

Programmification – the perspective of system rationality

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Information
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People

Abstract

Purpose – This article contributes to the understanding of programmification. Programmification is not only an organisational phenomenon, commonly referred to as the increasing use of programmes or portfolios of projects, but also an infrastructural one, where an ambient programmification of the public digital sphere occurs. The so-called decentralised autonomous organisations (DAOs) rely on this infrastructural programmification.

Design/methodology/approach – The article analyses the programmification of conventional organisations and DAOs with the concept of system rationality. It applies the framework that Niklas Luhmann laid out in his timeless, seminal work *Zweckbegriff und Systemrationalität*. System rationality is based on purpose programmes, which can be shaped in various ways and operate in an informational medium that is created by several complexity reduction strategies. Drawing on a review of available research results, these relevant factors are applied to map the system rationality impact of programmification for conventional organisations and DAOs.

Findings – System rationality of programmification shows contrasting patterns for conventional organisations and DAOs. Programmification enhances some system rationality factors but limits others. Projectification is closely connected to programmification of conventional organisations, but also an indispensable enabler of DAOs.

Originality/value – The lens of system rationality offers a deeper insight than what has been so far rendered by studies oriented to managerial and governance aspects. The direct comparison between programmification in these diverging organisational forms answers questions so far not addressed in the literature. The article explains how DAOs can engage in higher complexity products and services. It also argues that project governance within programme structures should mainly be oriented towards communication rather than process compliance.

Keywords Organisation, Decision making, Information society, Organisational change, Persistence, Exploratory framework

Paper type Conceptual paper

Received 18 January 2026

Revised 12 May 2026

28 June 2026

Accepted 6 July 2026

1. Introduction

Programmification is often mentioned in combination with projectification. We speak of projectification because projects have become an ubiquitous vehicle for achieving objectives, for organisations in the public and private sectors (Godenhjelm *et al.*, 2015; Moreno Escobar *et al.*, 2023), but also in the life of individuals (Jensen *et al.*, 2016). Programmification is considered to be induced by projectification and refers to programmatic management aimed at creating meaningful structures that order projects factually and temporally. Programmification has become an important instrument of strategic management and institutional governance (Maylor *et al.*, 2006; Sturup, 2009). As much as programmification is an organisational phenomenon, it can be placed within a broader societal context. In his seminal work *Legitimation durch Verfahren* (Luhmann, 1983), Luhmann underpinned how functionally differentiated societies increasingly rely on procedures, and, as a result, programmatic structures are increasingly coded into the various layers of society. Seen in this evolutionary perspective, the concept of programmification can be meaningfully applied to what is generally designated as algorithmisation. The term algorithmisation is a technical term that

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Information Technology & People
Emerald Publishing Limited
e-ISSN: 1758-5813
p-ISSN: 0959-3845
DOI 10.1108/ITP-01-2026-0139

emphasises the fact that a programmatic structure runs over a series of calculations. Considering algorithmisation as a form of programmification shifts the locus of attention to the fact that these algorithms are not just passive tools, but active agents, whose actions can be framed in means-purpose schemes. A segment of increasing importance is the ambient programmification of the digital public sphere, in the form of the proliferation of blockchain, decentralised applications (dApps), and Web3 (Ghosh *et al.*, 2024). Decentralised autonomous organisations (DAOs) are organisational entities that operate in this programmified digital sphere. They heavily rely on algorithms, which they apply to achieve decision-making consensus, complete transactions, procure and deliver products and services (Tang *et al.*, 2025).

For the purpose of developing the argument of this article, I distinguish between two forms of programmification. I will use the term organisational programmification when referring to programs that are internal to an organisation, and infrastructural programmification when referring to programs that are located and accessible in the environment of organisations (public, platforms, open source, etc.). Both of these are manifestations of ongoing societal programmification as initially argued by Luhmann.

Despite its recognised importance for management practice, programmification remains severely under-researched in management and organisation literature. In-depth studies, unravelling the more fundamental aspects of (organisational) programmification, have not been published so far. Research on DAOs has so far mainly addressed the processual IT aspects (Fang *et al.*, 2020; Xiong *et al.*, 2022), governance (Han *et al.*, 2023; Nabben, 2023) and business models (Murray *et al.*, 2023; Sharma *et al.*, 2024). There is a lack of insight into how DAOs function integrally as organisation systems.

This gap raises pressing questions about the deeper meaning and systemic significance of programmification in the wider sense of the concept. Programmification occurs on several levels in society and appears to be a force of increasing magnitude. Therefore, the need to better understand programmification becomes more than timely – it becomes essential.

When it comes to Niklas Luhmann's intellectual legacy, his later, so-called autopoietic works are the most well-known and have attracted the most scholars. These works are translated into English and are therefore accessible to a wider audience. A nevertheless seminal work published originally in 1968, *Zweckbegriff und Systemrationalität* (Luhmann, 1973) stands in the shadow of the later works, and is rarely referred to in the discourse. In a recent publication, Jürgen Habermas mentions that, at that time, he was deeply impressed by it (Habermas, 2024). The pivotal points of this work are the concepts of purpose and programmes. Luhmann, building on these concepts, lays out a highly original and comprehensive assessment of system rationality. Programs are conceived as purposive, regulating input-output structures, which operate with fixed and flexible premisses, and enable coordination and integration of relevant processes (Luhmann, 1973). Thus, programmification is equivalent to the increasing importance of programs in the functioning of social systems. Organisational programmification relates to organisation systems creating a new program-layer to govern and manage their temporary organisation, while DAOs are programmified in deploying external programmatic structures for their basic operations and governance, that is, they are programmified through their reliance on infrastructural programmification.

It is fitting to apply the framework of *Zweckbegriff und Systemrationalität* (further referred to as ZSR), considering the importance that it attributes to programs for the functioning of social systems to the contemporary phenomenon of programmification.

This article, therefore, explores how the central building blocks of ZSR can provide insight into how programmification contributes to the functioning of organisation systems. It further explores the similarities and differences between organisational and infrastructural programmification in their contribution to system rationality.

Responding to the gaps in our understanding of programmification, I lay out an analysis that first addresses the fundamental problem of systems, namely the problem of persistence. I then show how programs create system rationality by transforming the problem of persistence,

in which they benefit from five mediating factors of complexity reduction (subjectivation, institutionalisation, internal and external differentiation, structural indeterminacy) and are shaped by three factors that enhance their operation (operationalisation, institutionalisation, reflexivity).

The remainder of this article is structured as follows. In section two, I will discuss the main argumentation lines of *Zweckbegriff und Systemrationalität*. Next, I will discuss projectification, as projectification is intertwined with programmification. The organisational and societal sides of projectification are presented, which together contribute to the emergence of programmification. In section four, I address organisational and infrastructural programmification. In section five, the above-mentioned comprehensive analysis of programmification is laid out, both for organisational and infrastructural programmification. The last section discusses and summarises the main findings, explores further theoretical directions and empirical research, and brings up some practical implications.

2. The core argument of *Zweckbegriff und Systemrationalität*

2.1 *Systems approach*

In ZSR, Luhmann made a significant shift in the direction of conceptualising decision-making as the core activity of organisations, and at the same time, questioned whether action should be taken as the basic unit of analysis. Where [Simon \(1947\)](#) had already shown that the means-end scheme cannot fully capture the behaviour of organisations, Luhmann goes further, demonstrating that a means-purpose scheme is not possible without two further schemes, those of cause-and-effect and order of values. These schemes do not disclose an objective reality but are merely sense-making schemes, through which humans make the world and their actions comprehensible. Thus, as we cannot establish the truth or necessity of purposes, we can take recourse to the function of purposes, as enablers of sense-making or “reduction of infinity” ([Luhmann, 1973](#), p. 48). Elegantly, Luhmann argues that for this, however, we need an action system, “Purposes fixate certain estimated effects by drawing on system viewpoints in order to be able to declare other value aspects of the consequences of action irrelevant” ([Luhmann, 1973](#), p. 49).

Once having transferred purpose, and with that the means-purpose scheme, from the level of the individual action to the level of the system, the next crucial step is made. [Mayntz \(1971\)](#) summarised this as follows: “[...] Luhmann defines systems as identities that maintain themselves in a complex and changeable environment by stabilising the inside/outside difference (p. 120). The specific feature of the inside/outside difference is the lower complexity of a system compared to its environment. Thus, boundary conservation and system persistence coincide, and the reduction of complexity and variability becomes the decisive medianism of system conservation” ([Mayntz, 1971](#), p. 57, translation by author). What Luhmann calls the “Bestandsproblem”, the quest of the system to persist, is a permanent, principally unsolvable problem. With this reasoning, Luhmann is in the vicinity of his later, more radical conception of a system, where a system is defined as the difference between the system and the environment, with this difference produced and reproduced by the autopoiesis of the system.

2.2 *Purpose programmes*

The Bestandsproblem itself, having an open horizon, cannot be solved; therefore, to persist, the system has to transform it into solvable problems. At this point, the key concept of purpose programmes is introduced. The most general function of setting purposes is to reduce the complexity and variability of the environment ([Luhmann, 1973](#), p. 179). Purposes are integrated into systems by purpose programs. A purpose program is an informational form in which the means-purpose and input-output schemes are merged, and thus “refers to a flow of

information articulated by system boundaries, which is modified according to certain selection criteria (i.e. the program) in order to reduce complexity” (Luhmann, 1973, p. 259, translation by author).

A highly relevant aspect of purpose programs is that they are created by decisions, can only be changed through decisions, and operationally facilitate decision-making. Their organisational working can be described as follows. “Purpose programmes define system purposes and regulate their transformation into sub-purposes. They connect and integrate the subsystems involved by relating their respective outputs to each other in imagined causality and coordinating the value judgements implicit in the various subsystem purposes. This is not done by establishing a common transitive order of values, but by deliberately fixing certain decision-making premisses, some of which apply generally, some of which apply to the overall programme, and some of which apply only to individual stages of the decision-making process” (Luhmann, 1973, p. 302, translation by author).

Purpose programmes are shaped through operationalisation, algorithmisation and reflexivity.

Operationalisation is the process that makes a purpose programme useable for decision-making by defining which operations (actions, decisions, procedures) are consistent with achieving the intended purpose. Algorithmisation is the process of specifying sequences of steps or rules that can be followed to realise the purpose without the need for further decision-making during the deployment of the means. In organisations, this pertains to standardising routines, procedures or workflows. Reflexivity is directly associated with the fact that the programmatic nature of organisations implies that any decision is inevitably a decision about other decisions. Thus, decision-making is continuously applied to itself and thus becomes reflexive. Reflexivity is supported by three levels of control. The control of the transformation of the Bestandsproblem into purposes (crisis problem), the control of system-level purposes into operationalised sub-purposes (indicator control), and the control of realisation of the operationally defined sub-purposes (normative control) (Schmid, 1970, p. 363).

Purpose programs are embedded in an informational medium that is formed by five complexity-variability reduction strategies, which are functionally equivalent to purposes themselves: subjectivation, institutionalisation, environmental differentiation, internal differentiation and indeterminacy of the system structure (Luhmann, 1973, p. 237). Subjectivation relates to the circumstance that systems do not react to the immediate reality, but to their simplified version of reality. Institutionalisation of certain forms of experience processing (habits of perception, action patterns, values) contributes to simplifying and stabilising the external environment. Environmental differentiation relates to the segmentations that systems articulate in their representation of the environment. Associated with this segmentation, a system “forms particular boundaries with these different segments of the environment, stabilises particular relationships at their boundaries and bases its autonomy and its ability to be indifferent to environmental changes precisely on this difference” (Luhmann, 1973, p. 184). Through internal differentiation, a system enhances its capacity for processing environmental complexity. Thus, complexity is a relative concept that is expressed in the balance between environmental and system complexity. Similarly, indeterminacy of system structure is not, in the first place, an aspect to reduce the environmental complexity, but rather increases the capacity for processing complexity. Systems achieve this by making their decision premisses specific enough to make selections but also open enough to respond to complexity and variability in the environment.

Purpose programmes therefore act as a topologies which map the primary purposes of the organisation, which themselves have the function of complexity reduction, onto the organisation system and which manifest as connectivity patterns shaped through operationalisation, algorithmisation and reflexivity, and are informationally facilitated by the complexity reduction strategies of subjectivation, institutionalisation, external and internal differentiation, and indeterminacy of structure. System rationality is equivalent to the selectivity-capacity that the (organisation) system has operable due to this configuration of decision programmes, in responding to environmental complexity.

2.3 Research questions

Using Luhmann's theoretical framework, this article seeks to answer the following research questions.

- (1) How do organisational and deployment of infrastructural programmification contribute to solving the Bestandsproblem of conventional organisations and DAOs, respectively?
- (2) How do the five complexity-variability strategies complement organisational programmification and deployment of infrastructural programmification?
- (3) How are organisational programmification and deployment of infrastructural programmification shaped by operationalisation, algorithmisation, and reflexivity?

3. Projectification

3.1 Projectification in organisations

It is argued that organisations have witnessed a trend towards projectification, which is understood as the “change in organisational and governance structure to increase the primacy of the processes of projects within a central organisation and its supply networks” (Maylor *et al.*, 2006, p. 666). Hard evidence indicates that in Western economies, project work accounts for more than one-third of the entire economy's work. Projectification is shown to cause macroeconomic shifts as well (Henning and Wald, 2019; Wald *et al.*, 2025). Projectification is an enabler of international innovation processes when it is facilitated by a longitudinal programme management structure (Midler, 2019). Research indicates that projectification also has potential disadvantages, notably inducing a re-bureaucratisation aimed at fitting temporary structures into the permanent organisation (Moreno Escobar *et al.*, 2023). Projectification is equally prevalent in the public sector. Here, the politico-administrative embeddedness of projects impacts the various stages of the project life cycle, and the permanent structures are not always suitable for facilitating temporary organisations like projects (Godenhjelm *et al.*, 2015).

3.2 Societal aspects of projectification

Jensen points out that projectification as a societal phenomenon is associated with an orientation towards changing the future (Jensen, 2023). Boltanski argues that the project has long moved beyond the boundaries of organisations and transformed into an ordering principle of the lives of individuals. This leads to a fragmentation that can only be countered by continuously engaging in new projects (Boltanski, 2007). Resonating with this perspective, Jacobsson and Söderholm posited the “homo projecticus” (Jacobsson and Söderholm, 2022). Jensen *et al.* (2016) frame projectification as the shift from the disciplinary society to the project society, which they associate with reversing the influence relation between activity on the one hand and space, time and relations on the other hand. In the disciplinary society, space, time, and relations were the ordering elements, whilst in the project society, activity itself is the ordering element; space, time and relations act merely as contingencies for activities. The authors argue that bracketing is a key mechanism for individuals in the projectified world to effectively deal with the multitude of temporal and factual contexts. Wagner *et al.* (2022) found that projectification seems to be driven by pull forces rather than push forces, and project management associations are a mediating influence in this.

3.3 Perspectives

There is a paradox implied in the observation that in the projectified society, projects are not the exception but the rule.

Boltanski & Chiapello regard the project as a temporary pocket of accumulation and explain projectification as a succession of ideologies serving the purpose of sustaining the

capitalist accumulation process (Boltanski and Chiapello, 2018). In the vein of Boltanski and Chiapello, Barondeau and Hobbs underline the aspects of self-organising networks and collaboration-facilitating technologies, which shape the project world (Barondeau and Hobbs, 2019).

From a Luhmannian social system theory perspective, projectification can be interpreted as a means to deal with the factuality and temporality, more precisely, as an advanced manner of structuring time in conditions of increasing contingency. In *Soziologie des Risikos* (Sociology of Risk) (Luhmann, 1991), Luhmann demonstrates how the emergence of the experience of risk is associated with the contingency of the future, which is implied by the development that decisions increasingly shape the future, and the higher degrees of freedom to compose the set of alternatives to be decided upon. This is an autocatalytic process, as a decision will invoke follow-up decisions, thus amplifying the logic. Modern societies are subject to an inherent dynamic of generating variation (Luhmann, 2021).

Jensen also refers to the centrality of the decision concept in the emergence of projectified societies and argues that it is rooted “in our approach to time that we have moved from a clear culture of *a priori* evaluation to a *a posteriori* evaluation, meaning that the criteria for success are shaped by activity and that decisions are postponed as long as possible in order to have more information in a more unpredictable world” (Jensen, 2023, p. 35). I would disagree with Jensen’s formulation of postponing decisions, but I observe it as dealing with opportunism and retaining the malleability of decisions. As will transpire later in this writing, this is at the heart of Luhmann’s concepts of purpose and purpose programmes.

4. Programmification

4.1 Programmification in organisations

In a managerial context, the term programme is widely used in connection with projects. Programmes are organisational constructs devised and sustained to achieve holism through integrating a diversity of projects (Maylor and Murray-Webster, 2024). More specifically, the objectives of programmes are to accomplish “focus, control, efficiency and effectiveness of delivery for component projects”, while maintaining “flexibility, accommodation and staged benefit realization for the overall program” (Maylor and Murray-Webster, 2024, p. 483).

The trend of increasing reliance on programme management as a key management mechanism is called programmification (Maylor *et al.*, 2006). Programmes can be seen as a semantic umbrella that governs a group of projects. Programmes need a minimal organisational structure as well, as decisions need to be made on the programme level and the necessary information needs to be generated to be able to do this.

Projectification and programmification can therefore be seen as parallel developments that can catalyse each other. On the other hand, failing to integrate the multitude of projects into programmes can endanger their outcomes (Moreno Escobar *et al.*, 2023). Case study results also emphasise the importance of programmes in a projectified organisation (Midler, 2019).

Programmification has also set foot in the field of educational research (Marques, 2020; Zapp *et al.*, 2018).

Research into the COVID-19 response in France showed that a decision was made that programme management was to prevail over functional management, as would have been the orthodox approach. This was realised over alternative control structures installed, which enabled an adaptive control to the evolving pandemic and succeeded in organising operations into temporary structures, that is, a multitude of intertwining projects (Daniel, 2024). Further, companies execute their CSR activities in a programmified manner (Al-Marri and Pinnington, 2022). Programmes, therefore, can be said to have a structuring function in organisations; moreover, they replace conventional structures.

4.2 Infrastructural programmification

In this section, I will argue that the appearance of algorithms in various parts of society can be regarded as a form of programmification. What is of particular interest here are those algorithms that (can) replace an activity performed by an organisation.

Mendonca *et al.* (2023) consider algorithms to be a form of institutions and as such represent an institutional infrastructure of contemporary existence (p. 148). The authors adopt the reasoning that algorithms are agents (Russell, 2019, p. 42 ff), and understand algorithms as “elements that provide continuous mediation between structures and humans’ capacity to act. Algorithms have a structural dimension as they restrict action and delineate courses of action, but they also promote agency and are affected by action, as humans reinvent ways to interact with systems and with other humans through them” (Mendonca *et al.*, 2023, p. 21). As institutions, therefore, algorithms represent a certain invariance, embeddedness in a social context and agency external to human agency.

4.2.1 Blockchain. A first example of societal programmification through algorithms is blockchain.

Blockchain is a form of distributed ledger technology. A blockchain creates a secure, robust and transparent distributed ledger able to leverage resources within a global peer-to-peer network by building algorithmic trust through smart contracts (Narayan and Tidström, 2020). Blockchain has numerous applications, but is famously connected to the Bitcoin protocol, which was introduced by Satoshi Nakamoto (pseudonym), to create a monetary exchange medium that is not reliant on the traditional financial intermediaries and central authorities (Nakamoto, 2008).

Blockchain technology can be conceived as a layered program, consisting of different algorithms that work together through a set of basic rules. The basic algorithm, residing in the contract layer, generates the smart contract, which automatically executes the contract terms, and is stored in the blockchain in the form of code and data sets. Hash and digital signature algorithms reside in the data layer. The hash algorithm is mapping transaction-relevant information into strings of fixed length and has the function to uniquely link the blocks to each other and thus ensure data integrity across the chain, and verifying that no tampering occurred (Zhai *et al.*, 2019). The digital signature algorithms have the role of verifying and validating the message’s originality or a document by providing the integrity, authentication and non-repudiation. It essentially provides authenticity in the chain. A digital signature is generated using public–private key cryptography. Digital signature algorithms create a signature with a private key and verify it with a public key (Basha *et al.*, 2021; Fang *et al.*, 2020). Lastly, the central layer of blockchain technology is the consensus layer, in which the consensus algorithms reside. The consensus algorithm determines the nodes, that is, the peers in the network participating in a given chain that have accounting rights, enabling these nodes to quickly reach a consensus on transactions stored in a data block, ensuring the consistency and security of block data, and improving the computational efficiency of the blockchain (Xiong *et al.*, 2022). A wide variety of consensus algorithms exists, with varying application areas, parameters in terms of efficiency and primary advantages/disadvantages (Xiong *et al.*, 2022, p. 17).

4.2.2 Decentralised autonomous organisation (DAO). DAOs are a type of organisation that operates without a central authority or management hierarchy. All management and operational rules of the organisation depend on collaboration and group decision-making and are encoded on tamper-resistant blockchains in the form of smart contracts (Wang *et al.*, 2019). DAOs are collectively owned, with ownership expressed in the form of being a holder of tokens. These tokens demarcate the membership of a DAO and are associated with the right to participate in voting and share in the economic gains and losses the DAO realises (Han *et al.*, 2023). Voting governance in its simplest form prescribes a majority vote to pass a resolution, but quorums can also be defined. Alternative forms of voting are practised as well, like quadratic voting, where a larger number of tokens grants a disproportionate voting power; conviction voting, where the weight of a vote increases the longer its holdership remains

unchanged; holographic consensus voting is an innovative voting mechanism, that is based on a multi-step voting process that involves boosting of and staking on (i.e. betting on) proposals; in the liquid democracy voting mechanism token holders elect a few representatives to make voting decisions on their behalf, with the provision that these representations can be revoked at any time (Bellavitis *et al.*, 2023, pp. 189–190). Voting procedures are often preceded by so-called off-chain discussions in allocated forums. Artificial intelligence (AI) can enhance the governance and decision-making capabilities of DAOs by providing data-driven insights, automating routine tasks and facilitating more informed and efficient decision-making (Hammad and Abu-Zaid, 2024, p. 172).

In 2024, globally over 13,000 DAOs were active, in which collectively 24,5 billion USD had accumulated, representing 11,1 million token holders. DAOs are active in a variety of activities, amongst others: DAO tool development, decentralised finance (DeFi, often focused on cryptocurrencies), gaming, infrastructure, media and communication, NFTs (non-fungible tokens, often for the production of digital art). Apart from DAOs that have an economic rationale, so-called Social DAOs are active as well (Sharma *et al.*, 2024).

DAOs are quite limited as far as the in-house performance of the production of goods or services is concerned. DAOs, which are engaged in the production of fully digital products or services, are able to operate automatic production lines in the form of dedicated algorithms that execute the instructions contained in the smart contracts (e.g. in DeFi). Generally, it can be said that DAOs are heavily dependent on third parties; that is, activities are outsourced. This can be in the form of normal contracts, or smart contracts with other DAOs, or (teams of) contributors who are paid in the form of tokens (Sharma *et al.*, 2023). It is argued that the advancement of AI, in the form of generative adversarial networks and various forms of machine learning, can significantly extend the production capabilities of DAOs (Hammad and Abu-Zaid, 2024; Ly and Shojaei, 2025). DeFACT is a new concept, and concerns a framework of parallel manufacturing in DAOs. Integrated workflows are executed in a production setup consisting of robotic, digital and human workers (Yang *et al.*, 2023). DAOs can automatically execute e-Science workflows based on blockchain (Alimoğlu and Özturan, 2024). DAOs can feasibly execute work in decentralised autonomous project organisations (DAPOs), which are blockchain-supported project environments (Spychiger *et al.*, 2023).

4.2.3 WEB3. Web3 can be considered as the infrastructure that ties together Blockchain, DAOs and smart contracts. The essence of this new infrastructure resides in revolutionising the backend of the Internet by replacing central data storage with distributed data storage based on blockchain technology (Park *et al.*, 2023). The Web3 architecture is principally a layered one. The bottom layer consists of (1) the basic blockchain architecture, (2) a network infrastructure that regulates and realises the peer-to-peer traffic, as well as (3) the algorithms for consensus and validation, governance data and computational engines. The next layer contains the services and custom components like smart contracts, wallets, digital IDs, DAOs and off-chain computing. The top layer is the user interface layer, where the dApps, dApp browsers, programming languages and hosting services reside.

For the work that is done in the blockchain (bottom layer), that is mining and validation, a so-called gas fee is to be paid in the coin of the respective blockchain. Reading or assessing Web3 does not change the state of the blockchain; therefore, there is no mining/validation involved and no gas fees neither. In order to upscale blockchain performance and economise on gas fees, off-chain computation has been developed (in the middle layer), as well as side chains (in the bottom layer). These solutions reduce the effort that is required in the core blockchain and are therefore faster and cheaper (Ray, 2023).

Furthermore, the increased transparency and information symmetry that blockchain ensures in web interactions replaces the digital trust in a platform sponsor with digital truth through decentralised and transparent monitoring of transactions, automated contracts, and sophisticated consensus mechanisms, allowing for disintermediated transfer of digital ownership (Schmück *et al.*, 2025). Interoperability is, at the moment, still an Achilles heel of Web3, as the various blockchains and the associated applications are interchangeable to a

limited degree (Bitcoin, Ethereum, Solana, Avalanche), although progress is being made at quite a high pace (Polkadot, Nervos) (Ray, 2023).

Web3 delivers a decentralised online experience in which no single entity controls access to essential services or information and is not or less reliant on centralised firms. Moreover, Web3 will foster peer-to-peer interactions, thus enabling a new generation of user-developed content, applications and services. Importantly, the ability for creators and developers to immediately access users on public, decentralised blockchain networks means that ecosystems will rely less on single firms that act as gatekeepers to deploying and enjoying content (Murray *et al.*, 2023); networks and platforms can no longer be monopolised, and each participant and third party can capture value and create innovation (Schmück *et al.*, 2025).

4.3 Perspectives

In this section, I introduced programmification in two different contexts.

First, in the context of organisations, programmification as organising. Here, programmification is a means to deal with the shift from permanence to temporality. Programmification is related to projectification in the sense that organisations that execute work increasingly in the form of projects cannot effectively rely predominantly on traditional organisational structures as their response to the complexity of the external environment. Thus, it can be argued that via programmification, organisations solve the complexity problem not over internal differentiation but over the functional dimension of programmes. Therefore, function substitutes structure.

Second, in the context of blockchain technology and the emerging Web3, I pointed to the increasing prevalence of programs in the form of algorithms, smart contracts and decentralised applications. I referred to this as resorting to infrastructural programmification. The essential point here is that these programs are not internal to any organisation, but are elements of a digital public sphere, in which transparency, accessibility and information symmetry exist. Again, there is a relation with structure, on two levels, in fact. This programmification enables the creation of organisations with extremely low levels of structure, as we have seen in the form of DAOs. Although having little internal structure, these entities are versatile and are able to deliver complex services. The programmification of DAOs exists in their as-if internalisation of infrastructural programmification. The programmified digital public sphere can be used to substitute internal structures in conventional organisations, as has become apparent in the area of procurement and logistics already (Agrawal *et al.*, 2023; Chang *et al.*, 2019; Ran *et al.*, 2024). Both organisational programmification and infrastructural programmification are created by decisions, can be altered by decisions, and facilitate and orient decision-making.

5. Programmification through the lens of ZSR

In this section, I will use the ZSR framework to analyse programmification. I will first address programmification in conventional organisations, that is, programme-based management in projectified environments. After that, I will elaborate on the role of programs and programmification in DAOs, which is established through the as-if internalisation of infrastructural programmification. Accordingly, the analysis of infrastructural programmification focuses on DAO-relevant elements, i.e. blockchain, smart contracts, dApps, Web3, etc. Each analysis starts with a depiction of the Bestandsproblem, followed by an elaboration of the five mediating factors of complexity reduction (subjectivation, institutionalisation, internal and external differentiation, structural indeterminacy), and concludes with a discussion of the three factors that enhance the operation of programs (operationalisation, institutionalisation, reflexivity).

For each factor, the available literature was reviewed using Scopus and Google Scholar, applying relevant keywords, to arrive at an assessment of its current state. Placing this state in

ITP the ZSR framework, an evaluation is made regarding the contribution of the particular factor to system rationality. The review of the literature was guided by the factor operationalisations shown in [Table 1](#).

Table 1. Guiding operationalisations of the system rationality factors

System rationality factor	Indicative research evidence
<i>Informational mediators</i>	
Subjectivation	Sense-making mechanisms, strategic notions, frames of reference
Institutionalisation	Routines, practices, shared beliefs and values
Environmental differentiation	Segmentation of the environment, dedicated approaches and processes, effect expectations
Internal differentiation	Internal structures, specific roles, task divisions, process differentiation
Indeterminacy of structures	Openness of premisses, case-by-case handling, communication-intensive
<i>Program attributes</i>	
Operationalisation	Extent of breakdown and fixation of factual, time, social dimension (what, when, who)
Algorithmisation	Automatically triggered schematic sequences and decision rules, calculation-based step-by-step output generation
Reflexivity	Evaluation structures, feedback and learning processes, planning dynamic
Source(s): Author's own work	

Thus, this article has an empirical component because the assessment of each of the eight factors is based on an extensive review of the results of available, relevant research. The contribution the article intends to make is conceptual, as the ZSR framework is applied to apprehend the implications for system rationality. This is relevant because system rationality ultimately expresses the capability of a system to persist.

5.1 *Organisational programmification*

5.1.1 *Purpose programmes and the Bestandsproblem.* The tendency of programmification can easily be taken as the ultimate proof of the basic logic of ZSR, namely, that purposes are principally problems, in the sense that they frame the Bestandsproblem in a particular way, and that purpose programmes are acting on that as they articulate the response to the system problems. Hence, we can say that the function of programmification, that is, increasing reliance on managing via programmes, is to secure the continuation of the system by installing an additional level of purpose programmes. They can be regarded as super-purpose programmes, as they possess a level of abstraction that is theoretically explicitly implied in ZSR ([Luhmann, 1973](#), p. 273), but not envisaged, as the actual descriptions of purpose programmes in ZSR are far closer to the operational level of organisations. In the same vein, we can observe that the role of conditional programmes, which are specifying programmes operating with an IF-THEN logic and are functionally always connected to purpose programmes, is diminishing as their association with purpose programmes starts on a lower level.

5.1.2 *Subjectivation.* Programmification has an impact on the subjectivation of the environment, as sense-making will be based on the semantics of the programme ([Pellegrinelli, 1997](#)). A programme involves a much stronger selection than a multiple of functional selections, which it effectively replaces.

5.1.3 *Institutionalisation.* Programmification is based on the institute of projects, as it was explained that programmification is, in fact, a consequence of projectification ([Maylor et al.,](#)

2006; Maylor and Murray-Webster, 2024; Midler, 2019). Hence, all the artefacts and semantics that are related to projects as an institutionalised form are available, moreover, indispensable for programmification to exert its function of complexity reduction. Case study research has shown that program organisations are capable of building routines (Frederiksen *et al.*, 2024).

5.1.4 Environmental differentiation. In ZSR, environmental differentiation is, in the first instance, functionally related, e.g. an economic organisation differentiating its environment into various markets. The lesser stability of markets is possibly causing this rudimentary differentiation to be insufficient to produce a meaningful reduction of complexity. We may rather say that, if it can be regarded as differentiation at all, programmification is associated with a kaleidoscopic differentiation (Trzeciak *et al.*, 2022; Van De Waerdt *et al.*, 2024). This is a differentiation without rigid boundaries, and is principally based on the distinction relevant/not-relevant.

5.1.5 Internal differentiation. Two points that are raised in ZSR are relevant for the discussion here. First, internal differentiation serves the purpose of localising complexity, i.e. preventing a specific adaptation to the environment affecting larger sections of the system. Projects are a form of localising complexity (Aal, 2022), and since programmification establishes an umbrella over several related projects, organisations localise complexity by programmification too. However, the activity is shifted from permanent into temporary structures, which leave the basic international differentiation, the organisational structure, untouched. This brings me to the second point that is raised in ZSR, namely, that the enduring presence of the newly differentiated units increases the learning capability of the system. Since projects are temporary structures, this is not necessarily the case; in fact, retaining learning that is accomplished in a project and making it accessible to future endeavours is still one of the biggest challenges of project-based activity (Bakker *et al.*, 2011; Lindner and Wald, 2011; Scarbrough *et al.*, 2004). Further structures are needed to facilitate this, which I will address below in connection with the aspect of reflexivity.

5.1.6 Indeterminacy of the system structure. Indeterminacy refers to the attribute that a structure leaves options open; that is, it has limited redundancy. In ZSR, the means-purpose schema is an equivalent derivative of the input-output model. Inputs can be considered as means, and outputs as purposes. Inputs arrive from a differentiated environment, and outputs are supplied to a differentiated environment. In response, the system differentiates internally into subsystems, which also maintain input-output, and thus means-purpose relations with each other. In such a configuration, indeterminacy of system structure cannot refer to the structure of the subsystems, in other words, the organisational structure. Rather, indeterminacy refers to the programme structure, in the ways of shift of focus of orientation between conditional and purpose programmes, ambivalence in the definition of conditional programs, or a deliberate vagueness of purpose programmes.

Programmification does entail indeterminacy, contributing to complexity reduction, but in the opposite way to what ZSR argues. Foremost, programmification is associated with indeterminacy in organisational structure, reflected in the temporality of projects, but also in the practice that projects that do not deliver are terminated, and new ones are started if a need emerges. Rather than reverting to conditional programmes, there is a stronger emphasis on purpose programming (Lycett *et al.*, 2004; Sloot *et al.*, 2024). Instead of ambivalence and abstraction, the endeavour is to be as specific as possible.

5.1.7 Operationalisation. Operationalisation refers to adding information to a purpose programme that makes it actionable. Whereas in ZSR, operationalisation is exemplified as defining concrete actions, in the context of programmification, operationalisation takes the form of specifying projects by means of project charters, which have the function of a purpose programme. This is another illustration of the substitution of organisational structures by purpose programmes. As mentioned in ZSR, operationalisation implies the possibility that operationalised output does not fulfil the purpose. The degree to which project outputs, as well

as outcomes, are in line with the purpose is an important topic in project governance (Aubry *et al.*, 2021; Müller, 2019; Musawir *et al.*, 2017).

5.1.8 Algorithmisation. ZSR envisages, to a remarkably accurate degree, the transfer of programmatic tasks from humans to AI. However, since programmification also implies that purpose programs are situated on a higher level in organisations and have a far greater reach, algorithmisation should be observed from that perspective. In this context, certain aspects of programme and project governance systems can be interpreted as algorithmisation, as governance systems often stipulate methodologies and procedures codified in bodies of knowledge and represented in artefacts (Maylor *et al.*, 2006).

5.1.9 Reflexivity. Reflexivity is at the core of making programme-based management work, as transpires from a case study of a global automotive firm: "... our case provides an emblematic example of structuring a permanent organization (here, the international innovation process pattern) through a project-based learning process. It confirms the key role of vanguard projects in such transitions, as well as the importance of integrating both existing knowledge from the firm and new knowledge created in the particular situation" (Midler, 2019, p. 559).

Case studies confirm the planning intensity of program organisations (Miterev *et al.*, 2020), and particularly point to the importance of reflexive planning activity (Frederiksen *et al.*, 2021).

5.2 Programmification in DAOs

5.2.1 Purpose programmes and the Bestandsproblem. In essence, a DAO is operating on the basis of a single-purpose programme, which is the DAO smart contract, which is extended with three operational smart contracts, which are basically conditional programmes (Jentszsch, 2016). Thus, viewed through the ZSR lens, it transpires how radical an organisational form DAOs in fact are. In the absence of further purpose programs beyond the high-level DAO-smart contract, complexity reduction is performed on a case-by-case basis through proposals and their subsequent voting. A powerful instrument in this respect is the programs that collect the token votes, validate them in the blockchain and calculate consensus. On the other hand, in accordance with the nature of DAOs, there are no specific content requirements concerning the submission of proposals.

Proposals and the acceptance of proposals are the backbone of solving the Bestandsproblem. Research reveals several concerns regarding the content of and dynamics around proposals (Łabędzki, 2025; Wang *et al.*, 2025). Studies of voting behaviour and mechanisms point to issues of voter apathy, lack of participation and concentration of voting power (Bellavitis and Momtaz, 2025; Han *et al.*, 2025). Mechanisms to improve voting participation are suggested (Chen and Cai, 2024).

5.2.2 Subjectivation. Relevant here are the decentralised nature of DAOs, and the fact that in principle anybody can be a member of a DAO. Due to their decentralised setup, DAOs are more relying on "zero-trust" mechanisms rather than building trust (De Filippi and Merk, 2024; Merk, 2024; Schmück *et al.*, 2025), and shared beliefs are mainly related to governance aspects (Alawadi *et al.*, 2024; Augustin *et al.*, 2023; Axelsen *et al.*, 2022; Baliotti *et al.*, 2025; Han *et al.*, 2025; Peña-Calvin *et al.*, 2024; Rizq Moustafa and Moustafa Aldabousi, 2026; Santana and Albareda, 2022). The implication is that there is no selection mechanism "at the gate" like in traditional organisations. Thus, token holders cannot be selected based on similarity of orientations, shared viewpoints, etc. Adding the lack of programs that can mediate subjectivation to the previous two factors, DAOs do not have the structures or the medium that could foster any substantial subjectivation. A case study into conflict handling of a DAO indeed showed low levels of subjectivation (Chen and Cai, 2024).

Concludingly, subjectivation does not act as a means of complexity reduction in DAOs in any material way.

5.2.3 Institutionalisation. Institutionalisation in the context of DAOs can occur on the level of the DAO community and on the level of the Web3 community. Little research is available on

this topic. The articulation of shared values is argued to be important (Nabben, 2023), as are trust-building mechanisms (De Filippi and Merk, 2024). However, the limitations that DAOs face here were pointed out in the previous paragraph. The general assumption is that a certain element of shared values is involved in the creation of a DAO community (Sharma *et al.*, 2023; Tang *et al.*, 2025), but in its operation, agency motivations appear to dominate (Alawadi *et al.*, 2024). For the execution of tasks, DAOs typically use projects, contracted over smart contracts (Olaniyi *et al.*, 2023; Sharma *et al.*, 2023; Zhao *et al.*, 2022). Referring to projectification as a societal phenomenon, similar to what was argued above for traditional organisations, all the artefacts and semantics that are related to projects as an institutionalised form are therefore available to DAOs.

Concludingly, institutionalisation is likely to act as a, probably moderate, contributing factor to complexity reduction, which is mainly realised through the deployment of the project form as an institutionalised medium.

5.2.4 Environmental differentiation. The aspect of environmental differentiation pertains to the extent to which organisations discriminate between members and non-members, and subsequently to what extent they create segments of non-members (Luhmann, 1964, p. 132 ff, 1973, p. 184). While the differentiation between token holders and non-token holders is binary, the effectiveness of this differentiation is limited due to the fact that token ownership is volatile, the identity of token holders is scarcely known, and token holders often do not actively engage, i.e. they do not behave as members (Bellavitis and Momtaz, 2025; Rizq Moustafa and Moustafa Aldabousi, 2026; Saesen *et al.*, 2026; Sun *et al.*, 2024). Furthermore,

DAOs are limited in how they differentiate their environments. As for financing, they dominantly rely on native tokens (Faqir-Rhazoui *et al.*, 2021; Patil *et al.*, 2025). In the operations of DAOs, labour, supplier and user markets are convoluted and are often merged into platforms (Faqir-Rhazoui *et al.*, 2021), which is reinforced by the aspect that the value-adding activity of DAOs is a combination of programmified structures, protocols, tokenisation, and communities (Peña-Calvin *et al.*, 2024), while they are only partially connected to the legal system (Lustenberger *et al.*, 2026; Mignon, 2019; Sims, 2019). They put smart contracts out (Carron and Botteron, 2019; Wu *et al.*, 2021). It would neither make a lot of sense for DAOs to differentiate their environments, as they do not have the means to reflect this environmental differentiation into an associated internal differentiation. Thus, environmental differentiation is not a means of complexity reduction that could mediate with the purpose programme.

5.2.5 Internal differentiation. Generally, the fact of a lack of hierarchy is pointed to with respect to DAOs. Hierarchy is only one form of internal differentiation. Therefore, the more accurate observation is that in the base case of DAOs – an assembly of token holders that votes on proposals which trigger a smart contract when accepted (Ly and Shojaei, 2025; Wang *et al.*, 2025; Wu *et al.*, 2021) – there is neither vertical nor horizontal differentiation. It is worth noting that, where in his concluding work on organisations, Luhmann viewed hierarchies as an inherent product of the system, which has the function to keep the autopoiesis of decision-making going, in effect, a structural response to a time problem (Luhmann, 2000), in ZSR Luhmann already disputed a primary role of hierarchies in organisational functioning and argued that hierarchies are complementary and facilitating to purpose programmes (Luhmann, 1973, p. 301 ff). In practice, however, several forms of differentiation occur: structural inequalities in voting power (Sun *et al.*, 2024; Wang *et al.*, 2025), off-chain voting and discussion (Kitzler *et al.*, 2025; Monteiro *et al.*, 2024; Rikken *et al.*, 2023), temporary task-related structures (Ellinger *et al.*, 2024; Hassan and De Filippi, 2021; Sharma *et al.*, 2023; Zhao *et al.*, 2022). From a perspective of internal differentiation, these need to be qualified, though. Voting hierarchies as a result of unequal token holdings are unrelated to purposive programmatic structures that route the information flow in DAOs, that is, they do not facilitate purpose programs and, hence, are not an effective means of internal differentiation in terms of system rationality. It should be noted, though, that in a small proportion of DAOs, the roles of major contributor and majority voting-quota holder coincide (Kitzler *et al.*, 2025). In these

cases, it is questionable whether the term DAO is still appropriate. Off-chain activity is vital for developing proposals and preparing them for on-chain voting. Off-chain activity offers much more flexibility and saves transaction costs (Patil *et al.*, 2025; Wang *et al.*, 2025). Committees with a certain specialisation, which exist in certain DAOs (Alawadi *et al.*, 2024), point to a certain internal differentiation in the off-chain area. The results of various studies point to limitations in internal differentiation, however: a noticeable absence of consolidated communication channels (Monteiro *et al.*, 2024), potentially capable but highly unorganised diversity (Alawadi *et al.*, 2024), the fundamental contingency in the connection between the off-chain and the on-chain areas (Piyarisi and Shalpegin, 2025), and off-chain processes are predominantly used for planning and organising and seldom for performing leadership and control (Łabędzki, 2025). As an element of internal differentiation, DAOs use projects as temporary structures, principally serving the purpose of executing decisions (Alawadi *et al.*, 2024; Vella *et al.*, 2025; Zhao *et al.*, 2022). Nevertheless, these temporary structures have a limitation in the sense that they are derivative, that is, they are not directly connected to the complexity reduction of the external environment (which is performed by the preceding decision). Thus, on their own behalf, they may contribute to means rationality but not necessarily to purpose rationality. The overall conclusion is that, at best, internal differentiation will have a minimal contribution to system rationality, but, judging by the current practice, will show a deficit.

5.2.6 Indeterminacy of the system structure. Indeterminacy of the system structure of DAOs is located in the off-chain processes, as they were already discussed in the previous section.

To elaborate on this dimension of system rationality mediation, crucial to the understanding of complexity reduction in DAOs, it is useful to start off by referring again to the function of the causality scheme in systems. Luhmann phrased this as follows. “The function of causal interpretation is primarily to map complexity, but it does not stop there. Its purpose is also to provide a framework for the complexity and variability of the system environment in which they can be reduced to decidable structures” (ZSR, p. 198). Programmes contribute to complexity reduction because they represent sanctioned and consented causality schemes. Apart from their DAO-contract, DAOs have their transparent string of earlier approved smart contracts available, as programmes contributing to complexity reduction. The DAO-contract can obviously only act as a high-level reference, whilst the limitation of the earlier smart contracts is that they were not sanctioned and consented to as a premise. Hence, the construction of causality schemes has to be performed through the proposal and the (off-chain) communication around the proposal before voting. Accordingly, key communications on proposals can be expected to heavily draw on conditional semantic (e.g. “we are confronted with [...], so it was clear/logical/obvious we have to opt for [...].”), and purpose semantic (e.g. “currently it is our goal to [...], so clearly/logically/obviously the way forward is to [...].”).

Concludingly, DAOs have an extreme level of indeterminacy in their structure, which makes them highly responsive, but only to the extent that complexity reduction can be instantly resolved.

5.2.7 Operationalisation. With their operation being based on smart contracts (Carron and Botteron, 2019), operationalisation in DAOs is practically seamless. The reliance on smart contracts implies that DAOs are heavily input-oriented and, in essence, solve their Bestandsproblem over the conditional programme capacity of the smart contract.

5.2.8 Algorithmisation. The algorithmisation contained in the blockchain, the voting mechanism and the smart contract are a crucial compensation for the lack of complexity reduction elsewhere in DAOs. This does not need any further clarification, in light of the earlier discussed conceptualisation of algorithms as agents (Mendonca *et al.*, 2023; Russell, 2019). Notably, the algorithmisation of the environment, in the form of dApps, is a significant potential facilitator of complexity reduction to the DAO (Arvanitou *et al.*, 2024). Research indicates a great variation in the effectiveness of dApps (Qasse *et al.*, 2020).

5.2.9 *Reflexivity*. Following what was discussed so far regarding the complexity reduction capabilities of DAOs, reflexivity can be considered as a welcome contributor, in view of the lack of capabilities in other areas. As there is no research available, we do not know to what extent effective reflexivity occurs in DAOs. If any, this would show in the off-chain discussions in the respective forums. Based on what we know from governance-related research, it can be stated that there are pros and cons: transparency, decentralisation, low thresholds and shared mission work in favour of reflexivity; on the other hand, lack of participation, apathy and concentration of interests point in the other direction (Han *et al.*, 2025). Research showed that a DAO was quite effective in dealing with a crisis situation (Chen and Cai, 2024), which may be taken as an indication of reflexivity potential.

6. Conclusions

6.1 Discussion of main findings

The following Table 2 summarises the results of the previous analysis.

Table 2. Programmification in conventional organisations and DAOs

	Conventional organisation	DAO
Purpose programmes and Bestandsproblem	Creation of super-purpose programmes that articulate the response to system problems	DAO smart contract is the determining purpose program, the topology of which is determined by the voting algorithms
<i>Mediating strategy</i>		
Subjectivation	(+) programme semantics	(-) no selection “at the gate”
Institutionalisation	(+) project as an institution	(+) Web3 communication, project as an institution
External differentiation	(-) flexible boundaries	(-) no significant differentiation, reliance on smart contracts
Internal differentiation	(-) temporary structures	(-) effective differentiation only off-chain, limited if at all present
Indeterminacy of structure	(++) temporary structures, emphasis on purpose programmes	(++) causality schemes need to be constructed
<i>Programme shaping</i>		
Operationalisation	(0) programme governance	(++) smart contracts
Algorithmisation	(-) project governance	(++) dApps, DAO algorithms
Reflexivity	(+/++) based on content rather than rules	(-/+) ambivalent

Note(s): The symbols in brackets indicate the contribution to system rationality, (–) and (+) indicate limiting and enhancing, respectively

Source(s): Author’s own work

Table 2 tells us the following.

In conventional organisations, programmification can be considered as the creation of an additional layer of purpose programmes, which function as super-purpose programmes. The contribution to system rationality is mainly informational. Complexity reduction gains are made through subjectivation, institutional, and indeterminacy potential that the super-purpose programs offer. Limiting factors are the possibilities of external and internal differentiation. This implies that, for programmification to be successful, the contribution of subjectivation, institutionalisation and indeterminacy has to outweigh the drawbacks of the differentiation limitations. Caring for the programme semantics and effective decision-making processes are the most important elements in this respect. As for the shaping of programmification, there is a significant limitation in the contribution of operationalisation and algorithmisation to system

rationality. To positively contribute, the reflexivity potential of programmification needs to be fully exploited. The shared expectations that enable this reflexivity are not automatically given as a result of formalised rules, however. They will be decisively formed around content, which once more underlines the importance of programme semantics. As a further clarification, the indicated limitation in algorithmisation is not to say that the organisation is better off without project governance, but that the medium to algorithmise super-purpose programmes is project governance, but project governance offers hardly any means to actually achieve that.

In contrast to conventional organisations, programmification at DAOs causes significant informational deficiencies, as a result of substantial deficits in subjection and differentiation. Strong reliance on institutionalised means and exploitation of indeterminacy have to compensate for this. Therefore, DAOs have serious informational deficiencies when it comes to their ability to persist. In addition, in contrast with conventional organisations, DAOs need to heavily rely on shaping their purpose programming, through dApps and smart contracts, in order to assure the decision connectivity needed to establish system rationality. Reflexivity is a true dark horse. The space for reflexivity is simply unconditioned in DAOs.

An important finding is that projectification is fundamental both for conventional organisations and DAOs. Conventional organisations increasingly rely on temporary structures, which they integrate and coordinate through programmes. For DAOs, the contracting of projects through smart contracts is their *modus operandi*, without the institution of the project, it would be inconceivable for DAOs to persist.

6.2 Implications for theory and empirical research

Regarding the implications for Luhmannian organisational theory, three observations can be made. First, it transpired that *Zweckbegriff und Systemrationalität* is a powerful theoretical framework that renders highly accurate analytical observations of contemporary organisational developments. Therefore, the earlier works of Luhmann have actual theoretical relevance alongside the autopoietic Luhmann.

Second, the analysis of programmification shows dynamics for both conventional organisations and DAOs, questioning the centrality of the concept of formalisation in Luhmann's organisational theory. Still, this article shows that an organisation may be able to operate with very low levels of formalisation, thus relying on informal practice, which is not implied in the Luhmannian framework. Luhmann argues that formal organisation enables reflexivity of decision-making (ZSR, p. 340) and achieves this through establishing a structure of viable expectations and implied expectations. However, this article showed that reflexivity in programme organisations can hardly be attributed to increased formalisation. Rather than building expectations based on rules and fixed structures, programmes themselves create expectation patterns, which are related to content instead of a generalised set of rules.

At the same time, Luhmann's organisational thinking always paid due attention to the crucial role of informal organisation (Luhmann, 1964), and recent contributions in the Luhmannian stream investigate the balance between formalisation and non-formalisation in organisations (Lies, 2020; Reh and Haunschild, 2025; Schirmer, 2024). Simultaneously, new theoretical notions are contributed to the concept of formal organisation within this stream (Ahrne *et al.*, 2017; Apelt *et al.*, 2017; Besio and Tacke, 2024).

Third, the article makes a strong case for the societal evolution of programmatic structures in society, as was argued by Luhmann over fifty years ago in *Legitimation durch Verfahren* (Luhmann, 1983). In this respect, it contributes to the ongoing debate around the programme concept in social systems theory, particularly regarding the relationship between social systems and technology. It is argued that programmes are a pivotal element in the coevolution of technology and social systems (Watson, 2025). Liu (2026) shows how algorithmic AI may crowd out purpose programmes in organisations, which may be detrimental to their adaptive capabilities. Conversely, empirical research indicates that adequate adoption of GenAI requires a shift from conditional to purpose programmes (Stingl De Vasconcelos Guedes *et al.*, 2026).

The study of programmification needs an advancement of the theory of the temporary organisation, from temporary organisations as singular projects to programmatic constellations of projects (Frederiksen *et al.*, 2021, 2024). A recent stock-taking contribution (Sydow *et al.*, 2025) did not address this gap. However, the concept of semi-temporary organisation is forwarded in relation to project portfolios (Martinsuo and Geraldi, 2020), as well as the notion of ecology of temporary organisations to capture the non-singularity of temporary organising (Hernes, 2025). The concept of the programme and the broader framework of social system theory are well situated to advance the field here and illuminate the interaction between the permanent and the temporary organisation.

This article contributes to the organisational theory of the DAO, which is still in its very early stages. It responds to Sampò *et al.* (2025), who argue that strengthening the alignment between organisational and technical insights is crucial for advancing DAO research. Nabben (2023) defines DAOs as cyberocratic organisations. The author argues that DAOs may show tendencies to algorithmic centralisation, while it is vital for them to maintain decentralisation. For the system rationality perspective, this relates to the maintenance of indeterminacy of structure, on which DAOs are highly dependent to achieve system rationality. DAOs are conceived as rhizomatic structures characterised by multiplicity, interconnectivity and an inherent dynamism (Hung, 2025). The system rationality approach points to the informational deficiencies this causes, and what kind of means DAOs have to compensate. Lustenberger *et al.* (2025) propose six design factors for DAOs. The system rationality approach can relate these factors to each other and explain how trade-offs can be made.

Proposals have been made to measure the performance of programs (Rijke *et al.*, 2014; Walker *et al.*, 2024, pp. 219–234). These could be integrated into the system rationality framework forwarded in this article, which can be used to assess the effectiveness of programmification. The distributed notion of system rationality underlines that projects should not be seen as servant entities of strategy (Martinsuo and Geraldi, 2020), while pointing to the highly diverse consequences of programmification that ask for ambidexterity in programme management (Gregory *et al.*, 2015) and process maturity (Anantamula and Rad, 2018).

The analysis presented in this article brings up several topics for empirical research. The study of communication in DAOs is a topic that potentially can deliver valuable results. Promising research questions concern the construction of causal schemes and the presence of reflexivity in communication. The system rationality framework can be used to design research into benefits management of projects, where it is particularly important to adequately map the organisational context (Aubry *et al.*, 2021; Musawir *et al.*, 2017; Serra and Kunc, 2015). It may also inform research avenues suggested by Saesen *et al.* (2026) Finally, Table 2 indicates in which areas conventional organisations and DAOs can learn from each other, and this delineates an area of relevant research.

6.3 Practical implications

Table 2 shows that smart contracts have a strong influence on the system rationality of DAOs. The level of system rationality needed is proportional to environmental complexity. When DAOs endeavour to engage in supplying more complex products and services, their system rationality requirement increases, which will dominantly strain the smart contracts. In this respect, the difference between explicit and tacit transactions is critical, and the deficits that DAOs typically have when tacit transactions are concerned (Lumineau *et al.*, 2021). Responding to this, Systems Engineering (Locatelli *et al.*, 2014; Walden *et al.*, 2015) offers an attractive potential for DAOs to frame smart contracts. The systems engineering methodology creates smart contracts in the form of a hierarchy of clearly defined requirements that the requested project should meet. The supplier or contractor must prove the validation and verification of all requirements. This approach offers essential advantages. First, the top requirements, which represent the principal needs of stakeholders, can be determined through the voting process. Internal or external experts can perform the requirement breakdown.

Second, the validation and verification information that must be provided acts as the trigger for the execution of the smart contract. AI can be applied to evaluate these reports, whereby potential issues are flagged for human review. Third, DAOs achieve substantial gains in the complexity they can effectively handle. In order to successfully deploy Systems Engineering, DAOs need to integrate it into their overall proposal process, and develop its topology as suggested by Alawadi *et al.* (2024). Last but not least, system rationality does not guarantee optimal decisions, but is merely an enabler that increases the propensity to take optimal decisions. Thus, it is imperative for DAOs also to possess the capability to make many decisions, to exploit the potential of system rationality to its fullest extent. It is vital that DAOs work on shortening their proposal initiative-to-decision time (Wang *et al.*, 2025).

With regard to programmification in conventional organisations, there are several practical implications as well. First, organisations should not overly rely on governance mechanisms, and governance should be mostly oriented to ensuring reflexivity and dealing with the content of programmes (semantics in the broader sense). Governance should, therefore, primarily focus on ensuring communication, rather than process compliance. Second, organisations should be aware that they incur relative system rationality losses due to limitations in differentiation and need to be attentive, so they can nip emerging problems in the bud. The “curation” of informal social connections may be an adequate strategy of containment (Reh and Haunschild, 2025).

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