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DECENTRALISED AUTONOMOUS ORGANISATIONS IN ORGANISATIONAL DESIGN THEORY

Research full-length paper

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Abstract

As Decentralised Autonomous Organisation (DAO) is a new emerging form of organisation with unrevealed characteristics, this study examines how DAO can be classified in terms of organisational design theory and provides an overview of its characteristics. The investigation could further provide guidance on what types of organisations can be easily transformed into a DAO. A deeper look into the knowledge base on organisational design theory and organisational forms is essential as well as characteristic properties. In regard of DAO, the underlying concepts of blockchain and smart contracts are marked as they serve a better understanding, which is needed to characterise DAO. An analysis of DAO will specify how they are classified in terms of organisational design and how they differ compared to traditional organisation forms, which will be displayed in an overview. The results are discussed and concluded, also comprising the highlighting of potential paths for future work.

Keywords: DAO, decentralised autonomous organisation, blockchain technologies, smart contracts, organisational design theory.

1 Introduction

After many years of development, blockchain technology is increasingly being integrated into application scenarios in order to adopt its advantages of decentralised management and operation (Pohl et al. 2020; Tasca and Tessone 2018). In addition to the initial concepts of decentralised transaction management, the concept of smart contracts for decentralised regulation has also become strongly established. One of the potential areas of application aims to support structures and processes of organisations, leading to a so-called decentralised autonomous organisation (DAO). The benefits seem to be obvious. For instance, poor administration with impermeable information policies can lead to less confidence and trust in the organisation by its members, which could be counteracted as blockchain is ensuring transparency of information (Hyndman and McDonnell 2009). Through automatic execution of smart contracts under pre-defined conditions, administrative workforce can be reduced, and members can work on other tasks to support the overall purpose of an organisation. That would ultimately lead to less cost while preventing human made flaws in the working process (Shin et al. 2020).

The idea of decentralising organisational structures in Internet-of-Things applications has been discussed for decades (Dilger 1997; Schneider 2014). Decentralised collaborations and control mechanisms have been widely investigated and their organisational advantages, but also the coordination effort, have been demonstrated (Beckhard 1966; Freeland and Baker 1975; Shubik 1962). The potential to exploit the advantages of the decentralised organisational structure could be leveraged by the concept of the DAO (Hassan and De Filippi 2021). As DAO is a new emerging form of organisation with unrevealed characteristics, this study examines how DAO can be classified in terms of organisational design theory and provides an overview of its characteristics. In comparison to existing organisational forms, it will then be discussed to what extent the characteristics of these forms enable or constrain the adoption of blockchain technology in the sense of the DAO. The paper at hand addresses the following research question:

How can DAO be classified in context of organisational design theory compared to other organisational forms? (RQ 1)

To what extent do characteristics of organisational design forms enable the adoption of blockchain technology through transformation into DAO? (RQ 2)

At first, a deeper look into the knowledge base on organisational design theory and organisational forms is essential, which is described in the next section. Further, in regard of DAO, the underlying concepts of blockchain and smart contracts are marked as they serve a better understanding, which is needed to characterise DAO. In the third section, DAO is analysed to specify how they are classified in terms of organisational design and how they differ compared to traditional organisation forms, which will be displayed in an overview. The differences and similarities in the characteristic properties of the organisational forms should provide an incentive for the discussion of a potential transformation into the form of a DAO. Finally, the results are concluded, also comprising the highlighting of potential paths for future work.

2 Foundations

An introduction to the definition of the term “organisation” is followed by a presentation of characteristic dimensions from organisational design theory. In terms of theory, several typical forms of organisations have evolved, which can be identified based on the dimensions. The section concludes with a presentation of the concept of a DAO.

2.1 Organisations

2.1.1 Definition

Organisations are “(1) social entities that (2) are goal-directed, (3) are designed as deliberately structured and coordinated activity systems, and (4) are linked to the external environment” (Daft 2010). This definition is broad, as the spectrum of organisations can range from for-profit organisations like small family businesses to multinational corporations to non-profit organisations like associations or cooperatives. As expressed in the first part of the definition, organisations are social entities since they are not made up of buildings but people interacting with each other. Consequently, many special interest groups in form of share- and stakeholders are part of an organisation and have their own intentions and goals, influencing the decision making (Daft 2010). The goal-direction, as a second characteristic, can be understood as an internal organisational agreement to pursue a certain goal. To better define goals and fulfill a purpose, organisations are designed as deliberately structured and coordinated activity systems. Certain structures provide linkage between technology, tasks, and people to enable interactions between and coordinate them most expediently. The structure of an organisation serves two specific objectives. On the one hand, it should simplify the information flow to reduce uncertainty in the decision-making process. On the other hand, it should integrate organisational behaviour across its individual parts for better coordination (Duncan 1979). In the history of organisational theory, there was a shift from closed systems, where the focus lies exclusively upon the organisation itself, towards open systems and the realisation that the external environment is directly linked to an organisation and has to be considered (Daft 2010). To survive in a constantly changing environment, organisations are compelled to recognise and adapt to such changes, which is ever more important in times of the internet and electronic business (Daft 2010). The environment and context of an organisational design are considered in form of internal and external factors that are summarised to structural (internal) and contextual (external) dimensions. To distinguish and understand organisations, it is important to examine the dimensions as they interact and influence each other (Pugh 1973). According to Daft (2010), there are six structural and five contextual dimensions in total. The paper at hand mostly sticks to this classification as well as further explanations by Tolbert and Hall (2009) as they describe the internal factors based on Pugh et al. (1968) and Hage (1965) amongst many other authors who have also researched organisational design in the past. An overview of the dimensions and their main statements is presented in Table 1.

2.1.2 Structural Dimensions

Authoritarian structures in organisations are characterised by various individuals reporting information to higher-level supervisors and taking decisions as well as orders. The extent of such a structure incorporates the dimension, *Hierarchy of Authority*. The number of levels and involved parties determines tightness of a hierarchy. Closely related to the hierarchy is the dimension of *Centralisation*. The degree of centralisation reflects on which hierarchy level in the organisation decision-making is conducted. If decisions are made on the top level only, the organisation is centralised. On the other side, if decisions are made on lower levels, the organisation is accordingly more decentralised (Daft 2010). The number of authoritative levels as well as the centralisation of the organisational structure is accompanied by the *Specialisation* of the individual participants. If each member only operates on a small range of tasks, specialisation is high leading to a wide span of control. This interaction is summarised by Tolbert and Hall (2009) as “Complexity”, which, based on findings of Pugh (1968), is often negatively related to centralisation. As complexity increases, it gets harder for a few decision-makers to get adequate information to make decisions in a reasonable timeframe regarding all parts of the organisation. This leads to more delegation in decision-making and hence to a higher degree of decentralisation (Tolbert and Hall 2009). The level of detail in the description of all activities and

structures of an organisation is called *Formalisation* and ensures reliable and predictable behaviour and outcomes. When the level of formalisation is high, all members get access to the same information and descriptions, which provide equity among them in terms of accessible knowledge and methods of operation (Daft 2010). Complex and less centralised organisations tend to become more formalised (Pugh 1973). As the activities of more separate and specialised units need to fit together, a higher demand for coordination occurs. Subsequently, it is important to specify who reports which information to whom and determine standardised activity procedures (Tolbert and Hall 2009). The number of years of experience and training of participants in an organisation is reflected by the dimension of *Professionalism* (Daft 2010). According to Hage and Aiken (1967a, 1967b), professionalisation is likewise affected by the negative correlation between centralisation and formalisation as more formalised and merit-based personnel is more suitable for responsibilities in decision-making than less qualified personnel. The findings of Hage and Aiken (1967a, 1967b) show how this negative relation can affect professionalism because one of its main aspects is the capability and readiness to make decisions. Therefore, it could strengthen an organisation of more decentralisation through more professionalism as delegated decisions can better be controlled by formal rules. The number of people performing different functions in an organisation in relation to the total activity determine the last dimension, *Personnel Ratios*. It includes ratios of professional, clerical or administrative staff as well as the ratio of indirect and direct labour employees (Daft 2010).

2.1.3 Contextual Dimensions

The overall purpose and a plan on how to fulfill it, while also being able to compete with other organisations, is defined by *Goals and Strategy*. Further, it supports the allocation of resources and activities (Daft 2010). The strategy has a massive influence on the overall structure of an organisation as it is complicated and “doomed to failure” to master the implementation of a strategy if it stands in conflict with structure (Hrebiniak 2006). The *Size* of an organisation is measured by the number of members or employees and stands overall for the proportion of the human part as we speak of social entities (Daft 2010). The size is affecting the structural dimensions of a growing organisation. As the number of members is increasing, specialisation is more feasible, and complexity rises. This leads to a rise of personnel ratios in professional staff and a decrease in administrative staff (Daft 2010) and therefore to more challenges in communication and coordination. As decision-making gets more difficult, there is a demand for delegation of decision-making authority, and therefore more decentralisation could be advantageous (Tolbert and Hall 2009). The transition from input to output, determining how products or services are developed and provided, is related to *Organisational Technology* (Daft 2010). The degree of coordination depends on the interdependencies between activities, which is crucial to distinguish what kind of organisational technology is appropriate. Thompson (1967) declared three types of interdependence between tasks that involve how strictly coordination has to be. A pooled interdependence is characterised by a shared pool of resources and mainly independent highly formalised activities of low complexity. In process chains, a sequential interdependence occurs, while the activities are strongly connected. If the outcome as well as the sequence of activities is unpredictable, it is named reciprocal interdependence. From a closed-systems view on organisations, the dimension *Culture* provides for ethical behaviour, commitment, and efficiency as it sets the overall values, beliefs, understandings, and norms shared by members in an organisation (Burton and Beckman 2007; Daft 2010). The culture influences formal structures by aligning how far supervision and control is appropriate and individual self-actualisation and initiative of members is desirable and rewarded. Methods like participative decision-making, rituals and ceremonies or the formulation of an organisational philosophy could strengthen organisational culture and emotional bonding to an organisation. As members are merely cooperating and not competing to achieve organisational goals, decentralisation becomes more feasible (Kunda 2006). The external culture or *Environment* extends the perspective to an open-systems view. In comparison to the former closed-systems view, external requirements and limits are considered, which affect the design of

organisations. DiMaggio and Powell (1991) describe three sources of institutionalisation of formal structures. Coercive sources as the government or other influential organisations can force structural adoptions through sanctions, regulations or pressure from interconnected organisations. Mimetic sources are associated with organisations that tend to imitate other ones and use their design as a model. The trend of homogenisation could especially be caused by large and influential organisations as they dominate their environment. Finally, normative sources describe similar education as well as interaction between organisational members, which supports the spread of similar ideas and knowledge (DiMaggio and Powell 1991). Dyck and Zingales (2002) show how media influences organisations in their policy and decision making by affecting their reputation. Therefore, media attention can lead to politicians introducing corporate law reforms. Further, media portrayal has an influence on attempts at intra-organisational fraud, as a good image of the organisation and the belief in accurate representation of stakeholder interests can be preserved. Thus, the media does play an important role in decision making and can affect the design decisions of the organisation due to the pressure to adapt to societal norms. Cross-national differences in culture of societies could also have an impact on organisational design. Dobbin and Boychuk (1999) suggest that there are differences in the dimensions of formalisation and centralisation between organisations in the Nordic countries, the United States, Canada, and Australia. Gooderham et al. (1999) show that cross-cultural differences can affect decision-making processes.

Structural Dimension	Contextual Dimension
Hierarchy of Authority	Goals and Strategy
Centralisation	Size
Specialisation	Organisational Technology
Formalisation	Culture
Professionalism	Environment
Personnel Ratios	

Table 1. An overview of structural and contextual dimensions.

2.2 Organisational Forms

While the aforementioned dimensions are mainly discussed in organisational design theory, decentralisation and its impact, especially on the hierarchy of authority, is of major interest (Duncan 1979). In this regard, a change has emerged that has led to a more decentralised design over time. Due to new challenges such as globalisation, technological progress, increasingly valuable knowledge and information, the traditional top-down approach to organisational design has been questioned as the best solution in modern organisations (Daft 2010). Different forms of organisational design have evolved, which can be distinguished initially by the degree of hierarchy of authority and centralisation, which also leads to variations in the other dimensions. The organisational forms are presented below, and an overview of the differences with respect to the dimensions can be found in Table 2.

2.2.1 U-Forms

Duncan (1979) refers to two main forms, the functional and the decentralised organisation (Daft 2010), which are also termed U-form and M-form by other authors (Williamson 1992). U-forms are traditional organisations that follow a top-down approach. They are divided into functional components, such as research and development, sales, and engineering. Each member adheres to its part of the organisation with clear boundaries. This corresponds to a high degree of centralisation and hierarchy of authority and is suitable for smaller organisations with a stable and predictable environment. Organisational technology tends to be sequential, as rapid adjustments in processes are

unlikely. Professionalism tends to be low, as does formalisation, since it is easier to keep track of all functional departments and the need for information and coordination tends to be low (Duncan 1979). Specialisation and personnel ratios can be high because in small organisations relatively many people are responsible for few functions, but can specialise in that function (Tolbert and Hall 2009).

2.2.2 M-Forms

The M-Form is a more decentralised approach, as it is organised around a product or geographic categories. Lines of authority converge at a lower level as members (e.g., regional managers or product managers) are charged with decision making. Despite this, the functional structure remains centralised in the form of a high hierarchy of authority (Daft 2010). Each product or region has its own functional departments with narrow boundaries, which means that the units and the personnel ratios tend to be smaller compared to a U-Form. Smaller decentralised units likewise lead to a high demand for specialisation, since knowledge about every aspect is not necessary in every department (Tolbert and Hall 2009). For larger organisations, especially with complex process structures or frequent adjustments of product lines, this organisational form is suitable. Thus, a more complex organisational technology is also necessary. With a corresponding lack of formalisation, coordination and integration between decentralised units could be challenging (Duncan 1979).

2.2.3 Matrix-Forms

To improve lateral relationships and horizontal coordination via vertical collaboration between members of different functions through projects leads to more flexible frontiers within an organisation (Daft 2010). The functional and decentralised structures overlap in the manifested Matrix-Form and increase adaptation in the complex environment through horizontal and vertical decision making (Duncan 1979). The disappearing task boundaries require less specialisation but cross-unit knowledge, which, however, also suggests low staff ratios (Daft 2010). A broad range of education and a high degree of coordination and interaction are necessary for realisation. Crucial to success is the power of the individual rather than formal power, which contrarily suggests a high level of professionalism (Duncan 1979). Organisations that operate in markets with high competitive pressures and thus rely on short development cycles and high levels of knowledge can be encouraged to adopt the Matrix-Form, as long as they do not increase too much in size and complexity (Tolbert and Hall 2009). Organisations that evolve toward a more decentralised design to make fast decisions, referred to by Daft (2010) as learning organisations, are based on equality, open information, flat hierarchy, and a culture that encourages flexibility and participation by contributing ideas to support the organisation.

2.2.4 Network-Forms

The Network-Form, described by Podolny and Page (1998) as a collection of actors ($N > 2$) that cooperate and maintain exchange relationships through contractual agreements with each other but have no higher-level authority, are characterised by a high degree of decentralisation. The approach provides the ability to reallocate resources in a dynamic environment and to respond quickly to changing requirements, to operate globally with subcontractors, and to access experts for specific tasks. The demand-driven structure leads to lower personnel ratios, especially in the area of administrative staff. The downside is a loss of control, as managers cannot monitor all operations. Therefore, a high degree of cooperation and information exchange is required, resulting in relationships and tasks being formalised and contractually regulated (Daft 2010).

2.2.5 C-Forms

With the rise of the Internet, another form of organisation has become established in the field of open-source software (e.g. Linux OS). Seidel and Stewart (2011) describe this emerging form as

community-form (C-form), which has no clear organisational boundaries and where individuals pay tribute to the organisation by working together as a community without central decision making and higher-level managers. The C-form is characterised by four features. First, member boundaries are either peripheral, informal, or fluid. Everyone who contributes to the output is part of the community. Depending on the participation and its scope, there is an inner circle of members with more decision-making capacity than the members of the outer circle. The boundaries to become a member are permeable, but the barriers to contribute become higher as the number of members increases. Anyone can join and leave the community at will because the organisation is based on volunteerism, which is a second characteristic. There are no financial incentives and no legal employment contracts. This is the main difference from other forms of organisation. The personnel ratio cannot be precisely determined, as there are generally no fixed roles of staff in such an organisation. The payment of individual members or the entire organisation depends on voluntary donations, if necessary. The C-form is embodied by a high degree of formalisation in the form of open sharing of knowledge and information. Unlike other organisations, C-forms are not as concerned with hiding organisation-specific knowledge from competitors or the outside world in general. Lastly, the C-form tends to be more suitable for information-based product outputs as the cost of duplication is negligible, since it can be shared freely. The intensive use of organisational technology allows many different members to respond quickly to new problems under rapidly changing conditions in the environment. Nonetheless, C-form organisations can grow to enormous sizes dealing with complex projects, as illustrated by the example of Linux, which has had several thousand contributors throughout its history. Large organisations such as Google, Oracle, and Hewlett-Packard have been involved in the development of C-Form organisations (Seidel 2018; Seidel and Stewart 2011).

Dimension	U-Form	M-Form	Matrix-Form	Network-Form	C-Form
Hierarchy of Authority	high	high	low-medium	low	low
Centralisation	high	medium-high	medium	low	low
Specialisation	high	high	medium	high	low
Formalisation	low	low-medium	medium	high	high
Professionalism	low	medium	high	high	low
Personnel Ratios	high	medium	medium	low	-
Size	low	high	low-medium	low-medium	high
Organisational Technology	mediating	long-linked	intensive	intensive	intensive
Environment	stable	dynamic	dynamic	dynamic	dynamic

Table 2. Organisation Forms characterised by the Dimensions

2.3 Decentralised Autonomous Organisation (DAO)

To facilitate the understanding of the idea of DAO, the basic concepts of blockchain should be considered. First introduced by Satoshi Nakamoto with the cryptocurrency Bitcoin (Nakamoto 2008), blockchain represents encrypted transaction ledgers, called transaction blocks, that are concatenated with chaining references to each other. A higher-level concept of automatic transaction execution proposed by Szabo (1997) and firstly implemented by Ethereum (Wood 2019) enhanced the idea of simple transaction by controlled transactions through simple program code that are called smart contracts. As the blockchain concepts have been widely researched, main aspects like build-up of the blocks, characteristics, and the overall used technologies (Tasca and Tessone 2018; Yaga et al. 2018), consensus protocols (Baliga 2017; Cachin and Vukolić 2017), the network (Decker and Wattenhofer 2013), or security mechanisms (Raikwar et al. 2019; Wang et al. 2018) can be easily reconstructed.

High-level concepts to distinguish between specific blockchain network types (e.g. public, private, and consortium blockchain) provide a consideration of access restrictions to avoid disruptive behaviour and usage (Buterin 2015; Oliveira et al. 2018). In particular, complex code constructs of smart contracts that are distributed and can be executed in a blockchain network should be analysed from a security perspective (DuPont 2017; Wang, Ouyang, et al. 2019; Wood 2019).

The concept of DAO is introduced with the following definition by Wang et al. DAO is a “[...] a blockchain-powered organisation that can run on its own without any central authority or management hierarchy. In a DAO, all the management and operational rules are recorded on blockchain in the form of Smart Contracts, and the distributed consensus protocols and Token Economy Incentive are utilised to realise organisations’ self-operation, self-governance, and self-evolution” (Wang, Ding, et al. 2019). Comprised by the definition, there are three core concepts that constitute DAO and are given by the name itself. First, it starts with “D” as distributed and decentralised. As traditionally, organisations tend to follow a top-down approach connected to a central design with designated decision-makers on higher levels of the hierarchy, DAO are constructed vice versa. Even in decentralised organisations as described in section 2.2, where the hierarchy seems to be flat, a pyramid shape is noticeable. Not every participant has an influence on decisions towards the goals and strategies of the organisation and changes regarding its operation. DAO, in contrary, can be imagined like a “pancake”-shape (Schneckenberg 2009) where no ranks are fixed for members as there is no central authority nor management hierarchy. All members in the pancake design are placed on one level as they are autonomous and make decisions for themselves. Everyone has equal rights, and the success of the whole organisation depends on every participant (Kyriotaki et al. 2015). Furthermore, DAO follow a bottom-up instead of a top-down approach. Additionally, the interaction between members in coordination and cooperation is made autonomously through connections inside a P2P-network (Wang, Ding, et al. 2019). The second letter, “A”, stands for “autonomous and automated”. Shortly, this can be stated as “code is law”. DAO are supposed to run independently as there is no authority who decides about the future operation. This is done through code that contains the regulation rules and collaboration patterns defined by stakeholders. All rules and patterns are encoded in smart contracts which operate on top of a blockchain and regulate the DAO autonomously. The smart contracts are self-executing when triggered by some event like a message call from a user or another contract (Wang, Ding, et al. 2019). All information and regulations, thus the entire state of the organisation, are accessible through the blockchain. By means of transparent representation, a wide trust among the members as well as a very efficient operation of such an organisation is generated, since each member can create, execute and decide contracts at low cost (Hsieh et al. 2018). The last letter “O” stands characteristic for “Organised and Ordered”. Thus, governance rules are implemented, which provide for the coordination of responsibilities and interests among users. Accordingly, individuals can have different degrees of influence in decision-making depending on their contribution. Similar to other organisations, DAO are influenced by a dynamic external environment. Due to that, changes to the protocol may be necessary from time to time. Every member can propose changes like alterations in code or the amount of fees for contributors. If consensus is found in the organisation through a voting process, changes are implemented (Wang, Ding, et al. 2019).

3 DAO in the Context of Organisational Design Theory

According to the analysis of the literature, the classification of the concept of DAO in terms of the organisational design dimensions is presented in the following sections. Finally, a comparison with established forms of organisation will be prepared in a list of the characteristics.

3.1 Structural Dimensions

First, the *Hierarchy of Authority* in a DAO is flat. As mentioned earlier, the organisational hierarchy structure can be thought of as a pancake, i.e., there are no spans of control and no reporting to a superior. In the context of the *Centralisation* dimension, the DAO can be run in a fully decentralised manner, as decisions are made by all stakeholders through a voting mechanism. *Specialisation* represents the degree to which tasks are divided into individual jobs. Since most tasks are done autonomously by code, specialisation tends to be very low. Only a few key tasks need to be done within the organisation, such as providing code for the smart contracts, participating in the consensus process, validating transactions, and executing transactions by running the corresponding smart contracts. In general, all organisational tasks can be performed by all members. Through intelligent matching the organisation automatically recommends tasks to members based on their contributions and previously demonstrated skills (Wang, Ding, et al. 2019). This contradicts the theory of organisational design presented in the last chapter. Tolbert and Hall (2009) argue that high decentralisation is the result of high specialisation as well as high hierarchy of authority. In the case of DAO, this is not necessarily true, as it achieves complete decentralisation through blockchain technology, tasks are performed autonomously through smart contracts, and rather low *Professionalism* is required. Since almost all rules, processes, and protocols required to run the organisation are implemented through smart contracts, *Formalisation* is a key dimension in a DAO. This is also consistent with previous design theory, because the more decentralised an organisation is, the more formalisation is necessary. The degree of professionalism reflects how well-trained members of an organisation have to be to participate in it. According to Hage and Aiken (1967a, 1967b), there is a tendency through the negative relationship between centralisation and formalisation, as more formalised and performance-oriented personnel are better suited for more responsibility in decision making. On the one hand, the concept of DAO confirms that fact because members who contribute more to the system have a greater influence on decision making, but on the other hand, one does not need to be well educated and “the interests of the dull and stupid are protected with as much vigour as those of the intelligent and involved” (Merkle 2016). Developing and providing code to the system (Narayanan et al. 2016) is an activity that arguably requires deep knowledge and understanding of the system, while investors and miners, who do not need to be well educated, vote as well and thus decide whether newly provided code is accepted and implemented or rules are changed (Hsieh et al. 2017). Therefore, the level of professionalism is not necessarily high, as one can have great influence even without a high level of education. Regarding the *Personnel Ratio*, it is unclear how to evaluate this dimension since there are only two different roles that could be called staff: developers and miners. It is reasonable to assume that the larger a DAO grows, the higher the proportion of miners, but compared to all users, the proportion of miners and developers is rather small.

3.2 Contextual Dimensions

After considering the structural dimensions, in the following, the contextual ones are examined. The effects of increasing *Size* proposed in the organisational theory literature do not apply to this form of organisation. As discussed, although the personnel ratio might be affected, the measures to improve coordination and communication are not applicable as decentralisation and formalisation increase because automated information distribution is at a maximum level. Another aspect of size is how it affects the culture of the community and the environment. *Organisational Technology* is a key dimension, as anything that happens within a DAO means that a transaction has been executed. Every change of state in a DAO is recorded for transparency and security purposes and is mapped as a blockchain transaction converting inputs into outputs by a smart contract. Since this organisational technology is not applicable to every use case, it is obvious that the concept of DAO is not adoptable for every type of organisation. Not all types of the different interdependencies of activities shown are suitable to be coded and automated. In this context, Kypriotaki et al. (2015) suggest that tasks should

be divided into repetitive and trivial tasks as they lend themselves to automation by software code. Clustered interdependences have low complexity and are well defined and understood in their outcomes. Long-linked technologies in the sense of sequential dependency also fall into this category, as they consist of multiple tasks executed in a predictable order with well-defined steps that can be translated into code. The last type, reciprocal technology, which requires creative thinking, responsibility, and innovation, is not suitable for DAO in the sense of automation because these tasks depend on purely unpredictable events and require intensive human interaction. More concrete examples of use cases that would be appropriate for DAO are financial services, elections, donations, or content management (Kyriotaki et al. 2015). Exploring the dimensions of internal *Culture* and external *Environment* requires further research, as real DAO implementations need to be analysed to identify behavioural structures and the influencing factors. Specific analyses are scarce, often only speculations, as this organisational form is still in the early stages of its development. The culture of decentralised autonomous organisations seems to be very different from that of traditional hierarchical organisations because there is a diverse structure of stakeholders. Since this form of organisation is completely open, internal and external boundaries disappear. Moreover, a DAO can dynamically adapt to new situations such as new requirements and projects, since community members can propose changes that can be voted on within a certain period of time (Jentzsch 2016) before a potential change is implemented (Wang, Ding, et al. 2019). As stated by Buterin (2013), the mission statement, i.e., the prevailing beliefs and course of action of the organisation, is written down before the DAO is published. Changes to it are made by votes only if a majority of the community agrees. It is a completely open and equal community, comparable to open-source software communities, but with a wide range of stakeholders consisting of developers, miners, startups, enthusiasts, and users (Hsieh et al. 2018). In terms of the external environment, Hsieh et al. (2018) point out that several factors can influence the community and thus the decisions made in a DAO. They highlight the externalities of the media and public interest outside the community. The former are information brokers that can influence decision making through information, monitoring, and reputation effects. Social and public interest in an organisation may be affected by negatively oriented media or traditional organisational stakeholders such as suppliers, customers, and shareholders that may be involved in DAO decision-making processes (Hsieh et al. 2017). In particular, coercive sources such as regulators or political authorities raise questions among DAO researchers, as no clear legal status is defined for DAO (Takagi 2017; Wang, Ding, et al. 2019). Open-source software development, like in most blockchain technologies, allow hard forks by adapting a functional protocol in some components (e.g., security and consensus mechanism) and emerge as a new protocol in a new blockchain network. Adaptations of the Bitcoin protocol, so-called altcoins, have led to many examples so far, including Basecoin, Zerocoin, and its further follow-up Zerocash (Narayanan et al. 2016). On the other hand, it is also a phenomenon that traditional organisations mimic Decentralised Autonomous Organisations to some extent. This can be shown by the example of Hutten-DDO, a private DAO where only Siemens members can vote on different social projects they want to support (Kux et al. 2017). Normative sources of the external environment are also possible, as stakeholders are not locked into a specific protocol, but can offer different projects and contribute ideas from one community to another. A concrete study of DAO communities and their mutual behaviour or cross-country divergence on such communities is still open.

3.3 Resume

When compared to traditional approaches, blockchain technology and smart contracts can provide two key differentiating factors to organisations: first, complete decentralisation and autonomy of members, and second, complete formalisation and automation of tasks. These differences provide changes in organisational design as recognised in theory. Complete decentralisation in this form due to blockchain technology and due to the absence of a required hierarchy, and therefore no need for managers, has not been considered in any present form. But as with all types of organisational forms,

there is no dominant form that fits all purposes and every organisational context. It depends on conditions and characteristics, which can vary widely, and also the overall goals and strategy are critical (Daft 2010). Therefore, it is crucial to determine which types of organisations are appropriate and what differences can be obtained by comparing the traditional outline and the DAO version of an organisation. Based on the characteristics of the organisational forms outlined in organisational design theory (Table 2), the form of the DAO can be classified as a C-form or Network-form on the basis of its characteristics. Due to the strong proximity to open-source technologies, there is a tendency toward the C-form. The Network-form theoretically provides similar traits in regard of the network structure but can be clearly separated because of the openness and transparency of DAO. However, other properties, such as transparency and automated transaction execution, are not found in any of the previous forms. The core differences of DAO compared to the others, expressed in the dimensions, lay in the way of decentralisation, hierarchy of authority, and formalisation. Finally, a summary of the characteristics of DAO is given in Table 3.

Dimension	DAO	Description
Hierarchy of Authority	low	equal voting rights in organisational structure
Centralisation	low	voting mechanism for decentralised decision making
Specialisation	medium	demanding by implementation of new automated processes
Formalisation	high	highly formalised processes for automatic execution
Professionalism	low	automatic execution of organisational processes
Personnel Ratios	low	personnel for technical improvement and monitoring
Size	high	only limited by the size of the blockchain network structure
Organisational Technology	intensive	blockchain technology as backbone of organisational structure
Environment	dynamic	fast moving transformation in technology and organisation

Table 3. Characteristics of DAO

4 Discussion

The literature was reviewed to collect characteristics of structural and contextual dimensions. The relations between the dimensions were investigated. For example, organisations tend to be more decentralised if they grow as decision-making needs to be spread to coordinate the organisation. Organisational forms were investigated and evaluated based on the dimensions. An overview was created showing the different organisational types in comparison regarding the structural and the contextual dimensions (Table 2). Regarding the organisational design literature, the emerging form of DAO could be classified next to the existing ones in terms of the dimensions, giving an overview of the differences between them. During the analysis, the shift towards decentralisation throughout the different types was a central point. DAO underlines the development towards a decentralised organisational form without a mandatory professionalisation in the organisational processes. Determining some of the dimensions by theory, especially contextual dimensions like culture, is not sufficient, as it very much depends on the context of an organisation (Burton and Beckman 2007; Daft 2010; Kunda 2006). DAO is mainly characterised by the transparency of information and complete openness regarding the joining and leaving of members. While Culture sets the overall values, beliefs, understandings, and norms shared by employees in an organization, the transparency and openness of DAO represents a core feature of its Culture. Although, a general comparison of Culture can only be made on the basis of explicit cases, a general view from the perspective of transparency and openness is feasible (Table 4). While established organisational forms are characterised by confidentiality of business information and a selective admission process of members, C-form and DAO organisations are transparent and open for members by design. While it is possible to commit to disclosing business

activities and openly admitting members within organisations of the first four forms, other structural and contextual characteristics cannot necessarily be preserved and may lead to transformation processes. Similarly, a DAO via private blockchain systems or even a C-form organisation can be restricted with regard to these properties, but the general categorisation of an organisation is no longer applicable.

Dimension	U-Form	M-Form	Matrix-Form	Network-Form	C-Form	DAO
Culture	non-transparent closed	non-transparent closed	non-transparent closed	non-transparent closed	transparent open	transparent open

Table 4. Characteristics of DAO

C-Form organisations like open-source organisations and especially DAO have arguably added new dimensional properties to consider because their design is mainly characterised by the transparency of information and complete openness. These are concepts that are not integrated into the traditional organisational design literature, which, therefore, might need to be updated regarding these newly emerging forms and highlighted design characteristics. Thus, the positive correlation between formalisation and decentralisation is still valid for C-Form types and DAO.

Formalisation of organisational processes and specialisation in organisational technology are a fundamental prerequisite for the implementation of decentralised structures, while a change in the cultural characteristics within the organisation can complete a transformation into a DAO. Since the characteristics of the Network-Form as well as the C-Form overlap significantly with those of the DAO, a transformation of both organisational types into a DAO can succeed. This would be tantamount to facilitating the adoption of blockchain technology to manage the organisation. In other organisational forms, it requires prior intensive consideration to what extent the dismantling of hierarchies, a formalisation of processes, an intensification of technological support and corresponding specialisation can be made in order to achieve a transformation into a decentralised organisation or a DAO. Otherwise, there would be a discussion about the extent to which implementing blockchain technology to support organisational processes makes sense (Wüst and Gervais 2018).

5 Conclusion

A classification of DAO next to other organisational forms in the context of organisational design theory is conducted in the paper at hand. The overview provides causal guidelines on how specific organisational types are designed related to structural and contextual dimensions. The DAO is characterised mainly by the intensive use of blockchain technology to support organisational processes and the accompanying rigorous formalisation of processes and reduced specialisation in technology. By definition, the structure of the DAO is fully decentralised (RQ1). The examination of the individual dimensions shows the potentials and challenges of transforming established organisational forms into a DAO. While Network-Form and C-Form organisations enable a transformation with low effort, a deep analysis and restructuring is required in other organisational forms (RQ2).

The investigation could further provide guidance on what types of organisations can be easily transformed into a DAO. Furthermore, investigations of transformation processes of C-form and Network-form into a DAO are desirable, which consider a generic opportunity of the transformation. A transition of other organisation types into DAO requires intensive research and detailed consideration of individual aspects. In this context, other approaches of enterprise architecture or resource-based view may be helpful. An extension of organisational design theory regarding structural or contextual dimensions could also be part of future research. An exact integration of the DAO into

organisational design theory probably requires a deeper analysis of established cases of this form of organisation. Nonetheless, embedding and aligning with other scientific agendas seems beneficial (Aste et al. 2017; Beck et al. 2018; Pohl et al. 2020).

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