Governance in Decentralized Ecosystems:

A Survey of Blockchain and Distributed Ledger White Papers

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***Abstract*—For organizations of today, Information Technology (IT) governance is an important part of managing IT investments. To understand how governance is handled in blockchain projects, we surveyed a large body of project white papers to understand the level of organizational maturity in the field. The results show that governance has yet to receive a similar stance in blockchain projects as compared to IT governance in general. We introduce a discussion around implicit versus explicit governance, as to highlight the challenges in simplifying the debate around a level of distributedness, in terms of premissionless (public) and permissioned (private) blockchains.**

Keywords-governance; blockchain; distributed ledger technology; decentralized platforms; decentralized ecosystems.

I. INTRODUCTION

Over the last two decades, companies have begun understanding the importance of accountability in IT decision making. Today IT governance is part of any mature organization's toolset to determine that IT decisions truly provide a return on investment and that managers of IT-systems are accountable for the organizations decision making on investing in new and in maintaining legacy systems. An organization without a formalized approach to IT governance will have to rely on the individual system operator or manager to resolve issues as they arise and perhaps most importantly that this isolated decision making is also beneficial long-term to the company [1] [2].

Traditional IT systems are usually under the direct influence of the system owner, meaning that this system can receive updates and that the service can potentially be terminated in case a catastrophic error is detected. IT system decision making is also conceptually centralized around a system owner that may to a certain degree take input from users and customers, but the final decision is always in the hands of the owner. As IT architectures have moved over to a cloud provisioned model that may utilize a loosely coupled and fine-grained microservice architecture the control has become more difficult and may thus require an even deeper focus on IT governance.

The new type of distributed architectures based on technologies, such as public (permissionless) distributed ledgers and blockchains introduces a new set of problems that require an increased understanding of governance. The distributed nature of execution means that a system owner no longer has the full control over who uses the system or even for what usage purpose. For decentralized ecosystems, based on Distributed Ledger Technology (DLT), it may even become difficult to determine who the system owner is. Here, the decentralized ecosystem becomes the inherent infrastructure to build new systems and services upon, and the original ecosystem creator may no longer be a relevant party to the continued development and maintenance of said ecosystem and services. Still, this does not mean that governance of the ecosystem is no longer required, rather this suggests that in accordance with open source software development this becomes a group effort.

A core tenant of these decentralized ecosystems is that they offer users a certain amount of pseudonymity and this is something that often contrasts them from open source development. Architectures for decentralized ecosystems are based on the principal of achieving consensus based on trustless transactions. This can best be understood as that Alice and Bob can perform a transaction securely without the need for them to first establish trust towards each other. This is ensured by a consensus from the network peers that validate the transaction on behalf of Alice and Bob. Therefore, to enable anonymity in governance for decentralized ecosystems, the governance mechanisms should be distributed and arguably be based on the same trustless procedures as for other transactions.

In this paper, we survey white papers from DLT and blockchain projects, and related proposals to understand how they intend to deal with governance. The initial survey aims to select those white paper proposals that raise the subject of governance and then to further expand on the maturity of these approaches. We limit the scope of the survey to a focus on the

 ISBN: 978-1-61208-703-0

long-term benefits for users of these ecosystem. We acknowledge that there is an argument for a developer and investor viewpoint as well, but due to length constraints we have chosen this focus for our present study.

The structure of the paper is the following, first data gathering is described and from this material, we provide general observations and then describe models and challenges discovered. We then introduce the abstractions of implicit and explicit governance, to deliver an analysis of the implications of a lack of governance. Finally, we present conclusions and future work.

II. DATA GATHERING AND RESEARCH AIM

For the survey, we have examined 241 white papers, which all cover and describe blockchain- or distributed ledger technology-based projects. These white papers include different types of projects, for example protocols, platforms or applications, which we refer to in a common term as "ecosystems". The range of scanned white papers is wide and aims to select those papers that make a direct mention of governance for further study. The corpus was selected through non-probabilistic and discretionary sampling from various sources, that were found through search engines and various websites that report on relevant matters. Due to the inexistence of an all-inclusive global registry of DLT ecosystems, discretionary sampling remained our only alternative.

The role of releasing white papers has become the de-facto norm when projects and ecosystems are conceptualized, and design views, abilities and features are explained, and staff introduced. In this survey, we present the first results of our study. We start from the general findings and follow the path to explain what these results could mean in the larger context of institutions, actors, structures and organizations. Further research concentrates on the relevance of decentralization by analyzing potential institutional and organizational changes, in order to capture and understand current and future developments occurring in the society at large.

III. GENERAL OBSERVATIONS

The survey had a wide scope as to amass a large enough research body to examine. We start by discussing the common position and role of governance that is found in the whitepapers and then in consequent sections drill down into specific projects and their solutions.

Governance, decision-making structures, and the inner processes (human activity) of the decentralized ecosystem as an explicit standpoint are missing in a large part of the examined whitepapers. This does not mean though, that there would be no governance, decision-making structures, or processes in these ecosystems. Structures and processes of governance can also exist implicitly and can be assessed through various scales, e.g., centralization vs. decentralization, explicated vs. hidden, dynamic vs fixed, and technocentric vs. human oriented. There are commonly no explicit explanations for the absence of governance structures and processes in white papers nor is there a standardized format the white paper should adhere to, therefore in this study, the reason for absence can only be conjectured.

Potential reasons can be traced by considering the setting of white paper producers. Most of the white papers have been written by/for a company or other legal entity (e.g., foundation), whose main interest lays in initiating, developing and launching an ecosystem, but also to collect financing for the ecosystem through an Initial Coin Offering (ICO) or Security Token Offering (STO). Due to this latter target, some entities might want to hold quorum among the immediate beneficiaries of the project and are not prepared to discuss about the notion of distributing governance.

Other reasons for absence of governance structures can signal various features of organizational structure, incompleteness of the planned ecosystem, planned unimportance of decentralization, forgetfulness of writers, or intended mischievous behavior. Another possibility is a misconception concerning an audience. Those who have produced the white papers may have had beliefs, that by describing an implicit technical solution of governance, they would not need to give any further explanation of how it works. This type of minimalism can be found for example in the Bitcoin white paper [3]. As such, today it can be considered delusional in a sense, that as the white paper paves the way for the first blockchain and the first successful cryptocurrency ever, the ecosystem should be able to function without any other governance structure than incentives for mining. Since the launch of Bitcoin, we have observed how this minimalistic model has led to deep contradictions and hard forks, because of a lack of consensus around decision-making and governance concerning the continued development of the bitcoin protocol. Concerning the Bitcoin white paper, which was written 2008, it is understandable that governance was not understood and consequently described in more detail. In the more recent white papers we examined, which were published during 2017-18, the absence of a governance structure is more peculiar.

Altogether, for an ecosystem to seem genuinely decentralized, the absence of a governance standpoint in a white paper may indicate some long-term issues the ecosystem will have to face. However, there are also white papers in which governance is described in detail and in these white papers conditions of governance have been scrutinized profoundly and it is sometimes clear that problems of a technical or human design are attempted to be solved by using certain models of governance. Due to these differences in attitudes, one may ask if there is something to conceal in the ecosystem projects, which do not openly describe and justify their governance model or even worse do not mention a governance standpoint at all. Due to this lack of clarity, we find that continued research into the role of governance for building sustainable decentralized ecosystems is well merited.

IV. GOVERNANCE MODELS AND CHALLENGES

In the following sub-section, we start with a brief examination of what primary and secondary sources discuss on the topic of blockchain governance. The following sub-section then highlights findings from some of the blockchain projects surveyed.

 ISBN: 978-1-61208-703-0

A. Literature survey

Governance studies in academic literature is still sparse, particularly surveys of how blockchain projects view and implement governance. Some literature sources examine the philosophical aspects of decentralized governance and others consider how trust emerges towards a decentralized project. Others examine a specific case, such as the DAO project [4], but to the authors best knowledge none examined a multitude of projects as we do in this survey.

Secondary sources such as open blog posts have so far been the foremost place for fostering a discussion about how governance should be implemented and approached. The discussion and openings originating from influential blockchain researchers such as Nick Szabo and Vlad Zamfir focus on definition [5]. The former, Szabo has provocatively classified blockchain governance into three categories [6] 1. "Lord of Flies" [edit. disastrous attempt of self-governance], 2. Lawyers, 3. Ruthlessly minimized. His categorization gives an impression of frustration for governance choices and discussion about governance. However, all governance analysis does not remain as superficial as that. Zamfir has underlined the political aspect of governance and presented a "Blockchain governance outcome" model with five visions for the future [7]. These five visions are: Autonomous Blockchains, Blockchain Governance Capture, Internet Censorship as Blockchain Governance, Governance via Public International Law or Diplomacy, and Governance via International Private Cooperation. However, despite profound argumentation, Zamfir's view is validating the setting in which the general blockchain governance model is still very incomplete and even the definition is controversial.

CleanApp foundation has brought a more analytical grasp to the discussion about governance. In their continuation of Zamfir's five views, they introduced a "vocabulary for blockchain governance", which can be interpreted to be based on at least six layers or operational contexts [8]. The six layers are: Intra-blockchain governance, Inter-blockchain governance, Pan-blockchain governance, Supra-blockchain governance, Private-off-chain governance and Global governance. As a result of their analysis CleanApp concluded that "today's blockchain governance mechanisms are broken because it's almost impossible to access today's blockchain governance mechanisms" and "today's blockchain governance feedback mechanisms are either non-existent or grossly under-developed". To make governance easier to approach and understandable the concepts in-chain and off-chain governance is used. This categorization elucidates the differences between traditional and automated (voting and execution) features of governance [9].

By following commentaries about on-chain and off-chain governance, it can at times be an inflammatory theme of discussion. It seems that many writers do advocate the role of off-chain governance as a primary source of order and power in ecosystems. A good example of this genre is the title of Vlad Zamfir's blog article. "Against on-chain governance" [10]. Also, Haseeb Qureshi has promoted the ideology that "Blockchains should not be democracies" [11]. He has argued that governance process should be built around the expertise of capable technologists, who can "get shit done". However, his thesis is anchored to the phase of (radical) development of blockchain technology as he has stated himself: "Perhaps someday blockchains will be robust and stable enough to no longer need the guiding hand of capable technologists."

B. White paper survey

In Table I, we present a classification of the white papers surveyed. General refers to broad DLT projects such as the Bitcoin blockchain. Others mean projects that could not be categorized under our classification. In the leftmost column, we list the types of projects included. In the following four columns, we have categorized the papers on a scale of 0-3 defining the level of governance found. Here, 0 means that an explicit mentioning of governance is missing, while 3 means that governance is thoroughly described. We intentionally included a larger sample of media and content type projects as there was a higher ratio of white papers that described governance.

In the white papers, an explicit on-chain or off-chain conceptualization is not common. Still, the NEO [12] white paper [13] provides an exception and governance for on-chain/off-chain governance is briefly defined as following:

*"**Chain governance:** NEO token holders are the network owners and managers, managing the network through voting in the network, using the GAS generated from NEO to utilize the functions in the network. NEO tokens can be transferred.*

***Off-chain governance:** NEO Council consists of the founding members of the NEO project, under which the management committee, technical committee and the secretariat, respectively, are responsible for strategic decision-making, technical decision-making and specific implementation. The NEO Council is responsible to the NEO community for the promotion and development of NEO ecosystem as its primary objective."*

As we see, there are obvious reasons to ask if NEO is a centralized and not a decentralized ecosystem. Even though on-chain processes are enabled in NEO, crucial decision making is located in a predefined off-chain governance structure.

TABLE I - A SUMMARY AND CLASSIFICATION OF SURVEYED WHITE PAPERS

Types	Explicit governance missing	Vague reference	Brief description	Governance described	Total
General	31	3	5	15	54
Data	13	3	2	2	20
Energy	7	0	0	0	7
Finance	8	0	2	1	11
Media&content	42	7	5	11	65
Professional	6	0	1	3	10
Sharing&reputation	14	3	2	2	21
Tools	9	0	2	2	13
Health	5	1	1	2	9
Commerce	5	1	1	1	8
Others	18	2	1	2	23
Total	158	20	22	41	241

 ISBN: 978-1-61208-703-0

Essentially, the off-chain committees should be responsible for proposals and decision making and very little information exists on NEO's website on who belongs to these committees, the nomination and expulsion process of these individuals/institutions. The financial decision making is also centralized as this comes from reserved NEO tokens during the launch and according to the white paper from the GAS generated from the NEO transaction processing.

Recently, the NEO Council acknowledged the issue as well and have proposed a plan to instigate a decentralization of consensus nodes. Part of this process will be to rethink financing of the development work once the reserved tokens are consumed.

"NEO Council had been spending the reserved NEO tokens to accelerate development, reward community, and foster ecosystem. Decreasing amount of NEO held by NEO Council means decreasing voting power, and eventually all NEO tokens aka governance power will be distributed to the community." [14]

For a project to explicate their own governance model in a white paper format, seems to be a challenging task for the organization responsible for blockchain- or other DLT-based ecosystems. Although the study found dozens of white papers with some sort of explicit approach to the governance issue, pervasive and integrated (in-chain) models of governance were rare. One explanation for the difficulties may lie in the incompleteness of ecosystems. As the ecosystem has not been launched or exists in a very early phase, real life tests are not possible to experience how the ecosystem functions in a real-life context. However, in some white papers, the ecosystem defines a clearly articulated process, including roles and positions of governance and there are clear signs of an endeavor to decentralize the ecosystem in these projects.

Furthermore, the few whitepapers in which governance models are profoundly detailed, tend to be advancing decentralization at least on a discursive level as desirable and as the intended final state of the ecosystem.

As mentioned in the beginning, without exception, all the white papers have some sort of – although sometimes hidden - agenda for governance. However, the governance model does not have to be decentralized, it can be centralized or very minimalistic, but it exists. Dan Larimer [15] has described this as:

"Every blockchain that has a "process for upgrading" has a governance structure that is capable of changing the rules, rolling back stolen funds, etc. It is the good-old-boy network of Github admins, exchange connections, and mining pool operators. The problem is that these processes are informal and less predictable and even less accountable than the governmental structures we hope the blockchains would replace."

Even projects with a target of very thin governance can openly admit that some sort of governance is needed. In the white paper of Mixin [16] Network is stated:

"We try our best to make Mixin Network just work without any governance, but there are still situations the program can't handle" (p.27).

In order to find solutions for the in-chain/off-chain challenge, some ecosystems have been created with a written constitution. For example, EOS [17]and media platform Civil [18] attempt to base their operations on this type of model. In the constitution there are established rules and principles that should govern the continued operation of these ecosystems. Qureshi has used Blockchain 3.0. to define on-chain based ecosystems, *"On-chain governance is central to many "blockchain 3.0" projects, such as Tezos* [19], *DFINITY* [20], *and Cosmos* [21]. *Others, such as 0x* [22]*and Maker* [23], *are planning to eventually implement on-chain governance through a more gradual transition."*

V. GOVERNANCE ABSTRACTIONS

The traditional classification of blockchain types has been based on a technical distinction whether they are private or public. This usually refers to access control, determining, e.g., who may perform transaction validations and what incentive is offered to the nodes to stay honest. Below we consider the two main abstractions that we have found in the white-paper review.

A. Implicit governance

The most common governance abstraction found is implicit governance. Implicit governance refers to the lack of an explicated well-formed process that deal with decision-making and the governance of those humans that still make decisions in relation to the ecosystems. Implicit governance is used both by Bitcoin and Ethereum and refer to a model that is based on human expertise to make decisions when they arise. Often these decisions are of a technical nature, e.g., when advancing the protocol. Such measures may require a deep level of technical knowledge that few people behold, and the obvious choice is to delegate the decision-making to this group. However, the dilemma arises when the changes are not only of a technical nature but may also change the dynamics of the ecosystem.

An example of such a situation occurred when the Ethereum developer group decided to switch away from a pure Proof of Work (PoW) consensus model towards a Proof of Stake (PoS) model. The technical decision-making of such a change may require that a small group of physically identified and trusted people make the necessary design decisions, but the lack of an explicit governance model means that the users of Ethereum have as much input in the decision-making process as they would have with a private chain. In this case, the change means that the mining process is altered so that miners are no longer compensated and that mining hardware is not needed as before. Please, note that we are not taking the position that either PoW or PoS is either good or bad, this is merely an example of the conundrum.

Another example of implicit governance and lack of any institutionalized governance occurred in 2017 when there was a dispute over the 'segwit2x' hard fork and doubling of the block size among Bitcoin stakeholders. Due to the disagreement over doubling the block size, it led to that Bitcoin Cash was created and forked from the original Bitcoin. This could also have occurred, had a formally defined governance protocol existed, but for a characteristically decentralized ecosystem the latter system seems to be more effective, transparent, and foreseeable for all of the potential

 ISBN: 978-1-61208-703-0

stakeholders. Implicitness – trust without reservations and doubts – may entice conflicts when significantly upgrading the ecosystems, even when they are needed for the ecosystem to stay relevant in the market.

In time of change, implicit governance leaves the stakeholders with three options, accept the modifications, exit the ecosystem, or in some cases do a hard-fork. Some would argue that these options provide a technocratic society with minimalistic regulation, while still functioning. However, a critical view is to ask how mature such thinking is and if this is inclusive enough for mainstream users to place their trust in such technology.

B. Explicit governance

Explicit governance arises from a well-formed process for decision-making, oversight, and stakeholder participation. Explicit governance is therefore not a purely technological solution, but rather something that resembles real life. An explicit governance ecosystem must strive to embrace the occurrence of conflict through resolution, rather than to state a take-it/leave-it implication. A technocratic society may view this as a 'disastrous attempt of self-governance' and they may be correct in such an assumption, still for a more human-centric society, the aim is often not an autonomous ecosystem, but rather an automated ecosystem that increases peer participation in the decision-making process.

In addition to the operative and strategic decision-making process, explicit governance also seeks to define the development process. In IT governance we often see that the development process is defined through a maturity model, meaning that the initial stage (level 1) would likely be developer based, as we also often find in the case for implicit governance. The Capability Maturity Model Integration (CMMI) model [24] define five maturity levels, described in Table II. Considering our review of the white papers, we can characterize most governance models to be on a maturity level of one or two. To achieve explicit governance, we consider that it requires that the CMMI level is also raised to three or higher. As most blockchain development projects are still in an early stage, we should perhaps not be too surprised with these findings.

However, there may also be influences present from the traditional open source community that have often refuted commercial interests as a driving force for development. The question then becomes, moving beyond open source products towards online services and platforms based on various value instruments, such as coins and tokens, should this not be reflected in the maturity level of processes?

TABLE II - CMMI MATURITY LEVELS

Level	Description
5	Optimizing the process continously
4	Process is quantitatively managed
3	Process is defined and proactive
2	Development is managed, but process is often reactive
1	Unpredictable and poorly controlled

The level of decentralization cannot only be measured in a technical context (e.g., node distribution), but also needs to reflect the participation rate of human peers. Thus, a blockchain project may consider themselves decentralized, but without a communicated explicit governance structure this should not be understood as anything different to a centralized model around a private chain. As shown, the differentiation between private and public chains only serves to communicate whom its intended target group is.

VI. IMPLICATIONS FOR DECENTRALIZED ECOSYSTEMS

In consequence of the absence of clearly defined governance in the project white papers and especially the lack of explanations for this omission, it may lead to a dubious effect on the decentralization discussion and over time slowly reduce the trust for the ecosystems, incl. connected companies and foundations responsible for the development of these ecosystems. An ecosystem without open access for all stakeholders to participate in a transparent way on agenda setting and decision making may from a decentralized point of view be considered distrustful. In addition, given a highly speculative project (high Return on Investment (ROI) potential), if a party can become a project stakeholder (decision maker) by acquiring coins/tokens of the ecosystem, it suggests that a centralization of power will eventually occur as the financial incentives would likely outcompete other incentives in the long-term. Then at least from an ideology perspective, but likely also from a perspective of influence, the project will become more centralized than equally distributed among participants.

We cannot comprehensively know how the qualities of a governance model affect decisions of potential users when they choose between different alternative ecosystems. Nevertheless, these kinds of questions may arise in the near future if adaption of decentralized ecosystems takes place en masse. The relevance of governance as criteria for potential adopters should be elucidated through independent research.

A peculiar feature concerning claims for decentralized ecosystems, is that a decentralized ecosystem by default also embodies a conceptually decentralized governance structure. However, in our view, ecosystems without decentralized governance are not properly decentralized ecosystems and based on some project white papers it can be difficult to understand if or even how people are poised to operate in that kind of an ecosystem.

In this research, we have primarily considered white papers as research data when searching for the existence and features of governance models for DLT ecosystems. However, this does not denote that all aims of ecosystems and their governance have been documented in the white papers.

There may also be reservations concerning the transparency of ecosystems. Because of local regulations of raising funds for DLT ecosystems, governance may restrict, e.g., the potential rights of the token holders. Ultimately, this could mean that in some cases the genuine goal of the ecosystem and its governance structure has been hidden to enable the development and launch of ecosystem. However, without further research into these types of potential distortions, we can only convey an expression of uncertainty.

 ISBN: 978-1-61208-703-0

VII. CONCLUSIONS AND FUTURE WORK

As we have remarked, considering the size of the amassed research data we are yet to be aware of what governance features an ecosystem must have. Part of the problem is due to that there are more white papers without any explicit reference to governance than those that mentions the concept explicitly. The idea of a company, foundation or other organization as "owner" or "ultimate decision maker" of the ecosystem (through, e.g., initial token allocations), as the case is in quite many white papers, creates this enigma. Ultimately, if there is no mention of future aims of an ecosystem, i.e., to advance and deploy decentralization in governance, this kind of ecosystem refers to centralized governance without real commitment for decentralization. Hence, the traditional division of ecosystems as permissioned or permissionless, needs to be extended into a more complex framework that evaluates the current and future potential level of decentralized governance in the ecosystem.

Our future work will focus on elaborating on the project white papers that mention governance and to examine some of these in-depth to understand if they have implemented the said governance structure and to examine if they have gone beyond what they promised in their white papers. Additionally, we aim to extend the scope from the user perspective to the developer perspective.

ACKNOWLEDGMENT

The authors wish to thank the Lindstedt foundation for the financial grant that made this work possible.

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 ISBN: 978-1-61208-703-0