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A Revolution of Trust in Digital Networks?

Cyril Chambeftort, Magali Chaudey

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The paper studies DAOs (Decentralized Autonomous Organizations), which are based on blockchain technology, emphasizing that they rely on a complex, multi-level trust framework that extends beyond purely technological trust. We define DAOs as digital blockchain-based organizations powered by open virtual networks of contributors. Their coordination and management are decentralized, without any central control. This structure allows peers to work autonomously on a token-based system of on-chain coordination, where rules are self-executed using smart-contracts and off-chain coordination mechanisms. The study of DAOs reveals the emergence of a particular form of trust, "trust in code". Our contribution is threefold: First, we provide an empirical study of Uniswap DAO, the largest decentralized finance network. Secondly, we demonstrate that a complementarity exists in the notion of trust production in such networks, which includes trust in technology, but also personal trust developed outside the blockchain. Finally, the study of this particular network, combining multi-level trust, leads us to explore approaches in terms of social capital. Our description of the Uniswap network suggests that it both requires and enables the accumulation of social capital, in its relational, structural, and cognitive dimensions.

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Abstract

The paper studies DAOs (Decentralized Autonomous Organizations), which are based on blockchain technology, emphasizing that they rely on a complex, multi-level trust framework that extends beyond purely technological trust. We define DAOs as digital blockchain-based organizations powered by open virtual networks of contributors. Their coordination and management are decentralized, without any central control. This structure allows peers to work autonomously on a token-based system of on-chain coordination, where rules are self-executed using smart-contracts and off-chain coordination mechanisms. The study of DAOs reveals the emergence of a particular form of trust, “trust in code”. Our contribution is threefold: First, we provide an empirical study of Uniswap DAO, the largest decentralized finance network. Secondly, we demonstrate that a complementarity exists in the notion of trust production in such networks, which includes trust in technology, but also personal trust developed outside the blockchain. Finally, the study of this particular network, combining multi-level trust, leads us to explore approaches in terms of social capital. Our description of the Uniswap network suggests that it both requires and enables the accumulation of social capital, in its relational, structural, and cognitive dimensions.

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Introduction

In 2015 *The Economist* published an issue devoted to blockchain technologies, with the title “Blockchain: The Trust Machine”; as if trust could be created *ex nihilo* by computers. Satoshi Nakamoto, the creator of the first functional blockchain, Bitcoin, wrote in his original white paper (2008) that it was “an electronic payment system based on cryptographic evidence rather than trust”; as if infallible mathematical proof, the basis of the blockchain, could make it possible to dispense with trust. But while trust on blockchain networks is often taken for granted, we argue on the contrary that rather than replacing trust, blockchain will require and create different kinds of trust if these types of new networks are to function.

Blockchain is a technology for the transparent storage and sharing of data. It is based on a decentralized network of interconnected computer nodes that validate and record information in blocks, forming a chain of linked blocks (hence the term “blockchain”). This feature makes the network immutable over time. Blockchain has three intrinsic qualities that make it a highly promising technology. Firstly, blockchain is transparent, i.e., all the data recorded on the blockchain since the “genesis” block (the first one) is visible to all the participants, which implies that everyone is on an equal footing in terms of quantity and quality of information. Secondly, these networks are decentralized, which means that no node in the network can be superior to another, and that each node has a complete copy of all data on the blockchain. Finally, the blockchain is immutable, i.e., thanks to its architecture of interconnected blocks, it is virtually impossible to modify the information recorded on the blockchain,¹ which guarantees the legitimacy of the data recorded on the blockchain. This new form of network has some very interesting intrinsic qualities, and induces us to ask questions about the kind of trust that underpins its design.

Contractual approaches, i.e., agency and transaction cost theories, have been most widely used in the literature to analyze these new networks based on blockchain technology. For agency theory, agency costs arise from the need for the Principal to monitor, supervise, and control the Agent, so that the latter acts in the Principal’s interest. The Principal has incomplete information about the Agent’s behavior and must therefore, to a certain extent, trust him or her. Applied to network analysis, this approach focuses on the issue of contract design, which can limit information asymmetries and goal divergence. Through an appropriate incentive system, the contract should encourage greater convergence between the objectives of the contracting parties.

According to the theory of transaction costs, the network is the most efficient organizational form for a transaction (in the sense that it minimizes transaction costs) where neither the market nor a hierarchy prevails. The network can create a specific, sometimes intangible asset (know-how, experience effects, etc.) that justifies its superiority over other forms of organization.

From this rapid review of the literature, it emerges that trust between peers within a network can benefit participants by reducing transaction and control costs, reducing uncertainty and opportunism, and pooling strategic and complementary resources (Cappiello et al., 2020). Contract and reputation appear to be the backbone of the integration of the notion of trust into economic theory.

Network theory enables us to understand the dynamics of inter-organizational relations, focusing on the personal relationships between parties and the mutual creation of trust through processes of cooperation and exchange. To access external resources, companies need to establish relationships. Two types of interactions operate within these networks: exchange processes (social, commercial, and informational) and adaptation processes (products, productions and routines). These interactions facilitate the establishment of stable connections within a network. The question of governance within blockchain networks (Chambefort and Chaudey, 2024; Lumineau et al., 2021) provides a better

¹ For a detailed study of the security risks associated with blockchain, see Guo and Yu (2022).

understanding of how agents cooperate, and forces us to explore both theoretically and empirically the production of trust on these new networks. According to the “embeddedness” approach (Granovetter, 1985, 1992), each individual in a company is the holder of human capital whose effectiveness and value depend on the nature of the social networks in which he or she is embedded. The more actors are embedded in networks of social relationships, the more trust they generate. According to Breton and Wintrobe (1982), effective relationships between members of an organization, or between organizations within a network, are based more on informal exchanges than only compliance with formal rules, with trust playing a predominant role in informal relationships. Blockchain, as Galati (2022) suggests, can be analyzed within this theoretical framework. Both theoretical approaches offer promising concepts for analyzing DAOs, particularly with regard to trust.

Following Gambetta (1988), we could define trust as the subjective probability with which an actor assesses that another will perform a particular action, an action which he cannot control, in a context where it affects his own action. Adler (2001) distinguishes three sources of trust: *familiarity* resulting from repeated interactions can lead to trust; *interests* can lead to a form of trust calculated through an assessment of the costs and benefits to the other party of exploiting my vulnerability (a representation of trust similar to Williamson’s); and *values and norms* can engender trustworthy behavior that leads to trust.

Williamson (1993) offers a critical view of the use of the notion of trust in economics. In particular, for Williamson the notion of trust is less decisive than that of interest, and is the result of a calculation by the parties concerning the potential profits they could derive from opportunistic behavior in relation to the penalties incurred. The contract, even if incomplete, constitutes an incentive for the parties to behave in accordance with their promises, failing which the “betrayers” exposes himself to the threats contained in the contract. This representation of trust remains when Williamson introduces the notion of institutional trust: “Institutional trust refers to the social and organizational context within which contracts are embedded. In the degree to which the relevant institutional features are exogenous, institutional trust has the appearance of being non-calculative. In fact, however, transactions are always organized (governed) with reference to the institutional context (environment) of which they are a part. Calculativeness thus always reappears” (op. cit.).

For her part, Zucker (1986) also distinguishes three forms of trust, depending on how they are produced. *Characteristic-based* trust is attached to a person on the basis of specific characteristics such as membership of a family, ethnic group, or gender; *process-based* trust is based on past exchanges between partners, interpersonal relationships, and reputation; and *institutional trust* is based on a formal structure that provides guarantees on the behavior of an individual or organization.

Technological developments have a major impact on the production of trust (Lumineau et al., 2023). Our research seeks to analyze how trust is produced within a Decentralized Autonomous Organization (DAO). To this end, we will adopt an empirical approach, focusing on the Uniswap DAO, which is considered the largest decentralized finance protocol (OECD, 2022). This study will emphasize the multi-level nature of trust production, illustrating how the different phases of decision-making within Uniswap contribute to the construction and reinforcement of trust between participants.

In the first part, we present the technological framework and define the associated concepts. We then highlight the role of trust in the coordination mechanisms in a DAO in general and Uniswap in particular. In the second part, we explore the literature on trust in order to characterize the different types of trust at work in a DAO. We then show that the entire decision chain, both off-chain and on-chain, is built on trust and participates in the overall coordination of a DAO network.

1. From theory to practice: How do DAOs work and what is the process of building trust between agents on these networks?

1.1. From blockchain dataset to a new trust: understanding the mechanism between tokens, smart contracts, and DAOs

Despite its manifest potential and the features described above, blockchain alone is not enough to revolutionize trust between agents. Rather, the introduction of tokens and smart contracts plays an essential role in enabling DAOs to flourish.

1.1.1. Tokens as network management tools for these networks

We define a token as a digital unit designed as a “socio-economic tool to promote the coordination of the actors in a regulated ecosystem towards the pursuit of a network objective function, through a set of incentive systems” (Freni et al. 2022). In order to better understand the impact of tokens within this new system, we will differentiate these tokens in two ways: firstly, by their function, and secondly, by their nature. Tokens can perform different functions, depending on the agents’ objectives and the blockchain. Tokens are generally classified into three functional categories, as described by Garrido (2023): (1) Payment tokens facilitate debt settlement and transactions without the need for intermediary institutions, as exemplified by bitcoin tokens. (2) Security tokens represent investments in assets, offering returns and enabling more transparent and inclusive corporate management. (3) Utility tokens provide access rights to services or goods, digital or otherwise, via the blockchain. Voting tokens are considered to be utility tokens because they offer right holders the right to express their rights via the blockchain. We need to distinguish between native and non-native tokens, and to understand how they are issued. Native tokens are issued directly on a blockchain, which is essential for its specific operation. These native tokens are often used to pay transaction fees on their respective blockchain networks. For example, on the Ethereum blockchain, which serves as the main platform for decentralized applications, the Ether token (ETH) functions as a native token used to cover gas fees (the cost of running the blockchain). Native tokens encourage participation in the network by being based on an incentive system where users who validate transactions or ensure the security of the blockchain network are rewarded (this reward often takes the form of native tokens that can be exchanged for fiat currency).

Non-native tokens, on the other hand, are generated on existing blockchains and are therefore dependent on them. A notable example is Uniswap tokens, a decentralized finance protocol, the mechanism of which will be discussed later. Uniswap was created on the Ethereum blockchain using smart contracts and adhering to the ERC-20 standard. The survival of non-native tokens depends on the continued existence and functionality of the underlying blockchain. This underlying blockchain is not managed by the agents participating in the DAO, who may therefore have different objectives. Consequently, there is a network (the DAO) that depends on a larger network (the underlying blockchain). Stakeholders must therefore trust not only the final DAO protocol (Uniswap, in our example), but also the blockchain that supports it (Ethereum).

1.1.2. Smart contracts: A crucial development in blockchain technology

The smart contract is a computer program, stored in a blockchain, which can be used as a contract between parties. As a computer program, the smart contract is irrevocable and self-executes predefined “if... then” instructions. As a distributed ledger, this contract records information in a definitive but decentralized way, without the intervention of a certified third-party.

Non-native tokens are issued through the execution of a smart contract, which sets certain conditions (price, closing date...). As mentioned above, a token can represent a right, value, or power within a network. Any user can create a token and give it a personalized application, such as a means of payment, financial tool, or a right. Thanks to smart contracts, the various users of a blockchain can interact with each other using voting tokens (non-native utility tokens) that enable their holders to express their opinion on specific issues. These specific utility tokens created via smart contracts therefore play a crucial role in coordination within networks, enabling participants to take an active part in decision-making and in network development, notably through DAO.

1.1.3. DAOs: Definition and concepts for new trusts

We define DAOs as blockchain-based organizations powered by open virtual networks of contributors. Their coordination and management are decentralized, without any central control. This structure enables peers to work autonomously on a token-based system of on-chain coordination where rules are self-executing using smart-contracts and off-chain coordination mechanisms that support community decision-making (Buterin, 2014; Santana and Albareda, 2022).

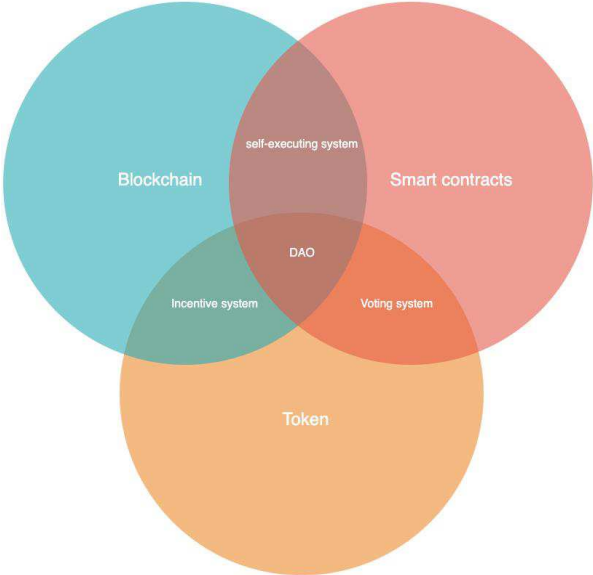


Figure 1: Network interactions: Blockchain, Smart Contracts, Token as a foundation for DAOs

A closer look at how this type of network works shows that DAOs enable agents to make decisions via a two-stage process. In the first stage, informal discussions take place outside the blockchain (off-chain), with agents coming together, usually on specialized forums hosted by the DAO website, to create, comment on, and modify proposals for future development or changes to the network, thus shaping subsequent decision-making. This off-chain phase is essential for generating proposals that will be evaluated via the blockchain. In the second phase, proposals are voted directly on the blockchain via DAOs and voting tokens. This ensures the cryptographic integrity of the proposals, with smart contracts automatically executing accepted proposals (see figure above). However, current research focuses mainly on the second part, on-chain voting, omitting an important part of the coordination process of these networks, which takes place off-chain. This duality in decision-making between off-chain and on-chain forces us to think in terms of multiple forms of trust between the agents operating these networks.

1.2. Example of a DAO: Uniswap DAO

To support our approach, we will examine the structure of this new form of network in practice through looking at the Uniswap DAO. We justify our choice by the fact that Uniswap is currently the largest decentralized exchange in the world, and that the process of coordinating this protocol goes through a DAO. Uniswap is a protocol created in 2018 that uses a set of smart contracts on blockchain to automatically execute transactions and enable the exchange of cryptographic asset tokens without a trusted third party. Uniswap is therefore the cornerstone of so-called Decentralized Finance (DeFi), since according to the latest OECD report (2022) on the subject, it accounts for 81% of all users of this type of protocol. In purely financial terms, Uniswap represents over than US\$481 billion exchanged and more than 71 million transactions.

But beyond its monetary and financial conditions, which make it the world's first decentralized exchange, the Uniswap protocol is extremely interesting in terms of the structure of its network, managed by a DAO since 2020. Users have the opportunity to decide on future developments and technical choices for the platform in a decentralized way on the blockchain via a voting token (Uniswap token).

The decision-making process for DAOs, and therefore for Uniswap, does not take place exclusively on the blockchain. There is a whole section of discussions and proposals to bring out the features that will be put to the vote on the blockchain. The coordination process within the DAO is therefore as follows: The Uniswap network protocol development is a three-stage process, with two off-chain stages (Request for Comment (RFC) and temperature check) and finally an on-chain vote.

1.2.1. Off-chain coordination

If we go further in the description of Uniswap, the first coordination process is the Request for Comment (RFC), enabling any agent, regardless of possession of a voting token, to propose improvements or changes to the Uniswap protocol. The agent must then create an account on the Uniswap site, which functions like an Internet forum. Once the proposal has been made, he or she opens a discussion where everyone can comment and respond to the initial proposal. This phase lasts 7 days, the aim being to enable agents to generate new proposals for improving the protocol.

The second phase of coordination between agents in this type of network is temperature taking. The aim of the temperature check is to signal the community's feeling about a proposal before moving on to voting on the blockchain. This vote takes place off-chain, as it is not possible to infinitely multiply votes on the blockchain due to the transaction cost associated with each vote on the blockchain. As the protocol takes place on the Ethereum blockchain, the cost of each vote is not negligible, since each vote costs a certain amount in native Ether tokens in order to pay for the gas needed to register each vote on the blockchain (one study estimates the cost of each vote at \$8.86 (Uniswap, 2024)). Taking the temperature involves taking the first proposal (RFC) and improving it with the comments that may have been made. A voting *quorum* of at least 10 million voting tokens in 5 days must be met to be able to move on to the third stage and vote on the blockchain. This is known as off-chain voting, as it takes place outside the blockchain (however, the quantity of voting tokens held by the agents is important, as this vote determines the possibility of voting and locking the vote on the Uniswap blockchain). Agents must connect their token wallets, then vote on the proposals.

1.2.2. The ‘trust system’ of off-chain coordination

We thus realize that in the process of coordination of the DAO network, and thus Uniswap, a large part of the process takes place informally over the Internet between agents. A ‘trust system’² has therefore been built by the creators of this DAO.

The aim of this ‘trust system’ was to enable the network of agents to operate effectively and build trust on the blockchain. This system is based on a fundamental concept of network theory: the chronological sequence of actions over time and the anteriority of behavior. Agents start with very few rights and, over time, must demonstrate their positive contribution to the network, which will help them progress up the hierarchical pyramid of this trust system: “users’ abilities are restricted for safety—both theirs and yours”.³ This Uniswap DAO ‘trust system’ is explicitly inspired by the book *Community Building on the Web* (2000). This book provides an overview of strategies for developing and sustaining viable online communities. In addition, agents who cease to participate actively in the network are demoted over time.

This system is based on five levels of trust (indexed from 0 to 4), which are based on the agent’s preceding actions within the network:

Trust level	0	1	2	3	4
Title	New	Basic	Member	Regular	Leader
Main rights	Reads only some topics	Read nearly all topics	Edit posts	Access a secure category only visible to users at trust level 3 and higher	Edit/Close/Archive/Unlist /Split and merge all post
How to reach this level in the community?	Inscription on Uniswap website	Read 30 posts / entering 5 topics/ read for 10 minutes	Visiting at least 15 days/ Reading at least 100 posts	Must have visited at least 50% of days on 100 last days.	Manual promotion by staff only
Number of members in each level trust ⁴	4,607	4,045	203	44	13

Table 1: “Trust system” in Uniswap DAO

1.2.3. The on-chain coordination

Once the first two stages of off-chain coordination have proved successful (RFC + off-chain vote with over 10 million Uniswap voting tokens), the third phase of voting is launched, involving the creation of the on-chain proposal and direct blockchain-based voting. This proposal, formed via smart contracts, remains active for a period of two days, allowing participants to assimilate its conditions and implications. A 7-day voting period is then declared. If the proposal receives a quorum of 40 million positive votes via the Uniswap voting tokens (corresponding to 4% of the mass of Uniswap tokens in circulation), the proposal is automatically accepted (or rejected otherwise). A delay of two days after the end of the vote is respected, and the smart contract automatically deploys the proposal after this time. The proposal is therefore active on the blockchain.

² This is the exact term used to describe it on the Uniswap website.

³ Uniswap trust system citation.

⁴ Data collection from Uniswap website (10/09/2024). Total cumulative number of agents involved (or having participated) in network: 8 912 (<https://gov.uniswap.org/>).

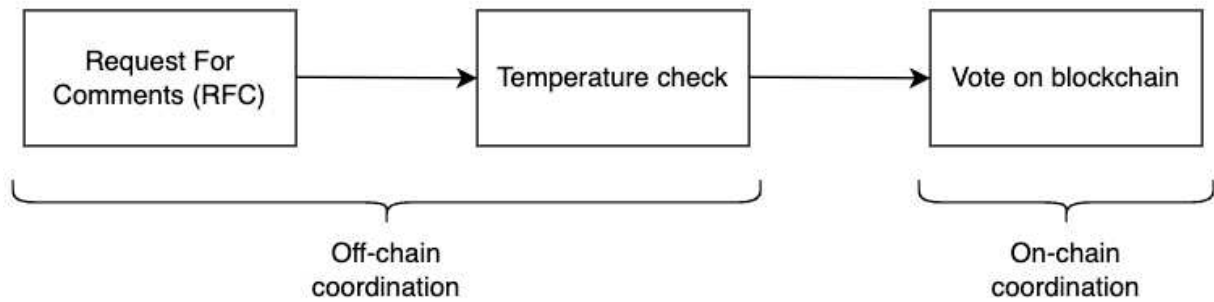


Figure 2: Coordination mechanism on Uniswap DAO

1.2.4. Voting process and distribution of power among agents

In DAO, the last two stages of the coordination process involve a vote, the first taking place off-chain and the second on-chain. Both votes require a quorum and are based on the number of voting tokens held by agents. The main distinction lies in the number of tokens required to pass the vote. For the off-chain vote, a quorum of 10 million tokens (equivalent to 1% of tokens in circulation) is required for the proposal to be eligible on the blockchain. Then, when voting on the blockchain, the quorum increases to 40 million tokens (4% of tokens in circulation) to validate the proposal and activate it.

Power is unevenly distributed between agents, as it is determined by the number of voting tokens (Uniswap tokens) each agent owns. These voting tokens are tradable and quoted on crypto-currency exchanges, which means that some agents have more voting influence than others. The initial distribution, or airdrop, of voting tokens (Uniswap tokens) when the Uniswap DAO was created in 2020, marks a key moment in the protocol's evolution. This allocation of voting tokens was created *ex nihilo* by distributing them to early adopters (61% of airdrop), the protocol development team (22% of airdrop), and early investors (18% of airdrop). This initial distribution laid the foundations for a power structure between agents.

2. Trust production in DAOs

The various theoretical approaches to networks are relevant here and can help to highlight certain characteristics of blockchain-based networks. By exploiting the intrinsic attributes of blockchain (decentralization, immutability, and security),⁵ smart contracts and DAOs function as coordination mechanisms to enable inter-agent coordination. Furthermore, by leveraging the transparency and immutability inherent in blockchain, smart contracts and DAOs enable agreements to be found and recorded securely, automating contractual clauses and eliminating the need for interpretation. They eliminate information asymmetry and the need for trusted third parties.

DAOs, as a new network model, present a very interesting design and force us to ask questions about a fundamental attribute of all networks: trust. We therefore decided to carry out empirical work to characterize the production of trust in these networks by studying the Uniswap DAO. This study highlights the multi-level nature of trust in this DAO, with very distinct functions for personal and interpersonal trust, which have not previously been described in this type of network.

⁵ We only consider permissionless blockchains, because it is only these that respect the intrinsic qualities of blockchains and therefore generate new forms of trust.

2.1. Technological trust, a new way of building trust

To explain the first type of trust, which is trust in code and blockchain, we will distinguish three distinct trust mechanisms inherent in blockchain technologies (De Filippi et al. 2020). Firstly, it is a decentralized technology, which reduces agency problems. Secondly, blockchain creates a transparent network, enabling agents to verify the information entered. Finally, by using an incentive system, these networks enable agents to predict the actions of their counterparts, leading to greater reliability.

2.1.1. Decentralized trust

Firstly, blockchain technology has a decentralized network architecture, which means that no single node can have decision-making or censorship power over the other nodes on the network. In this way, each agent has decision-making power, which prevents the entire network from being controlled by individual interests, to the detriment of other network users. For agency theory, asymmetries are characteristic of relationships between agents, whether within a company or a network. These asymmetries can be limited by the implementation of control procedures or the design of a contract. Instead of these costly control mechanisms, blockchain and smart contracts ensure distributed and reliable execution of the coordination process, thanks to software code execution, clause automation, and data logging. Finally, the smart contract is based on consensus mechanisms and verifiable proof of contract performance, which reduces the need for institutions (the trusted third party) and therefore sanctions.

According to our case study and the on-chain coordination of the Uniswap DAO, no agent has the voting power (i.e., a sufficient number of voting tokens) to decide unilaterally on decisions to be made within the network. Any information or decision taken via the DAO and recorded on the blockchain must be based on consensus, which creates trust within the blockchain network. The absence of institutions has been at the root of blockchain technologies since their inception: the loss of trust in institutions was behind the creation of the first blockchains (Bitcoin), particularly in the wake of the 2008 financial crisis, symptomatic of the danger of an all-powerful financial system (excessive credit, excess securitization, speculation, etc.).⁶ The creators of these blockchains had lost faith in institutions (known as trusted third parties) and no longer trusted them not to abuse their privileged position in the economic system. Blockchain, on the other hand, is a decentralized network, meaning that no single node can exercise all-powerful control over the others (leading to censorship, registration of false information, etc.).

2.1.2. Verifiable trust: proof for blockchain networks

Verification acts as a trust-generation mechanism: each agent holds a complete copy of the information recorded in the blockchain file, from its creation (*genesis* block) to the most recent block of information added to the network, making the system transparent. This means that anyone can check the veracity and reliability of the information contained in the file, as well as its compliance with the protocol's predefined rules (e.g., the proposal acceptance system). Trust is thus created by the fact that, at any time, at any place, a simple search on the file held by the agents can attest that the data recorded on the blockchain database is accurate. Proof is therefore a mechanism for creating trust. According to transaction cost theory, this quality drastically reduces the costs associated with finding relevant information and monitoring partners' actions (Schmidt and Wagner, 2019).

⁶ For an in-depth study of the roots of blockchain, see Lakowski-Laguerre and Desmet, 2021.

Thus, on Uniswap, all decisions taken by the network via voting on the blockchain are visible, as are the voting details for each address, guaranteeing the legitimacy of the vote and the proper execution of the corresponding smart contract.

Network transparency goes even further, as the computer code that administers all interactions within the blockchain (source code) is also visible and open, enabling users to anticipate and know the network rules that will determine their decision whether to join.

2.1.3. Incentives: A framework to deter opportunistic behavior

Finally, these networks are based on an incentive system designed to reduce opportunism. In this way, participants in the blockchain network can anticipate future events with a high degree of accuracy, thereby reducing the uncertainty surrounding operations. Let's take the example of a vote on the Uniswap DAO: Agent A wishes to vote on a future Uniswap protocol project (having passed the two preliminary stages of off-chain consensus). He therefore votes on the DAO, considering the transaction cost (\$8.86 on average) of recording his vote on the blockchain, while knowing the conditions for adoption or non-adoption of the proposal (quorum of 40 million Uni tokens) as well as its deployability (two days after the end of the vote through the smart contract). He also knows that his vote will only be validated if he actually holds voting tokens, otherwise it will be rejected. In fact, a number of agents (miners) are responsible for checking the quality of information and transactions in the networks, and are paid for this task: if a transaction, such as in our example a vote, is invalid, they will refuse to record it on the blockchain. Agents have confidence in the audit performed by these miners, as any erroneous information in the blockchain (which is transparent to all agents), will result in the offending miner being challenged, thus depriving him of his reward.

This conception of the blockchain network, according to Williamson's analysis mentioned in the introduction, discourages opportunistic behavior thanks to a systematically negative cost/gain calculation, thus establishing trust between all network players and discouraging deviant behavior via its incentive system and potential sanctions. The three aspects of trust in blockchain networks combine to form a new concept of trust, described by Werbach (2018) as "algorithmic trust". However, as illustrated by the Uniswap DAO example, the structure of these networks is not entirely contingent on blockchain; thus, outside the blockchain, this technological trust cannot exist. Given that decisions originate outside the blockchain network, we will therefore examine the type of trust that underpins DAOs.

2.2. Beyond technological trust: Digital social capital

2.2.1. Trust in blockchain networks

As we have just shown, blockchain technology relies on a particular type of trust, "trust in code". Thus, a smart contract uses the blockchain protocol as a means of execution, resulting in a shift in trust: from trust in the courts to trust in the code (Vatiero, 2022). DAOs mobilize this trust as a specific form of coordination. But "trust in code" is not enough to explain the trust model at work in a DAO. The analysis of trust proposed by Williamson is relevant to explain the trust created when the network makes decisions on the blockchain (on-chain stage) while being secured and governed by a smart contract, but it is insufficient to capture the specificity of the trust generated in the off-chain stages of DAOs.

The Uniswap example, and its off-chain steps, is representative of an analysis of trust that goes beyond algorithmic trust. Although blockchains aim to mitigate opportunism and create trust in the

system, there are still important human actors who play a significant role in creating trust. Thus, trust in the system ultimately depends on personal trust in a multi-level system (Lumineau and Schilke, 2018).

Zucker (1986) identifies three modes of trust production: (1) institution-based trust; (2) characteristic-based trust, where trust is derived from traits such as affiliation with a particular social category; and (3) process-based trust, where trust is rooted in past or anticipated exchanges between collaborating entities. Our approach to trust generation in DAOs is in line with the work of Wang et al. (2022) or Schilke et al. (2017).

Institution-based trust. As we saw earlier, Uniswap’s DAO is based on an institutional framework of trust, in particular via the blockchain technology itself. This first form of trust production refers to the reliable immutability of the code and the mathematics underlying the blockchain and the smart contracts. After the off-chain coordination phases, final decisions are taken on the blockchain by decentralized voting. This voting mechanism transparently and immutably records the decisions taken by the agents, guaranteeing compliance with the protocol rules and the irrevocability of decisions. This institutional framework reinforces trust by creating an environment where opportunistic behavior is limited thanks to the verifiability and reliability of actions on the blockchain.

Process-based trust. In the Uniswap DAO model, trust is strongly linked to the history of agents’ interactions within the network. DAO users have to prove their value and positive contribution to the community over time, which helps build trust between network members. The decision-making process, which includes discussion and voting phases, reflects this principle of trust based on past and future exchanges. Agents who actively participate in the network gain in reputation, enabling them to move up the hierarchy of the DAO’s trust system. On the other hand, agents who no longer actively participate in the network or who have made mistakes, may lose reputation or be banned by higher-level members.

Characteristic-based trust. Uniswap DAO also incorporates an element of trust based on the characteristics of network members or categories. “The perception of sharing similar characteristics makes the trustor believe that common assumptions, convergent background expectations and like-minded understandings will exist, which in turn can lead to greater anticipation of trustworthiness of the trustee” (Schilke and al, 2017; Zucker, 1986). We saw in the trust system that the creators of the DAO want to build a ‘community’, and this is why the trust system is structured the way it is: agents must learn and reproduce the ‘expected’ behavior in order to appear to be a trustworthy partner.

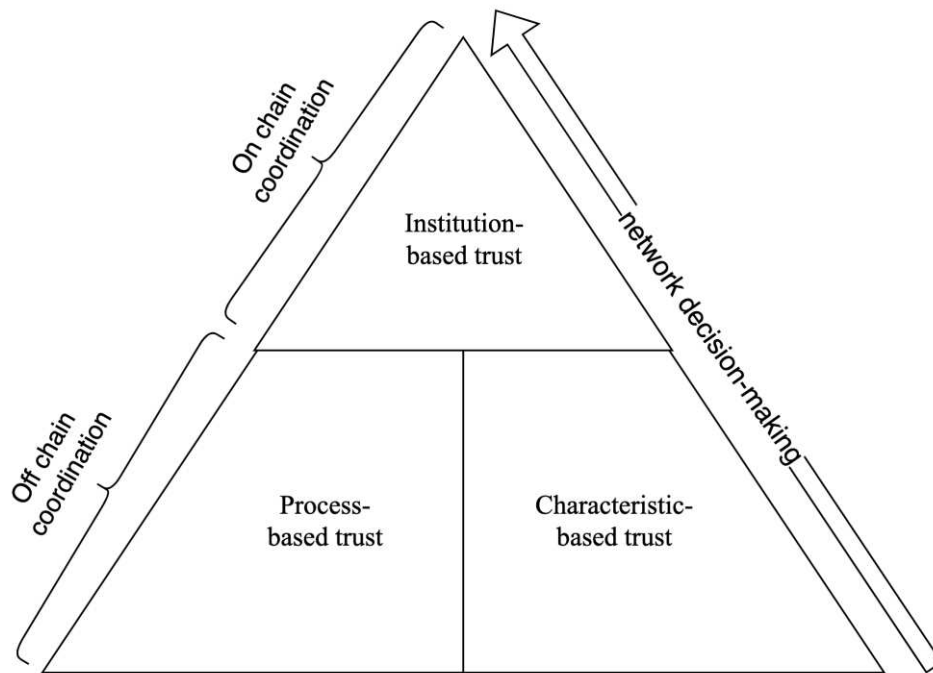


Figure 3: Pyramid of trust production in DAOs networks

This representation reveals the role of the network as a condition for the emergence of trust and, more specifically, of the cooperative links that are forged within it. In the case of Uniswap, this cooperation, and the reputation it engenders, take place in the off-chain stages. This framework, combining cooperation, trust, and networks, is reminiscent of social capital analysis, which is particularly relevant to understanding the DAO model. Taking Uniswap as an example, we may well ask whether the various stages of this protocol do not contribute to the construction of a social capital of their own, contributing to both the construction and operation of this DAO.

2.2.2. Digital Social Capital

According to Coleman (1990), one of the most important determinants of trust emerges from the “network” definition of social capital: the number, intensity, and horizontal structure of interactions within a network as an essential determinant of trust. If we take up the theoretical and practical elements of DAOs mentioned above, we can see that part of the cooperation takes place outside the blockchain, notably via the ‘trust system’, based on reputation and the anteriority of exchanges, which corresponds to the first founding elements of trust. On the other hand, the decentralized nature of blockchain and on-chain cooperation create a horizontal structure between agents, which corresponds to trust in on-chain code. Thus, all the elements of Coleman’s notion of trust are brought together, creating a new way of conceiving trust on these networks, and demonstrating the contribution of social capital theories to a better understanding of the concept of trust in these new digital networks.

Social capital theory postulates that in the context of interconnected groups of companies, actors’ actions and opportunities are “embedded in concrete, ongoing systems of social relations” (Granovetter, 1985). For Burt (2001), social capital is the set of real or virtual resources from which an organization benefits by virtue of possessing a durable network of more or less institutionalized relationships of mutual knowledge and recognition. Generally speaking, social capital theory suggests that individuals and organizations are embedded in social networks endowed with a specific structure, and with codes

and norms that give them access to resources and facilitate certain achievements. Bernardes (2010) distinguishes between personal relationships (relational anchoring) and the structure of the collective arrangement of these relationships (structural anchoring), and argues that social capital has a remarkable effect on organizational behavior and performance. A high level of social capital should improve network performance, as it implies the creation of shared norms, rules, and routines, and the adoption of similar cognitive frameworks between partners (Galati, 2022).

Nahapiet and Ghoshal (1998) classify social capital into three interdependent dimensions: structural, relational, and cognitive. Structural social capital refers to the configuration of the network, encompassing the connections between actors that shape their interpersonal ties (Moran, 2005; Nahapiet and Ghoshal, 1998). In particular, the centrality of actors within the network explains the number of direct contacts they establish, which determines the sharing of resources and the dissemination of knowledge. Relational social capital refers to the nature and quality of relationships. Trust and reliability play an essential role in facilitating the exchange of knowledge, reducing the time spent acquiring information and enabling greater informality. Cognitive social capital refers to shared codes, narratives, and languages (Nahapiet & Ghoshal, 1998) that can enhance mutual understanding between members. Indeed, a shared vision between peers plays a key role in forming a common perception of how people should interact (Inkpen and Tsang, 2005; Tsai, 2000).

The relevance of social capital theory to network analysis is confirmed by the analysis of DAOs in general and Uniswap in particular. In this case, we propose to speak of digital social capital. The description of the Uniswap network shows that it requires and enables the accumulation of social capital, in its relational, structural, and cognitive dimensions. In this particular digital environment, the Uniswap model makes it possible to develop the relational dimension of social capital through the relationships of trust gradually built up, particularly during off-chain stages. These preliminary stages make it possible to “evaluate” potential participants in this DAO. Generally speaking, the relational dimension of social capital manifests itself through trust in the code linked to adherence to blockchain technology. Uniswap also improves the quality of the connections between participants, thanks to the use of smart contracts, which characterize the structural dimension of the social capital at work in the DAO. We can extend the discussion by considering that it is both necessary to have a certain amount of social capital to join a DAO, and that the DAO then manages its own social capital. Finally, the cognitive dimension of social capital refers to a vision shared between participants. In the Uniswap model, this vision is linked to the sharing of the same technological environment, between players who have gradually built up a relationship of trust. Finally, we can consider that sharing of the same cognitive social capital is the very foundation and manifestation of the effectiveness of this original Uniswap DAO.

3. CONCLUSION AND PERSPECTIVES

To conclude our analysis, we have seen through the examination of these new digital networks that are DAOs, and the example of Uniswap, that trust requires a holistic vision within these networks. These blockchain-based networks, powered by tokens and smart contracts, force us to redefine the traditional conception of trust and coordination between agents.

Blockchain technology introduces “trust in code” through its decentralized architecture by distributing decision-making power among network participants, eliminating the need for trusted third parties. Transparency and verifiability enable agents to independently check information and transactions on the blockchain. In addition, incentive mechanisms encourage cooperative behavior and discourage opportunistic actions. These are the fundamental pillars of algorithmic trust.

However, the trust required within DAOs goes beyond blockchain technology. Off-chain coordination stages, such as proposal discussions and off-chain voting, rely on trust outside the

blockchain, based on reputation, anteriority of action, and a clear hierarchy ('trust system'). The introduction of the notion of digital social capital makes it possible to encompass both types of trust between participants in these digital networks. Agents' reputation and past behavior determine their reliability within the network, underlining the importance of repeated interactions and community norms. Social capital theory, in particular its structural, relational, and cognitive dimensions, provides a framework for understanding how trust is built and maintained within DAOs.

The example of Uniswap, the most important protocol in what is known as decentralized finance, illustrates the multi-level of trust production, the interplay between "trust in code" and personal trust. While blockchain technology guarantees the security and transparency of coordination between agents on the blockchain, off-chain interactions contribute to the development of relational links, collective structural arrangements, and shared cognitive frameworks between participants. Together, these elements form the basis of a new trust within DAOs, enabling decentralized coordination and decision-making in blockchain-based networks.

The analysis we have carried out so far highlights the crucial importance and complementary of different types of trust production within blockchain networks that are natively digital. However, blockchain and DAO technologies are often accused of being too complex to be fully understood by most agents, making it difficult to produce trust between them. But as De Filippi et al. (2020) argue, "It is important to note, however, that confidence does not require a complete mastery and understanding of all the technical components that a particular system is made of—i.e. one does not need to understand the workings of a plane in order to feel confident that the plane will fly safely and arrive at destination." Further research into trust is therefore needed to understand the prerequisites of agents in terms of technical capability, so that what we can call technological trust can be mobilized in these complex environments.

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