveness of the use of distributive ledgers in the supply chain environment. But on-chain disputes are, like any transaction, subject to challenges. And where these challenges arise, it is important to view them through the lens of more traditional disputes as an arbitral institution or national court would. Accordingly, the bulk of this section discusses both tech-based and traditional DR from the traditional terminology of commercial arbitration despite the obvious practical differences.

In that sense, what we find particularly important to look at is how the legal principles, e.g., confidentiality, party autonomy, and right to be heard, translate into tech language. To this date, there is no legal framework that comprehensively deals with these and other due process aspects for on-chain disputes. However, from the regulatory stance, the recent Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts COM/2021/206 final (“EU AI Act Proposal”) (Eur-Lex, 2021) provided in Point 8 of Annex III identifies which AI systems in the administration of justice and democratic processes are to be considered high-risk AI systems, and it lists:

“(a) AI systems intended to assist a judicial authority in researching and interpreting facts and the law and in applying the law to a concrete set of facts.”

It is concerning that only the term “judicial authority” is mentioned, and this should be considered an incomplete consideration of the use of AI systems in dispute resolution, as there are many adjudicative dispute resolution mechanisms, such as arbitration, adjudication, and expert determination, that might engage with AI systems in the same manner. This would leave the parties to those disputes in a more vulnerable position, and it would undermine the use of dispute resolution methods alternative to national courts. Hence, hopefully, the EU Commission will remedy this in future drafting. Still, arguably, this point would not adequately address completely autonomous tech-based DR methods, as it deals only with those systems that assist a decision-making authority.

We are aware that the legitimacy of tech-based DR heavily depends on the trust the parties can lay into the legal framework, especially the one for the enforcement of the parties’ agreements to submit their disputes to a particular dispute resolution method and the enforcement of the decisions rendered by virtue of technology. When discussing these matters, we will use the New York Convention as a backbone of discussion, which provides the main framework for the global enforcement of arbitral awards. These provisions should be used as a template when considering possible issues around and arguments against the enforcement of the decisions made via technology. We are aware that a new international tool would be needed to address these issues properly and in a uniform manner, but at this stage, we are aiming at identifying the areas that will need regulation. It is also important to mention that in the meantime, the issues below will heavily depend on national laws of the place of enforcement of decisions made via technology.

5.1. Party Autonomy in Tech-Based Dispute Resolution

As mentioned above, the tech-based dispute resolution methods are consensual, *i.e.*, they

are based on a parties' agreement. In that regard, several issues might arise when it comes to the enforcement of such an agreement. In the case of arbitration, Article II of the New York Convention provides that

[e]ach Contracting State shall recognize an agreement in writing under which the parties undertake to submit to arbitration all or any differences which have arisen, or which may arise between them in respect of a defined legal relationship, whether contractual or not, concerning a subject matter capable of settlement by arbitration (*United Nations Commission on International Trade Law*, 1958).

Having this in mind, questions that follow from the consensual nature of the tech-based dispute resolution are:

- a. What is the most appropriate form for an agreement to resolve disputes via tech-based DR, and what are possible legal issues surrounding the chosen form?
- b. Which disputes, both contractual and non-contractual, can be submitted to such dispute resolution method?

There was a good reason for adjudicative DR methods to be based on an agreement "in writing" in the past, mainly for evidencing the will of the parties. However, even that standard has been adjusted by allowing the electronic communication to be recognized as an agreement "in writing," with some jurisdictions going that far that an oral agreement to arbitrate was deemed sufficient under the national law.

It is not impossible to assume that supply chain contracts will retain a written form one way or the other, allowing for these traditional dispute resolution clauses to be included for tech-based dispute resolution methods. Still, it is reasonable to assume that the submission of disputes

to tech-based dispute resolution methods will be concluded in the form of a smart contract, which then may involve a series of new issues regarding evidencing a freely and validly concluded agreement. The existence of digital commerce is well recognized in the international community already. For example, the United Nations Convention on the Use of Electronic Communications in International Contracts (*United Nations Commission on International Trade Law*, 2005) has 15 parties to the Convention. In general, many other States have adopted domestic law in electronic signatures and electronic contracts' enforceability. The vast majority of these Conventions and domestic laws (often based on the UNCITRAL Model Law on Electronic Commerce (*United Nations Commission on International Trade Law*, 1996) recognize the validity of an electronic signature and require enforcement of an electronic contract. As such, in general, it is very difficult to argue electronic signatures and electronic contracts - which are not technically 'in writing' – are not enforceable in the majority of jurisdictions. Electronic contracts and electronic signatures created in a digital world are enforceable in the vast majority of jurisdictions.

5.2. Due Process in Tech-Based Dispute Resolution

Once the agreement to refer parties' disputes to a tech-based DR method is enforced, the automated process may proceed. This, however, does not put a full stop when it comes to *post facto* arguments against the final decision at the enforcement stage. In the field of international arbitration, these arguments are based on due process considerations, and they include some of the following considerations:

- whether the parties to the agreement, under the law applicable to them, were under some incapacity, or the said agreement is not valid under the law to which the parties have subjected it or, failing any indication thereon, under the law of the

country where the arbitral award was made;

- whether the party against whom the award is invoked was not given proper notice of the appointment of the arbitrator or of the arbitration proceedings or was otherwise unable to present his case;
- whether the award deals with a difference not contemplated by or not falling within the terms of the submission to arbitration, or it contains decisions on matters beyond the scope of the submission to arbitration, provided that, if the decisions on matters submitted to arbitration can be separated from those not so submitted, that part of the award which contains decisions on matters submitted to arbitration may be recognized and enforced;
- whether the subject matter of the difference is not capable of settlement by arbitration under the law of that country;
- whether the recognition or enforcement of the award would be contrary to the public policy of that country.

These grounds are internationally recognized as the minimum due process grounds that need to be guaranteed in every arbitration procedure. We suggest adopting a similar approach when it comes to tech-based dispute resolution by providing a similar list of minimum requirements for due process to be integrated into the process:

- a. The parties to the contract must have the capacity to conclude such an agreement on tech-based DR method, and the agreement needs to be valid,
- b. The parties must receive notices about the process to effectively exercise their

right to be heard

- c. The decision in tech-based DR must be rendered within the mandate set by the parties.
- d. The dispute must be admissible, *i.e.*, it needs to concern the right and obligations that the parties are allowed to resolve through a consensual adjudicative dispute resolution method.
- e. Finally, the decision should not be against the country's public policy in which it is to be enforced.

6. RECOMMENDATIONS

From a business consideration point of view, the recommendations are expansive but manageable:

1. Resolve prior sources of legal conflicts with supply chain partners before embarking on blockchain and smart contracts. Technology in and of itself will not improve past contract failures but instead represents "papering over the cracks."
2. Ensure business process owners and legal teams are involved early in the technology discussions. Process owners will have a more comprehensive understanding of past pain points, *i.e.*, historical driver shortages causing delays and thus a need for reconciliation exercises.
3. Remedy systemic problems prior to blockchain implementation and develop performance metrics specific to blockchain for the agreed minimum viable ecosystem and associated processes.

4. Consider the use of Figure 3 as a guide to the dispute mechanisms for each blockchain process. For example, invoice reconciliation below a specific value may automatically trigger a smart contract award, but any amount over the threshold may generate a “stop clause” in the smart contract to allow for human intervention.

From a legal point of view, much work is still required to support the widespread adoption of smart contracts:

1. The community must begin to identify and address the definitional distinctions in ‘on-chain’ and other types of issues arising within the supply chain environment.
2. The community must embrace dispute resolution to resolve all disputes and may benefit from an arbitration institution developing specific institutions, rules, and procedures for the resolution of smart contract disputes, including on-chain and off-chain issues.
3. Work needs to be done within the legal community to fully consider due process requirements and to insist on adherence to those requirements within the smart contract dispute resolution environment.
4. The autonomous tech-based DR and the segmented tech-based DR should be specifically regulated as the concept of national justice does not sit well within the emerging global digital society.

7. CONCLUSION

As has been revealed in this paper, technology - especially in the supply chain ecosystem, is an area of exponential growth. Yet, the increased reliance on technology has left key areas of discussion unresolved, especially in the use of various potential mechanisms of resolving conflict within the digital supply chain. Of course, digital tools can (and should) be integrated into the conventional DR processes. Yet, in many instances, one can imagine autonomous tech-based systems as an essential part of resolving disputes in the global supply chains. Just as the traditional DR continuum, there is a tech-based continuum. The authors have explained and considered the main issues within the tech-based continuum of dispute resolution systems. Although a different set of criteria are necessary, as can be seen, the new criteria are still compliant with the main legal text that makes the outcomes enforceable, that being the New York Convention. Of course, issues remain, and further conversations must occur within the tech-legal community. Yet, none of these issues are insurmountable; they are merely guideposts for future regulation. As such, the blockchain-driven global supply chain should embrace the very real possibility that the dispute resolution of the future may just be fully technology-driven.

REFERENCES

- Aron, D., & Waller, G. (2014). Taming the digital dragon: The 2014 CIO agenda. *Gartner.com*, 12. https://www.gartner.com/imagesrv/cio/pdf/cio_agenda_insights2014.pdf
- Bradautanu, V., Chelioti, C., Zghibarta, P., & Skoryk, L. (2020). *From digitisation to digital transformation*.
- Cartoni, B. (2015). Small Claims and Institutional Arbitration: An Overview. Available at SSRN 2641318. <https://doi.org/https://doi.org/10.2139/ssrn.2641318>
- Chevalier, S. (2021). *Global retail e-commerce sales 2014-2024*. Statista. <https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>
- Devanesan, R., & Aresty, J. (2012). ODR and Justice—An Evaluation of Online Dispute Resolution’s Interplay with Traditional Theories of Justice. *Online Dispute Resolution: Theory and Practice A Treatise on Technology and Dispute Resolution*, 270-271.
- Distributed Ledger Technology: beyond block chain*. (2016). Government Office for Science (UK). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf
- Eur-Lex. (2021). Proposal for a regulation of the European Parliament and the Council laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union legislative acts. *EUR-Lex-52021PC0206*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0206>
- FDA. (2018). *FDA food safety modernization act*. U.S. Department of Health and Human Services. <https://www.fda.gov/Food/GuidanceRegulation/FSMA/default.htm>
- Gangjee, D., Zou, M., & Bora, A. (2021). *Alternative Dispute Resolution (ADR) mechanisms in B2B digital copyright disputes*. University of Oxford, Faculty of Law. <https://www.law.ox.ac.uk/news/2021-09-13-faculty-members-co-author-report-use-alternative-dispute-resolution-adr-mechanisms>
- Global Blockchain Supply Chain Market*. (2021). Research and Markets. <https://www.researchandmarkets.com/reports/5304951/global-blockchain-supply-chain-market-by-offering>

- Hackett, R. (2017). *Why big business is racing to build blockchains*. Fortune, Inc. <http://fortune.com/2017/08/22/bitcoin-ethereum-blockchain-cryptocurrency/>
- Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2019, 2019/09/01/). The rise of blockchain technology in agriculture and food supply chains. *Trends in Food Science & Technology*, 91, 640-652. <https://doi.org/https://doi.org/10.1016/j.tifs.2019.07.034>
- Katsh, E., & Rabinovich-Einy, O. (2017). *Digital Justice*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780190464585.001.0001>
- LexMachina. (2021). LexMachina. <https://lexmachina.com/legal-analytics/>
- McCurdy, D. (2020). The Role of Collaborative Governance in Blockchain-Enabled Supply Chains: A Proposed Framework. https://scholarworks.gsu.edu/bus_admin_diss/131/
- Organisation, E. M. V. (2021). *Introduction to the European Medicines Verification System (EMVS)*. <https://emvo-medicines.eu>
- Paris, C. (2021). Ever Given Customers Face New Payments to Get Shipments Moving. *WSJ, Inc.* https://www.wsj.com/articles/ever-given-customers-face-new-payments-to-get-shipments-moving-11618341378?mod=searchresults_pos5&page=1
- Salah, K., Nizamuddin, N., Jayaraman, R., & Omar, M. (2019). Blockchain-based soybean traceability in agricultural supply chain. *IEEE Access*, 7, 73295-73305.
- Schallmo, D., & Williams, C. (2018). *Digital Transformation Now!* Springer. <https://doi.org/10.1007/978-3-319-72844-5>
- Shonk, K. (2021). *Types of Mediation: Choose the Type Best Suited to Your Conflict*. Harvard Law School. <https://www.pon.harvard.edu/daily/mediation/types-meditation-choose-type-best-suited-conflict/>
- Susskind, R. (2021). Online Guidance. In *Online Courts and the Future of Justice*. Oxford University Press. <https://doi.org/10.1093/oso/9780198838364.001.0001>
- Szabo, N. (1997). Formalizing and Securing Relationships on Public Networks. *first monday*, 2(9). <https://firstmonday.org/ojs/index.php/fm/article/view/548>
- United Nations Commission on International Trade Law. (1958). <https://uncitral.un.org/en/texts/arbitration>

United Nations Commission on International Trade Law. (1996).
https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_commerce

United Nations Commission on International Trade Law. (2005).
https://uncitral.un.org/en/texts/ecommerce/conventions/electronic_communications

United Nations Commission on International Trade Law. (2018).
https://uncitral.un.org/en/texts/mediation/conventions/international_settlement_agreements

WIPO. (2021). <https://www.wipo.int/portal/en/index.html>

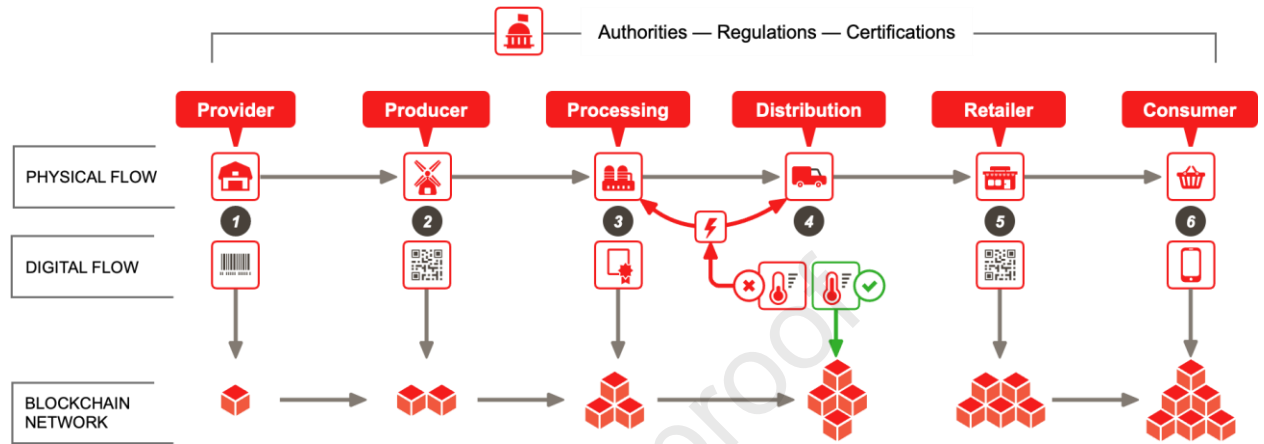
TABLES

Table 1

	Facts or law	Binding or non-binding for the parties	Regulation
Tech-based assistant in arbitration or litigation	Facts	Subject to the decision-maker	- national laws (where available), - EU AI Act Proposal qualifying it as high-risk AI (August 2021)
Tech-based conciliation	Facts and law	Non-binding	N/A
Truth-seeking through technology	Facts	Binding	- national laws (where available), - EU AI Act Proposal qualifying it as high-risk AI (August 2021)
Tech-based expert	Facts and law	Binding	- EU AI Act Proposal qualifying it as high-risk AI (August 2021)
AI-based adjudication	Facts and law	Binding	- EU AI Act Proposal qualifying it as high-risk AI (August 2021)

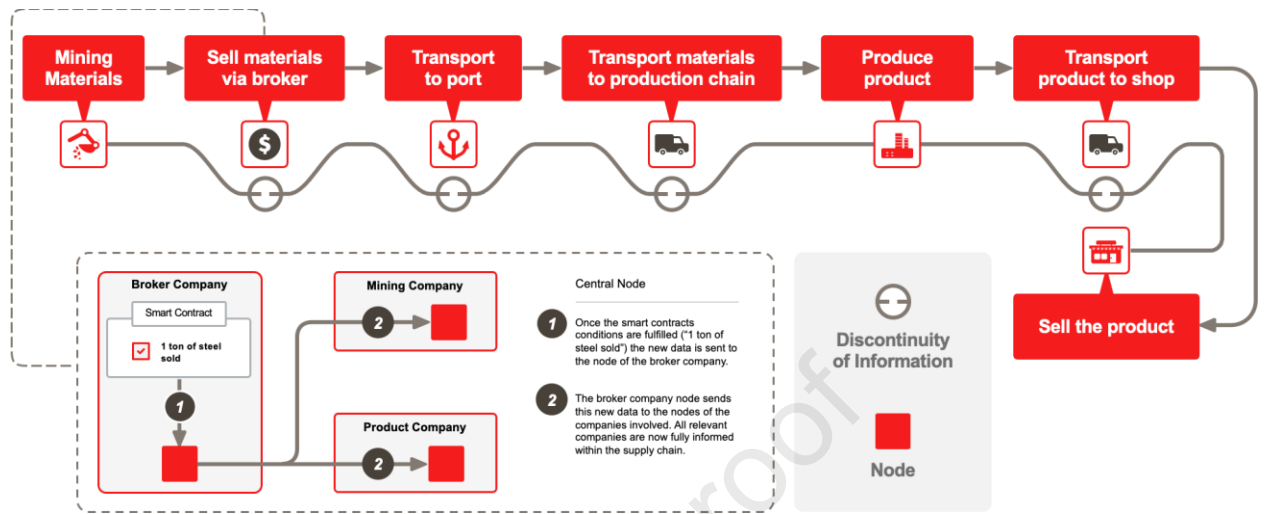
FIGURES

Figure 1: Example of Environmental Monitoring for a Supply Chain



Adapted from (Kamilaris et al., 2019)

Figure 2: Fictitious Mining Company Supply Chain



Note: Diagram produced within an IU student team capstone project (2020)

Figure 3: Traditional Dispute Resolution Continuum

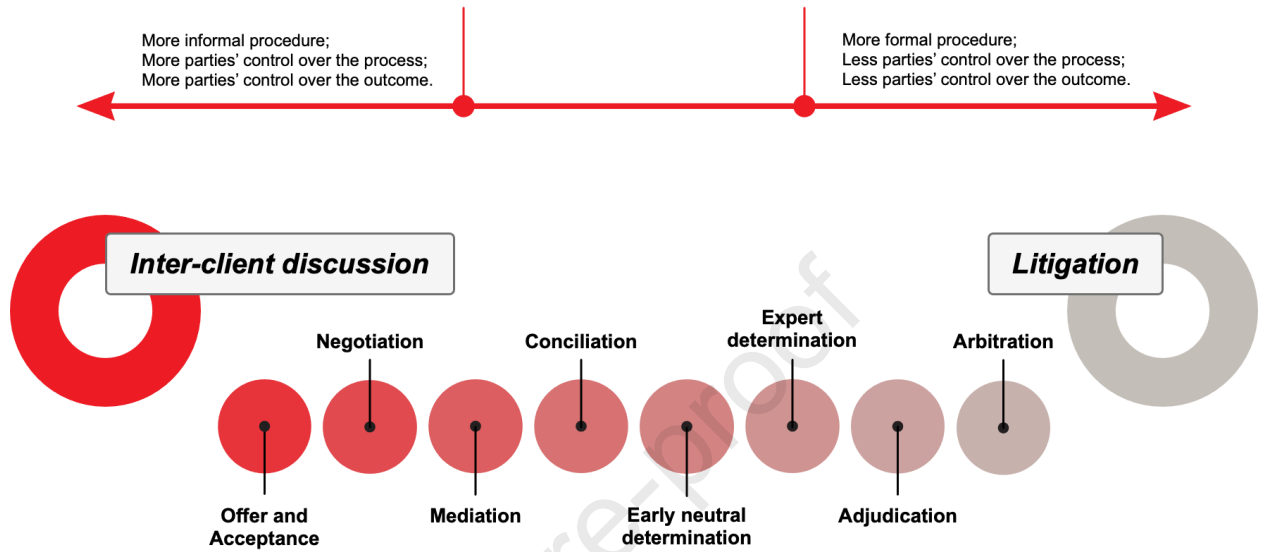


Figure 4: Tech-Based Dispute Resolution Continuum

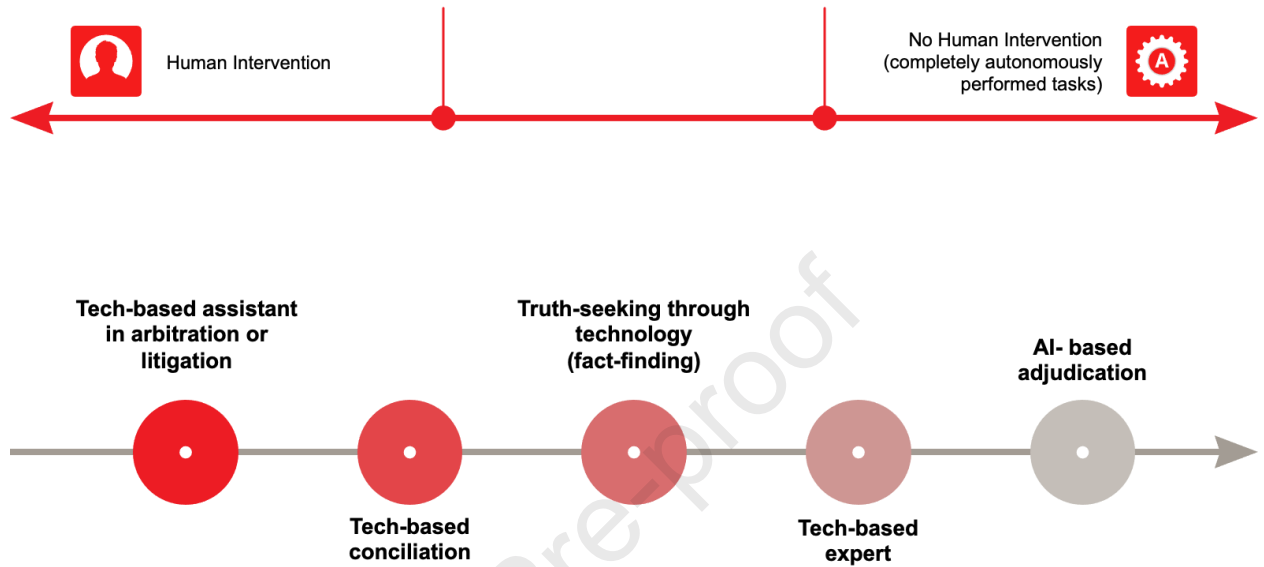


Figure 5: Autonomous Adjudicative Tech-Based Dispute Resolution

